

1993

Econoline, F-150,
F-250, F-350, Bronco,
F-Super Duty

Body / Chassis Service Manual



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Body/Chassis Manual

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INTRODUCTION

Important Safety Notice

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Service Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each.

Accordingly, anyone who departs from the instructions provided in this manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

Notes, Cautions, and Warnings

As you read through the procedures, you will come across NOTES, CAUTIONS, and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transaxle, set it in PARK unless instructed otherwise for a specific operation. If you have a manual transaxle, it should be in REVERSE (engine OFF) or NEUTRAL (engine ON) unless instructed otherwise for a specific operation. Place wood blocks (4" x 4" or larger) against the front and rear surfaces of the tires to provide further restraint from inadvertent vehicle movement.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on a vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle.
- If it is necessary to work under the hood, keep hands and other objects clear of the radiator fan blades! The electric cooling fans can start to operate any time by an increase in underhood temperature, but only when the ignition switch is in the RUN position. For this reason care should be taken to ensure that the electric cooling fan motor is completely disconnected when working under the hood when engine is not running.

HOW TO USE THIS MANUAL

SUBJECTS COVERED IN THIS MANUAL	1
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Subjects Covered in This Manual

This 1993 Service Manual covers normal service repairs and maintenance for vehicles sold in the United States and Canada.

A separate publication, the 1993 Powertrain Control/Emissions Diagnosis Manual covers:

- Engine Controls and Diagnosis
- Transmission/Transaxle Controls and Diagnosis
- Emissions Diagnosis

How This Manual is Organized

This manual is organized by Group, Section, and Page.

Group

A Group covers a specific portion of the vehicle. The first set of numbers on each page indicate the Group.

				GROUP NUMBER		01-00-1
				GROUP		
				BODY		01
SECTION TITLE		PAGE	SECTION TITLE		PAGE	
BODY, GENERAL SERVICE.....		01-00-1	HANDLES, LOCKS, LATCHES AND			
FRONT END BODY PANELS			MECHANISMS.....		01-14-1	
AND STRUCTURE.....		01-02-1	FRONT WINDOW WIPERS.....		01-16A-1	

NOTE: A Group usually contains more than one Section.

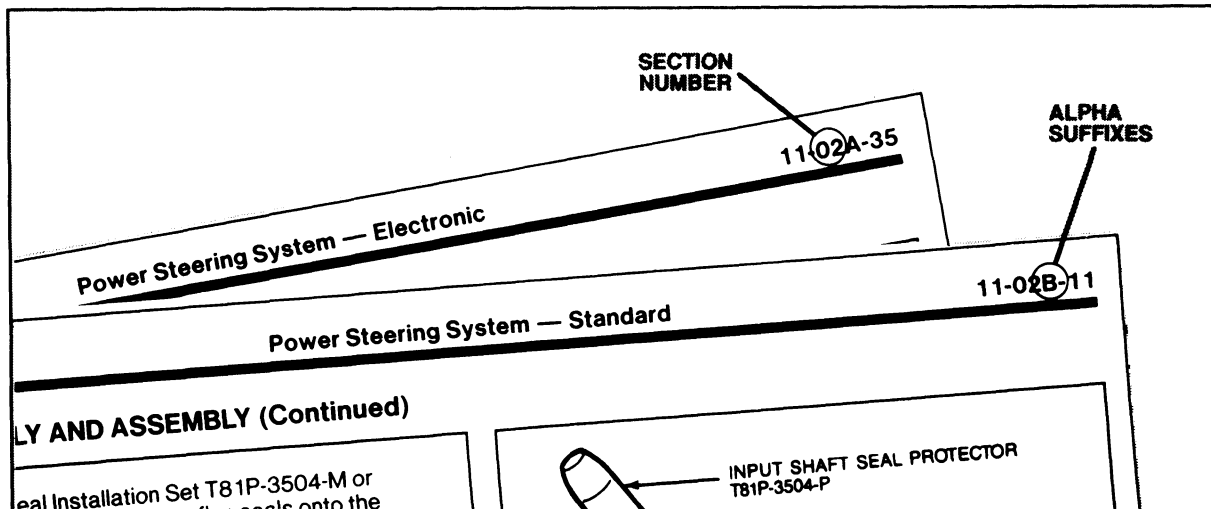
The eighteen Groups found in this manual are:

- 00 – General Service Information
- 01 – Body
- 02 – Frame and Mounting
- 03 – Engine
- 04 – Suspension
- 05 – Driveline
- 06 – Brake System
- 07 – Transmission (rear-wheel drive) or Transaxle (front-wheel drive)
- 08 – Clutch System
- 09 – Exhaust System
- 10 – Fuel System
- 11 – Steering System
- 12 – Climate Control System
- 13 – Instrumentation and Warning Systems
- 14 – Battery and Charging System
- 15 – Audio Systems
- 17 – Lighting
- 18 – Electrical Distribution

Section

Each Section covers a component or system. The second set of numbers on each page indicate the Section.

If the vehicle has more than one type of component, such as two types of engines or power steering systems, alpha suffixes are used.

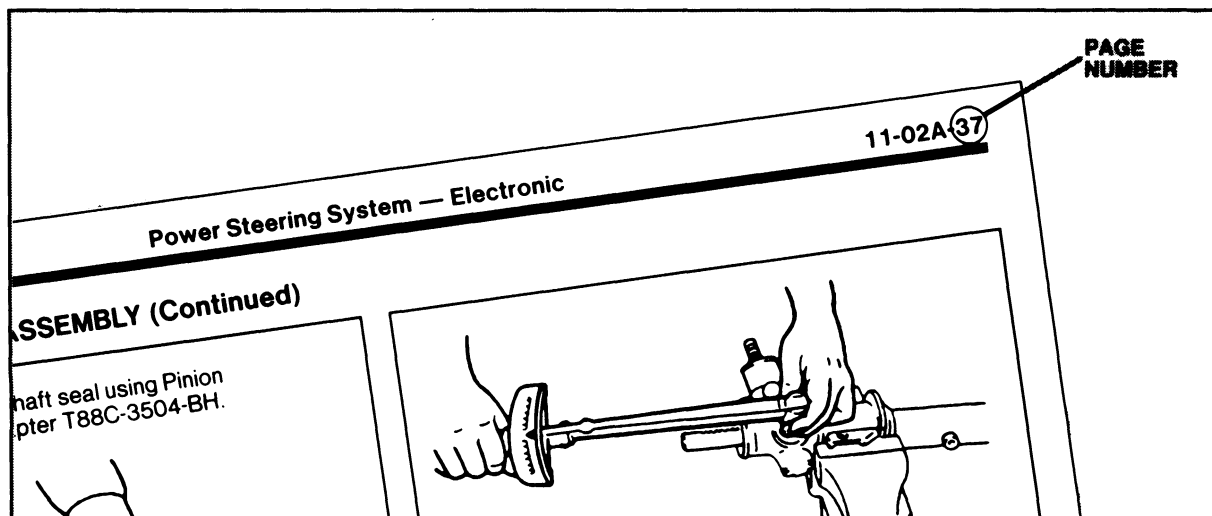


To assist in locating a subject, whenever feasible, Section titles have the subject first, followed by a descriptive word(s).

- Mirrors – Rearview
- Mirrors – Power

Page

The third set of numbers indicate the Page in each Section.



How to Find Material in This Manual

1. Locate the Group number in the Table of Contents. **If you are not sure which Section contains the information you need, look up the component/system in the alphabetical index located in the back of this manual.**
2. Locate the Section number by using the Group index located at the beginning of each Group.
3. Locate the specific Page by using the Section index at the beginning of each Section.

How to Use Each Section

Each Section has a standard organization that consists of the following information:

Vehicle Application

Identifies the product (vehicle, model, engine, transmission, etc.) that the section applies to:

- Probe GT
- Aerostar and Ranger with integral carrier and 7.5 ring gear

Description and Operation

Describes how the component or system works.

Diagnosis and Testing

Identifies how to pinpoint problems.

Removal and Installation

Describes how to remove and reinstall components and systems.

Disassembly and Assembly

Lists how to take apart the component/system, and put it back together.

Adjustments

Describes how to perform in-vehicle adjustments.

Specifications

Summarizes all the specifications used in the Section.

Special Service Tools/Equipment

Lists all the Special Service Tools and Rotunda Equipment used in the Section.

Additional headings such as General Service Procedures and Cleaning and Inspection may be used.

What's New in This Manual

You will notice that changes have been made to some of the standard terminology that was found in past Service Manuals. Changes in state or federal law have mandated terminology changes. Please refer to the J1930 Terminology List that is located in the back of this manual.

One additional feature found in this manual is the footer located at the bottom of each page. This footer denotes the vehicle model year, carline, and Service Manual print date. If a page is accidentally separated from the manual, the footer will help you determine its proper location.

What to Do if You Discover an Error

If you discover a questionable procedure or if you have any suggestions for improving this manual, please use one of the feedback forms provided in the front and back of this manual. Your feedback is very important to improving Ford technical publications. You will get a response to your concern. If necessary, a revision will be issued.

NOTE: The descriptions and specifications contained in this manual were in effect at the time this manual was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design without notice and without incurring any obligation.

GROUP

GENERAL
INFORMATION

00

SECTION TITLE	PAGE	SECTION TITLE	PAGE
HOISTING, JACKING, SPARE TIRE STOWAGE AND EMERGENCY TOWING	00-02-1	NOISE, VIBRATION AND HARSHNESS DIAGNOSIS.....	00-04-1
IDENTIFICATION CODES	00-01-1	ROADABILITY DIAGNOSIS	00-05-1
MAINTENANCE AND LUBRICATION.....	00-03-1		

SECTION 00-01 Identification Codes

SUBJECT	PAGE	SUBJECT	PAGE
GENERAL INFORMATION		GENERAL INFORMATION (Cont'd.)	
Bulld Date Stamp Locations	00-01-5	Vehicle Safety Compliance Certification Label.....	00-01-1
Vehicle Data	00-01-5	VEHICLE APPLICATION	00-01-1
Vehicle Identification Number (VIN)	00-01-4		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty Series
and Bronco Vehicles

GENERAL INFORMATION

Vehicle Safety Compliance Certification Label

The English Safety Compliance Certification Label is attached to the drivers door lock pillar. The French Safety Compliance Certification Label is attached to the door latch edge on the passenger's side door. The label contains the name of the manufacturer, the month and year of manufacture, the certification statement, and the Vehicle Identification Number. The label also contains gross vehicle weight ratings, wheel and tire data, and information codes for additional vehicle data.

GENERAL INFORMATION (Continued)

SAFETY COMPLIANCE CERTIFICATION LABELS
COMPLETE VEHICLES

(UNITED STATES)

MFD. BY FORD MOTOR CO. IN U.S.A.
GVWR: 8800 LB/3900 KG

DATE: 10/92

FRONT GAWR: 2915 LB
1322 KG
LT235/85R16E
16x6K
AT 51 PSI COLD

WITH TIRES RIMS

REAR GAWR: 6084 LB
2759 KG
LT235/85R16E
16x6K
AT 80 PSI COLD

WITH TIRES RIMS

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

VIN: 2FTHF25Y5LCA00001

TYPE: TRUCK

F0128
T0423

W7408
EXTERIOR PAINT COLORS

WB 133 | TYPE GVW F257 | BODY AK4 | TRANS G | AXLE 35 | TAPE | SPRINGS CF

▽ F0TA-15204A10-AA

(QUEBEC)

FABR. AUX E-U PAR LA FORD MOTOR CO.

DATE: 9/92

PNBE AV: 3765 LB
1707 KG
LT235/85R16E
16x6K

PNBV: 8800 LB/ 3991KG
PNBE AR: 6084 LB
2759 KG
LT235/85R16E
16x6K

AVEC PNEUS JANTES

À 51 LB/PO² À FROID

À 80 LB/PO² À FROID

CE VEHICULE EST CONFORME A TOUTES LES NORMES FEDERALES DE SECURITE DES V.A. EN VIGUEUR A LA DATE DE FABR. INQUEE CI-DESSUS.

NIV: 1FTHX25G6LKA00002

TYPE: CAMION

F0195
T0040

AV COULEUR

B2
N° COMM SPEC.

EMPATT. 155 | TYPE/PBV X259 | CARR FKM | B.V. E | PONT C5 | BANDE 2 | RESSORT H3A

▽ F0TA-15204A10-CA

FOR VEHICLES MFG. IN U.S.A. FOR QUEBEC, CANADA.

(QUEBEC)

FABR. PAR FORD DU CANADA LIMITEE

DATE: 9/92

PNBE AVANT: 2800 LB
1270 KG
P235/75R15XL
15x6.0JK

PNBV: 6250 LB/ 2834 KG
PNBE ARRIERE: 3800 LB
1723 KG
P235/75R15XL
15x6.0JK

AVEC PNEUS JANTES

À 35 LB/PO² À FROID

À 41 LB/PO² À FROID

CE VEHICULE EST CONFORME A TOUTES LES NORMES FEDERALES DE SECURITE DES V.A. EN VIGUEUR A LA DATE DE FABR. INQUEE CI-DESSUS.

NIV: 2FTEF15Y4LCA00004

TYPE: CAMION

F0144
T0269

YW COULEURS EXT.

B2
N° COMM SPEC.

EMPATT. 133 | TYPE/PBV F155 | CARR CJ4 | B.V. E | PONT H9 | BANDE | RESSORT CD

MADE IN CANADA

▽ F0TA-15204A10-DA

FOR VEHICLES MFG. IN CANADA FOR QUEBEC, CANADA.

INCOMPLETE VEHICLES (U.S.)

THE INCOMPLETE VEHICLE RATING DECAL IS INSTALLED ON THE DRIVER'S DOOR LOCK PILLAR IN PLACE OF THE SAFETY COMPLIANCE CERTIFICATION LABEL.

INCOMPLETE VEHICLE MANUFACTURED BY FORD MOTOR COMPANY
MADE IN U.S.A.
GVWR: 11000 LB/4989 KG

DATE: 9/92

FRONT GAWR: 4200 LB
1905 KG
LT215/85R16D
16x6K
AT 58 PSI COLD

WITH TIRES RIMS

REAR GAWR: 8250 LB
3742 KG
LT215/85R16D
16x6K
AT 65 PSI COLD

WITH TIRES RIMS DUAL

VIN: 1FDKF37M0LKA00005

YY
EXTERIOR PAINT COLORS

410047
DSO

WB 161 | TYPE GVW F379 | BODY AJ8 | TRANS E | AXLE 65 | TAPE | SPRINGS N Y

▽ F0TA-15204A10-EA

CY2666-L

(CANADA)

MFD. BY FORD MOTOR CO. OF CANADA LTD.
GVWR: 8800 LB/3900 KG

DATE: 9/92

FRONT GAWR: 2915 LB
1322 KG
LT235/85R16E
16x6K
AT 51 PSI COLD

WITH TIRES RIMS

REAR GAWR: 6084 LB
2759 KG
LT235/85R16E
16x6K
AT 80 PSI COLD

WITH TIRES RIMS

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

VIN: 2FTHF25Y5LCA00003

TYPE: TRUCK

F0128
T0423

W7408
EXTERIOR PAINT COLORS

WB 133 | TYPE GVW F257 | BODY AK4 | TRANS G | AXLE 35 | TAPE | SPRING CF

MADE IN CANADA

▽ F0TA-15204A10-BA



INCOMPLETE VEHICLES (CAN)

THE INCOMPLETE VEHICLE RATING DECAL IS INSTALLED ON THE DRIVER'S DOOR LOCK PILLAR IN PLACE OF THE SAFETY COMPLIANCE CERTIFICATION LABEL.

INCOMPLETE VEHICLE MANUFACTURED BY FORD MOTOR CO. OF CANADA LTD.
MADE IN CANADA
GVWR: 11000 LB/4989 KG

DATE: 9/92

FRONT GAWR: 4200 LB
1905 KG
LT215/85R16D
16x6K
AT 58 PSI COLD

WITH TIRES RIMS

REAR GAWR: 8250 LB
3742 KG
LT215/85R16D
16x6K
AT 65 PSI COLD

WITH TIRES RIMS DUAL

VIN: 2FDKF37M6LCA00006

W7408
EXTERIOR PAINT COLORS

B81057
DSO

WB 181 | TYPE GVW F379 | BODY AJ8 | TRANS E | AXLE 65 | TAPE | SPRINGS N Y

▽ F0TA-15204A10-FA

GENERAL INFORMATION (Continued)

①	MFD. BY FORD MOTOR CO. IN U.S.A.		⑦
②	DATE: 2/93	GVWR: 6600 LB/2994 KG	⑧
③	FRONT GAWR: 3320 LB	REAR GAWR: 4004 LB	⑨
④	1508KG	1816KG	⑩
⑤	LT 215/85R 16D	LT 215/85R 16D	⑪
⑥	18 x 8K	16 x 8K	
	AT 51 PSI COLD	AT 58 PSI COLD	
	THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE		
⑫	VIN:	1FTEF25H5PLA00000	
⑬	TYPE: TRUCK		
	(A) (B) (C) (D) (E) (F) (G) (H)		
		F0083	⑭
		T0112	⑮
⑭	7N	9M	
	EXTERIOR PAINT COLORS		⑯
	WB	TYPE-GVW	
	133	F251	
	BODY	TRANS	
	LG4	E	
	AXLE	TAPE	
	342	B	
	SPRING		
	2 D 2 9		
	(A)(B)(C)(D)		
		DSO	⑰

① NAME AND LOCATION OF MANUFACTURER

② DATE OF MANUFACTURE

③ FRONT GROSS AXLE WEIGHT RATINGS IN POUNDS (LB) AND KILOGRAMS (KG)

④ FRONT TIRE SIZE

⑤ RIM SIZE

⑥ FRONT TIRE COLD PSI

⑦ GROSS VEHICLE WEIGHT RATING IN POUNDS (LB) AND KILOGRAMS (KG)

⑧ REAR GROSS AXLE WEIGHT RATING IN POUNDS (LB) AND KILOGRAMS (KG)

⑨ REAR TIRE SIZE

⑩ RIM SIZE

⑪ REAR TIRE COLD PSI

⑫ VEHICLE IDENTIFICATION NUMBER

(A) WORLD MANUFACTURER IDENTIFIER

(B) BRAKE SYSTEM AND GROSS VEHICLE WEIGHT RATING (GVWR) CLASS FOR FORD COMPLETED TRUCKS AND MPV'S. FOR BUSES AND INCOMPLETE VEHICLES, THE FOURTH DIGIT DETERMINES THE BRAKE SYSTEM (ONLY).

(C) MODEL OR LINE, SERIES, CHASSIS, CAB OR BODY TYPE

(D) ENGINE TYPE

(E) CHECK DIGIT

(F) MODEL YEAR (FORD-COMPLETED TRUCKS AND MPV'S)

(G) ASSEMBLY PLANT CODE

(H) SEQUENCE NUMBER

⑬ TYPE VEHICLE

⑭ EXTERIOR PAINT CODES (TWO SETS OF FIGURES DESIGNATES A TWO-TONE)

⑮ WHEELBASE IN INCHES

⑯ MODEL CODE AND GVW

⑰ INTERIOR TRIM, SEAT AND BODY/CAB TYPE

⑱ TRANSMISSION CODE

⑲ REAR AXLE CODE

⑳ FRONT AXLE CODE IF SO EQUIPPED

㉑ DISTRICT/SPECIAL ORDER CODES

㉒ EXTERNAL BODY TAPE STRIPE CODE

㉓ SUSPENSION IDENTIFICATION CODES

(A) AUX./OPT. USAGE CODE (FRONT)

(B) FRONT SPRING CODE

(C) AUX./OPT. USAGE CODE (REAR)

(D) REAR SPRING CODE

㉔ FRONT AXLE ACCESSORY RESERVE CAPACITY IN POUNDS

㉕ TOTAL ACCESSORY RESERVE CAPACITY IN POUNDS

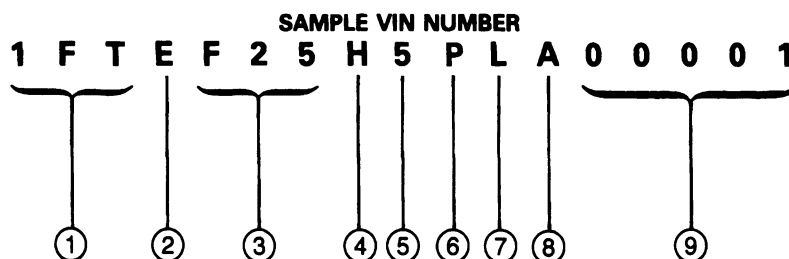
CW1017-A

GENERAL INFORMATION (Continued)**Vehicle Identification Number (VIN)**

A seventeen-digit combination of numbers and letters forms the Vehicle Identification Number (VIN). The VIN is stamped on a metal tab that is riveted to the instrument panel close to the windshield. The VIN number is viewable by looking through the front windshield on the driver's side. The VIN number is also found on the Safety Compliance Certification Label.

By looking at the seventeen-digit VIN number a variety of information about the vehicle can be determined. The first three digits identify the manufacturer and the vehicle make and type. The fourth digit determines the Gross Vehicle Weight Rating (GVWR-Class) and Brake System for Ford completed Trucks and MPV's. For Buses and incomplete vehicles, the fourth digit determines the brake system (only). Digits five, six and seven identify the model or line, series, chassis, and cab or body type. The eighth digit points out the particular engine found in the vehicle. Digit nine is the VIN check digit. The tenth digit identifies the model year of a Ford-completed vehicle, or the model year of the incomplete vehicle, if sold by Ford as an incomplete vehicle. The eleventh digit determines the assembly plant. Digits twelve through seventeen make up the sequence serial and warranty number. Digit twelve uses the letter A until the production or sequence of 99,999 units (digits thirteen through seventeen) is reached. Letter A then becomes B for the next production sequence of vehicles.

Refer to the following illustrations to help in further explanation of the Vehicle Identification Number (VIN).



① POSITION 1, 2 AND 3 – MANUFACTURER, MAKE AND TYPE (WORLD MANUFACTURER IDENTIFIER)

② POSITION 4 – BRAKES SYSTEM/GVWR CLASS FOR FORD-COMPLETED TRUCKS AND MPV'S. FOR BUSES AND INCOMPLETE VEHICLES, BRAKE SYSTEM (ONLY).

③ POSITION 5, 6 AND 7 – MODEL OR LINE, SERIES, CHASSIS, CAB OR BODY TYPE

④ POSITION 8 – ENGINE TYPE

⑤ POSITION 9 – CHECK DIGIT

⑥ POSITION 10 – MODEL YEAR (FORD-COMPLETED VEHICLES)

⑦ POSITION 11 – ASSEMBLY PLANT

⑧ POSITION 12 – CONSTANT 'A' UNTIL SEQUENCE NUMBER OF 99,999 IS REACHED, THEN CHANGES TO A CONSTANT 'B' AND SO ON

⑨ POSITION 13 THROUGH 17 – SEQUENCE NUMBER – BEGINS AT 00001

CY2376-M

GENERAL INFORMATION (Continued)

VEHICLE IDENTIFICATION NUMBER (VIN) CODES

WORLD MANUFACTURER IDENTIFIER
(VIN POSITIONS 1, 2 AND 3)

1FT EF25H5 P LA00001

VIN CODE	MANUFACTURER	MAKE	TYPE
1FM	FORD MOTOR COMPANY, USA	FORD	MULTI PURPOSE PASSENGER VEHICLE (MPV)
1FT	FORD MOTOR COMPANY, USA	FORD	TRUCK (COMPLETED VEHICLE)
1FD	FORD MOTOR COMPANY, USA	FORD	INCOMPLETE VEHICLE (IV)
1FC	FORD MOTOR COMPANY, USA	FORD	BASIC (STRIPPED) CHASSIS
1FB	FORD MOTOR COMPANY, USA	FORD	BUS
1FF	FORD MOTOR COMPANY, USA	FORD	MOTOR VEHICLE EQUIPMENT WITHOUT ENGINE/ POWERTRAIN (GLIDER)
2FM	FORD MOTOR COMPANY OF CANADA, LTD.	FORD	MPV
2FT	FORD MOTOR COMPANY OF CANADA, LTD.	FORD	TRUCK (COMPLETED VEHICLE)
2FD	FORD MOTOR COMPANY OF CANADA, LTD.	FORD	INCOMPLETE VEHICLE
2FC	FORD MOTOR COMPANY OF CANADA, LTD.	FORD	BASIC (STRIPPED) CHASSIS
2FB	FORD MOTOR COMPANY OF CANADA, LTD.	FORD	BUS
2FF	FORD MOTOR COMPANY OF CANADA, LTD.	FORD	MOTOR VEHICLE EQUIPMENT WITHOUT ENGINE/ POWERTRAIN (GLIDER)
3FC	FORD MOTOR COMPANY OF MEXICO	FORD	BASIC (STRIPPED) CHASSIS

CY2377-M

Refer to the code definition portion of this section for specific definitions of the numbers and letters of the Vehicle Identification Number (VIN).

Build Date Stamp Locations

The vehicle build date stamp is located as follows: On Bronco and Light Trucks (F-150-250-350) the vehicle build date is stamped on the front surface of the radiator support on the passengers side of the vehicle. On Econoline vehicles (E-150-250-350), the build date is stamped on top of the radiator support. Following is a sample of the four-digit number that indicates the month and day of build.

Actual Build Date / Vehicle Date Stamp**January 24 / 0124****October 21 / 1021**

Yellow ink is normally used for the date stamp. When the marking surface is painted the body color, the date stamp will be marked in red ink. Units from the Ontario Truck Plant (Code C) will be marked with silver ink.

Vehicle Data

The Vehicle Data appears on the Safety Compliance Certification Label on the second and third lines following the identification number. The code set (two numbers or a number and letter) above COLOR identify the exterior paint color (two sets of codes designate a two-tone). The three digits under WB designate the wheelbase in inches. The letter and three digits under TYPE-GVW designate the truck model within a series and the gross vehicle weight rating. The letters and / or numeral under BODY designate the interior trim, seat and body type. The transmission installed in the vehicle is identified under TRANS by an alphabetical code. A letter and a number or two numbers under AXLE identify the rear axle ratio (when required, a letter is also stamped or number after the rear axle code to identify the front axle). The letters and / or numerals under TAPE designate the external bodyside tape stripe. The spring usage codes for the vehicle is identified under SPRING.

A two-digit number is stamped above DSO to identify the district which ordered the vehicle. If the vehicle is built to special order (Domestic Special Order, Foreign Special Order, Limited Production Option or other special order), the complete order number will also appear above DSO. The following charts list the various vehicle data codes.

GENERAL INFORMATION (Continued)

Vehicle Identification Number (VIN) Codes

**BRAKE SYSTEM AND GVWR CLASS FOR TRUCKS AND MPV'S —
BRAKE SYSTEM (ONLY) FOR BUSES AND INCOMPLETE VEHICLES
(VIN POSITION 4)**

1 F T **E** F 2 5 H 5 P L A 0 0 0 1

BRAKE SYSTEM	GVWR CLASS	GVWR RANGE	VIN CODE
HYDRAULIC	CLASS A	NOT GREATER THAN 3,000 POUNDS	A
HYDRAULIC	CLASS B	3,001 — 4,000 POUNDS	B
HYDRAULIC	CLASS C	4,001 — 5,000 POUNDS	C
HYDRAULIC	CLASS D	5,001 — 6,000 POUNDS	D
HYDRAULIC	CLASS E	6,001 — 7,000 POUNDS	E
HYDRAULIC	CLASS F	7,001 — 8,000 POUNDS	F
HYDRAULIC	CLASS G	8,001 — 8,500 POUNDS	G
		8,501 — 9,000 POUNDS	H
HYDRAULIC	CLASS H	9,001 — 10,000 POUNDS	J
HYDRAULIC	CLASS 3	10,001 — 14,000 POUNDS	K
HYDRAULIC	CLASS 4	14,001 — 16,000 POUNDS	L
HYDRAULIC	CLASS 5	16,001 — 19,500 POUNDS	M

CY2674-K

GENERAL INFORMATION (Continued)

General Information

MODEL OR LINE, SERIES, CHASSIS, CAB OR BODY TYPE
(VIN POSITIONS 5, 6, AND 7)1FTE **F** H5PLA00001

VIN CODE		LINE	SERIES	CHASSIS TYPE	CAB OR BODY TYPE	VEHICLE TYPE ①
CLUB WAGON E11 E31 —	SUPER WAGON — — S31	CLUB WAGON CLUB WAGON CLUB WAGON	CUSTOM E150 E350 E350	4x2 4x2 4x2	CLUB WAGON CLUB WAGON SUPER WAGON	MPV OR BUS MPV OR BUS ②
MEMO: ONE OF THE FOLLOWING OPTIONAL EXTERIOR NAMEPLATES (INDICATING DIFFERENT TRIM LEVELS) MAY ALSO BE AFFIXED TO THE VEHICLE IN ADDITION TO THE CLUB WAGON XL NAMEPLATE: •XLT •CHATEAU ②EXCLUDES SCHOOL BUS						

REGULAR VAN E14	SUPER VAN		BASE			
E24		ECONOLINE	E150	4x2	CARGO VAN – REGULAR VAN/ SUPER VAN	TRUCK OR IV
E34	S34	ECONOLINE	E250	4x2	CARGO VAN – REGULAR VAN/ SUPER VAN	TRUCK OR IV
		ECONOLINE	E350	4x2	CARGO VAN – REGULAR VAN/ SUPER VAN	TRUCK OR IV
OTHER E29 E37 E30 E39	— — — —	ECONOLINE ECONOLINE ECONOLINE ECONOLINE	E250 E350 E350 E350	4x2 4x2 4x2 4x2	COMMERCIAL STRIPPED CHASSIS COMMERCIAL CUTAWAY RV CUTAWAY COMMERCIAL BASIC (STRIPPED) CHASSIS	IV IV IV IV
E33	—	ECONOLINE	E350	4x2	RV BASIC (STRIPPED) CHASSIS	IV

① "MPV" MEANS MULTI PURPOSE PASSENGER VEHICLE. "IV" MEANS INCOMPLETE VEHICLE. "TRUCK" MEANS COMPLETED VEHICLE.

MEMO: FOR ALL ECONOLINE EXCEPT BASIC (STRIPPED) CHASSIS, THE OPTIONAL EXTERIOR NAMEPLATES "XL" AND "RV CONVERSION" (INDICATING TRIM LEVEL) MAY ALSO BE AFFIXED TO THE VEHICLE IN ADDITION TO THE ECONOLINE NAMEPLATE.

NOTE: ALL 1993 MODEL COMMERCIAL AND RV BASIC (STRIPPED) CHASSIS INCOMPLETE VEHICLES ARE DESIGNATED BY A "1FC" WORLD MANUFACTURER IDENTIFIER (WMI) CODE. THE RV BASIC (STRIPPED) CHASSIS IS AVAILABLE ONLY ON A SPECIAL ORDER BASIS.

VIN CODE	LINE	SERIES	CHASSIS TYPE	CAB OR BODY TYPE	VEHICLE TYPE ①
U15	BRONCO	CUSTOM	4x4	BRONCO	MPV
MEMO: ONE OF THE FOLLOWING OPTIONAL EXTERIOR NAMEPLATES (INDICATING HIGHER TRIM LEVELS) MAY ALSO BE AFFIXED TO THE VEHICLE IN ADDITION TO THE BRONCO NAMEPLATE: • XLT • EDDIE BAUER					

REGULAR CAB	SUPER CAB OR CREW CAB		XL			
F14 F15	X14 X15	F-SERIES F-SERIES	F150 F150	4x4 4x2	PICKUP – REGULAR CAB/SUPER CAB PICKUP – REGULAR CAB/SUPER CAB	TRUCK TRUCK
F25 F26	X25 X26	F-SERIES F-SERIES	F250 F250	4x2 4x4	PICKUP – REGULAR CAB/SUPER CAB PICKUP – REGULAR CAB/SUPER CAB	TRUCK TRUCK
F35	W35X35	F-SERIES	F350	4x2	PICKUP – REGULAR CAB/CREW CAB/ SUPER CAB	TRUCK
F37	—	F-SERIES	F350	4x2	REGULAR CAB (CHASSIS CAB)	TRUCK
F36	W36	F-SERIES	F350	4x4	PICKUP – REGULAR CAB/CREW CAB	IV
F38	—	F-SERIES	F350	4x4	REGULAR CAB (CHASSIS CAB)	IV
F47	—	F-SERIES	F-SUPER DUTY	4x2	REGULAR CAB (CHASSIS CAB)	IV
F53	—	F-SERIES	F-SUPER DUTY	4x2	RV BASIC STRIPPED CHASSIS	IV
F59	—	F-SERIES	F-SUPER DUTY	4x2	COMMERCIAL BASIC STRIPPED CHASSIS	IV

① "MPV" MEANS MULTI-PURPOSE PASSENGER VEHICLE. "IV" MEANS INCOMPLETE VEHICLE.

MEMO: ONE OF THE FOLLOWING OPTIONAL EXTERIOR NAMEPLATES (INDICATING HIGHER TRIM LEVELS) MAY ALSO BE AFFIXED TO THE VEHICLE IN ADDITION TO THE F-SERIES NAMEPLATES:
• XLT

NOTE: SPECIAL ORDER (DSO) UNITS WILL BE CODED WITH THE APPROPRIATE SERIES VIN CODES LISTED ABOVE.

CY2379-M

GENERAL INFORMATION (Continued)

ENGINE TYPE, DISPLACEMENT, CYLINDERS,
FUEL TYPE, AND MANUFACTURER
(VIN POSITION 8)1 F T E F 2 5 **H** 5 P L A 0 0 0 0 1

VIN CODE	DISPLACEMENT		CYLINDERS	FUEL	MANUFACTURER
	LITER	CID			
Y	4.9	300	I-6	GASOLINE	FORD
N	5.0	302	V-8	GASOLINE	FORD
H	5.8	351	V-8	GASOLINE	FORD
R	5.8	351	V-8	GASOLINE	FORD
G	7.5	460	V-8	GASOLINE	FORD
M	7.3	445	V-8	DIESEL	NAVISTAR
C	7.3	445	V-8	DIESEL	NAVISTAR

CY2380-M

CHECK DIGIT FOR ALL VEHICLES
(VIN POSITION 9)1 F T E F 2 5 H **5** P L A 0 0 0 0 1

CY2381-M

VEHICLE MODEL YEAR
FOR FORD-COMPLETED VEHICLES
(VIN POSITION 10)1 F T E F 2 5 H 5 **N** L A 0 0 0 0 1

VIN CODE	YEAR
K	1989
L	1990
M	1991
N	1992
P	1993
R	1994
S	1995
T	1996
V	1997

CY2382-M

ASSEMBLY PLANT CODES
(VIN POSITION 11)1 F T E F 2 5 H 5 P **L** A 0 0 0 0 1

VIN CODE	VEHICLE ASSEMBLY PLANT — NAME AND LOCATION
C	ONTARIO TRUCK: OAKVILLE, ONTARIO
H	LORAIN: LORAIN, OHIO
J	MONTERREY, N.L.: MEXICO
K	KANSAS CITY: CLAYCOMO, MISSOURI
L	MICHIGAN TRUCK: WAYNE, MICHIGAN
N	NORFOLK: NORFOLK, VIRGINIA
P	TWIN CITIES: ST. PAUL, MINNESOTA
U	LOUISVILLE: LOUISVILLE, KENTUCKY

CY2383-M

PRODUCTION SEQUENCE NUMBER
(VIN POSITIONS 12 THROUGH 17)1 F T E F 2 5 H 5 P L **A 0 0 0 0 1**

SEQUENCE NUMBER
A 00001 — A 99,000 B 00001 — B 99,999 AND SO ON.

CY2384-M

GENERAL INFORMATION (Continued)

**EXTERIOR PAINT COLOR CODES
BRONCO, F-150-250-350, F-SUPER DUTY**

MFD. BY FORD MOTOR CO. IN U.S.A.


DATE:	GVWR:
FRONT GAWR:	REAR GAWR:

WITH TIRES RIMS WITH TIRES RIMS
 AT PSI COLD AT PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

VIN: _____

TYPE: _____



YC

EXTERIOR PAINT COLORS						DSO
WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	SPRING
133	F252	LG4	F	342	B	2D29

BRONCO EXTERIOR PAINT COLOR CODES

CODE	COLOR
YC	BLACK
MS	SMOKE METALLIC
EH	MEDIUM CABERNET SOLID
MW	BRIGHT REGATTA BLUE METALLIC
MX	DARK SHADOW BLUE METALLIC
DB	LIGHT MOCHA SOLID
PB	JEWEL GREEN METALLIC
MC	LIGHT SMOKE METALLIC
EP	VERMILION SOLID
DW	DARK MOCHA METALLIC
DJ	MEDIUM MOCHA METALLIC
YO	OXFORD WHITE SOLID
FIBERGLASS ROOF COLORS	
A	BLACK
B	BLUE
K	PAWNEE TAN
R	CURRANT RED
W	WHITE

NOTE - TWO SETS OF CODES INDICATE TWO-TONE PAINT

F-150-250-350 AND F-SUPER DUTY EXTERIOR PAINT COLOR CODES

CODE	COLOR
YC	BLACK
MS	SMOKE METALLIC
MC	LIGHT SMOKE METALLIC
EH	MEDIUM CABERNET SOLID
MW	BRIGHT REGATTA BLUE METALLIC
YY	WHITE
DC	MEDIUM MOCHA C/C
DB	LIGHT MOCHA SOLID
DW	DARK MOCHA METALLIC
RC	MEDIUM PLATINUM C/C
YN	SILVER C/C
PB	JEWEL GREEN METALLIC
MK	TWILIGHT BLUE C/C
EL	WILD STRAWBERRY C/C
DD	MOCHA FROST C/C
MX	DARK SHADOW BLUE METALLIC
K3	BIMINI BLUE C/C
EG	ELECTRIC CURRANT RED C/C
EP	VERMILION SOLID
DJ	MEDIUM MOCHA METALLIC
6C	IRIS C/C
YO	OXFORD WHITE SOLID

CY2668-K

GENERAL INFORMATION (Continued)

EXTERIOR PAINT COLOR CODES
E-150-250-350

MFD. BY FORD MOTOR CO. IN U.S.A.						
DATE:		GVWR: LB/ KG				
FRONT GAWR: LB		REAR GAWR: LB				
KG	WITH TIRES RIMS	KG	WITH TIRES RIMS			
AT PSI COLD		AT PSI COLD				
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE						
VIN: 						
TYPE: 						
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">DC</div> <div style="border: 1px solid black; padding: 2px;">EC</div> </div>						
EXTERIOR PAINT COLORS DSO						
WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE
138	E112		EY	T	16	B
						SPRING
						2C2D

E-150-250-350

CODE	COLOR
ZC	GLACIER WHITE SOLID
YY	WHITE
RC	MEDIUM PLATINUM C/C
YN	SILVER C/C
K2	ATLANTIC BLUE SOLID
MA	LIGHT CRYSTAL BLUE C/C
DD	MOCHA FROST C/C
YC	BLACK SOLID
DC	MEDIUM MOCHA C/C
EG	ELECTRIC CURRANT RED C/C
MK	TWILIGHT BLUE C/C
EC	CURRANT RED SOLID

NOTE: TWO SETS OF CODES INDICATE TWO-TONE PAINT.

CY2794-H

GENERAL INFORMATION (Continued)

**TYPE — GROSS VEHICLE WEIGHT (GVW) CODES
BRONCO, F-150-250-350, F-SUPER DUTY**

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: _____ GVWR: _____
 FRONT GAWR: _____ REAR GAWR: _____

WITH Tires RIMS WITH Tires RIMS

AT PSI COLD AT PSI COLD

**THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF
MANUFACTURE SHOWN ABOVE**

VIN: _____

TYPE: _____

7N 9M
EXTERIOR PAINT COLORS

WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE	SPRING
133	F251	LG4	F	342	B	2D29	

DSO

F25 1

SERIES	SERIES CODE	GVWR CODE	GVWR (LB.)	WHEELBASE (IN.)
BRONCO				
U150	U15	2	6050	105
	U15	4	6300	105
	U15	5	6450	105

F-150-250-350				
F-150 (4x2)	F15	3	5250	117
	F15	4	5450	133
	F15	5	6250	133
	F15	1	5000	117
	F15	2	5450	117
	F15	7	5150	117
	X15	1	6050	139
	X15	2	6250	155
F-150 (4x4)	F14	1	6100	117
	F14	2	6250	133
	X14	3	6250	139
	X14	1	6250	155
F-250 (4x2) LIGHT DUTY	F25	1	8600	133
F-250 (4x2) HEAVY DUTY	F25	7	8600	133
	F25	9	8800	155
	X25	9	8800	155

SERIES	SERIES CODE	GVWR CODE	GVWR (LB.)	WHEELBASE (IN.)
F-250 (4x4)	F26	1	6800	133
	X26	8	8800	155
	F26	8	8600	133
F-350 (4x2)	F35	2	10,000	133
	F37	4	8800	133
	F37	8	10,000	137, 161
	F37	9	11,000	137, 161
	W35	2	9200	168
	W35	3	10,000	168
	X35	1	10,000	155
F-350 (4x4)	F36	1	9000	133
	F38	2	8800	133
	F38	4	11,000	137, 161
	F38	1	16,000	137
	W36	1	9200	168
F-SUPER DUTY (4x2) CHASSIS CAB	F47	8	15,000	185
	F47	7	15,000	137, 161
F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS	F59	1	16,000	158, 178
F-SUPER DUTY MOTOR HOME STRIPPED CHASSIS	F53	1	16,000	178, 203
		1	17,000	178, 190
	F53	0	15,200	208, 228
				178

CY2669-K

GENERAL INFORMATION (Continued)

GROSS VEHICLE WEIGHT (GVW) CODES
E-150-250-350

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: _____ GVWR: LB/ KG
FRONT GAWR: LB REAR GAWR: LB

KG WITH TIRES RIMS KG WITH TIRES RIMS

AT PSI COLD AT PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF
MANUFACTURE SHOWN ABOVE

VIN: _____

TYPE: _____

1D 7A

EXTERIOR PAINT COLORS DSO

WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE	SPRING
138	E11	2	EY	T	16	B	2C29

E11	2
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E-150-350 CLUB – CUSTOM XLT AND CHATEAU WAGONS

SERIES	SERIES CODE	GVWR CODE	GVWR (LB.)
E-150 REGULAR	E11	2	6,700
E-350 REGULAR	E31	P	8,700
E-350 SUPER	S31	5	9,300
	S31	4	9,100
	S31	3	8,800

E-150-250-350 CARGO VANS

SERIES	SERIES CODE	GVWR CODE	GVWR (LB.)
E-150 REGULAR CARGO	E14	1	5,500
	E14	2	6,500
	E14	3	6,700
E-250 REGULAR CARGO	E24	1	7,200
	E24	2	8,450
	E24	3	8,550
E-250 SUPER CARGO	S24	1	7,300
	S24	2	8,450
	S24	3	8,550
E-350 REGULAR CARGO	E34	1	9,400
	E34	2	9,500
E-350 SUPER CARGO	S34	1	9,400
	S34	5	9,300

E-350 RV CUTAWAY

SERIES	SERIES CODE	GVWR CODE	GVWR (LB.)
E-350 RV CUTAWAY	E30	Q	9,600 SRW
	E30	2	10,500 DR
	E30	Y	11,500 DR

SR: SINGLE REAR WHEELS
DR: DUAL REAR WHEELS

E-350 COMMERCIAL CUTAWAY

SERIES	SERIES CODE	GVWR CODE	GVWR (LB.)
E-350 COMMERCIAL CUTAWAY	E37	1	10,000 DR
	E37	2	10,300 DR
	E37	3	10,700 DR
	E37	Q	9,600 SRW

SR: SINGLE REAR WHEELS
DR: DUAL REAR WHEELS

E-250-350 COMMERCIAL STRIPPED CHASSIS

SERIES	SERIES CODE	GVWR CODE	GVWR (LB.)
E-350 COMMERCIAL STRIPPED CHASSIS	E39	U	9,400 SR
	E39	W	10,000 DR
	E29	2	8,450 SR
	E29	3	8,550 SR

SR: SINGLE REAR WHEELS
DR: DUAL REAR WHEELS

E-350 STRIPPED CHASSIS

SERIES	SERIES CODE	GVWR CODE	GVWR (LB.)
E-350 RV STRIPPED CHASSIS	E33	Y	11,500 DR

CY2779-J

GENERAL INFORMATION (Continued)

**BODY CODES
BRONCO, LIGHT TRUCK,
(F-150-250-350, F-SUPER DUTY)**

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE:

GVWR:

FRONT GAWR:

REAR GAWR:

WITH
TIRES
RIMS

WITH
TIRES
RIMS

AT PSI COLD

AT PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF
MANUFACTURE SHOWN ABOVE

VIN:

TYPE:



1D 7A
EXTERIOR PAINT COLORS

DSO

WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE	SPRING
133	F252	LJ4	F	342	B	2D29	

A J 4

LIGHT TRUCK

CODE	FABRIC	SEAT TYPE
A	VINYL	BENCH
B	KNIT VINYL	BENCH
C	KNIT VINYL	BENCH
D	BODYCLOTH	FLIGHT BENCH
F	CLOTH	CAPTAINS CHAIR
G	BODYCLOTH	BENCH
P	CLOTH	BUCKET

BRONCO

CODE	FABRIC	SEAT TYPE
S	VINYL	BUCKET
V	CLOTH	CAPTAINS CHAIR
W	CLOTH	CAPTAINS CHAIR
X	LEATHER	CAPTAINS CHAIR
U	CLOTH/VINYL	SPLIT BENCH

BRONCO AND F-SERIES

TRIM COLOR	
CODE	COLOR
J	GRANITE
D	SCARLET
B	CRYSTAL BLUE
K	MEDIUM CHESTNUT


**F-SERIES ONLY
CAB/BACK OF CAB**

REGULAR	SPECIFICATIONS
4	STYLESIDE PICKUP
8	CHASSIS CAB
X	STRIPPED CHASSIS (MEXICO)
M	STYLESIDE PICKUP - SUPER CAB
D	STYLESIDE PICKUP - CREW CAB
3	FLARESIDE
C	FLARESIDE - SUPER CAB

CY2388-M

GENERAL INFORMATION (Continued)

BODY CODES
E-150-250-350

MFD. BY FORD MOTOR CO. IN U.S.A.						
DATE:		GVWR: LB/ KG				
FRONT GAWR: LB		REAR GAWR: LB				
KG	WITH TIRES RIMS	KG	WITH TIRES RIMS			
AT PSI COLD		AT PSI COLD				
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE						
VIN:						
TYPE:						
						
1G 9N						
EXTERIOR PAINT COLORS						
WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	DSO
138	E112	AJ	T	16	2	2C2D

A	J
---	---

SEAT TRIM AND STYLE

CODE	TRIM	TYPE
A	VINYL	BUCKET
B	VINYL	BUCKET
C	CLOTH	BUCKET
D	CLOTH	CAPTAINS CHAIR
L	CLOTH	CAPTAINS CHAIR
X	NO TRIM	CAPTAINS CHAIR


TRIM COLOR

CODE	COLOR
B	CRYSTAL BLUE
J	GRANITE
P	MOCHA

CY2780-J

GENERAL INFORMATION (Continued)

TRANSMISSION CODES
BRONCO, E-150-250-350, F-150-250-350, F-SUPER DUTY

MFD. BY FORD MOTOR CO. IN U.S.A.						
DATE:		GVWR:				
FRONT GAWR:		REAR GAWR:				
		WITH TIRES RIMS		WITH TIRES RIMS		
AT PSI COLD		AT PSI COLD				
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE						
VIN:						
TYPE:						
						
EXTERIOR PAINT COLORS						
WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE
133	F252	LG4	F	342	B	DSO
						SPRING
						2D29

CODE	DESCRIPTION
BRONCO	
M	MANUAL - 5-SPEED OVERDRIVE (M5OD) (MAZDA)
E	AUTOMATIC - E4OD
F	MANUAL - 4-SPEED (B-W T-18)
W	MANUAL - 5-SPEED HD OVERDRIVE (M5OD-HD) (ZF)
T	AUTOMATIC - 4-SPEED - AOD

E-150-250-350	
G	AUTOMATIC - C6
T	AUTOMATIC - 4-SPEED AOD
E	AUTOMATIC - E4OD
U	AUTOMATIC 4R70W (AODE-W)

F-150-250-350, F-SUPER DUTY CHASSIS CAB, F-SUPER DUTY STRIPPED CHASSIS	
G	AUTOMATIC - C6
T	AUTOMATIC - AOD
E	AUTOMATIC - E4OD
F	MANUAL - 4-SPEED (B-W T-18)
C	MANUAL - 5-SPEED CLOSE RATIO (Z-F)
M	MANUAL - 5-SPEED OVERDRIVE (M5OD) (MAZDA)
W	MANUAL - 5-SPEED H.D. OVERDRIVE (M5OD-HD) (Z-F)

CY2390-L

GENERAL INFORMATION (Continued)

AXLE CODES
BRONCO, F-150-250-350, F-SUPER DUTY

MFD. BY FORD MOTOR CO. IN U.S.A.						
DATE:		GVWR:				
FRONT GAWR:		REAR GAWR:				
		WITH TIRES RIMS			WITH TIRES RIMS	
AT PSI COLD		AT PSI COLD				
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE						
VIN: _____						
TYPE: _____						
7N 9M EXTERIOR PAINT COLORS						
WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE
133		F252	LG4	F	252	B
						DSO
						SPRING
						2D29

25	2
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REAR AXLE CODES

CODE	CAPACITY (LBS.)	RATIO
12	3800	2.73
18	3800	3.08
19	3800	3.55
H5	3800	4.10
H8	3800	3.08
H9	3800	3.55
25	3800	4.10
29	5300	3.55
B5	5300	4.10
B9	5300	3.55
35	6250	4.10
39	6250	3.55
C5	6250	4.10
C9	6250	3.55
45	7400	4.10
49	7400	3.55
D5	7400	4.10
65	8250	4.10
69	8250	3.55
F5	8250	4.10
72	11,000	4.63
73	11,000	5.13
W5	8250	4.00


FRONT AXLE CODES (NOT APPLICABLE ON E-150-250-350)

BRONCO AND F-150-250-350	
CODE	DESCRIPTION
2	FRONT AXLE LIMITED SLIP

CY2671-H

GENERAL INFORMATION (Continued)

AXLE CODES
E-150-250-350

MFD. BY FORD MOTOR CO. IN U.S.A.						
DATE:		GVWR: LB/ KG		WITH TIRES RIMS		
FRONT GAWR: LB		REAR GAWR: LB		WITH TIRES RIMS		
KG		KG				
AT PSI COLD		AT PSI COLD				
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE						
VIN:						
TYPE: 						
1D 7A EXTERIOR PAINT COLORS						
WB	TYPE	GVW	BODY	TRANS	AXLE	DSO
138	E112	EY	T	18	B	2C2D

E-150-250-350 REGULAR REAR AXLE

CODE	# CAPACITY	RATIO
12	3800	2.73
18	3800	3.08
19	3800	3.55
23	5400	3.54
24	5400	3.73
33	6340	3.54
52	7800	4.10
32	6340	4.10
62	8000	4.10
17	3800	3.31
36	6340	4.09
34	6340	3.73
56	7800	4.10


E-150-250-350 LIMITED-SLIP REAR AXLE

CODE	# CAPACITY	RATIO
H8	3800	3.08
H9	3800	3.08
B4	5400	3.73
C2	6340	4.10
C3	6340	3.54
E2	7800	4.10
F2	8000	4.10
H7	3800	3.31
C5	6340	4.09
C4	6340	3.73
E6	7800	4.10

CY2761-H

GENERAL INFORMATION (Continued)

EXTERNAL BODY TAPE STRIPE CODES
BRONCO, E-150-250-350, F-150-250-350, F-SUPER DUTY

MFD. BY FORD MOTOR CO. IN U.S.A.						
DATE:		GVWR:				
FRONT GAWR:		REAR GAWR:				
		WITH TIRES RIMS		WITH TIRES RIMS		
AT PSI COLD		AT PSI COLD				
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE						
VIN:						
TYPE:						
						
7N	9M					
EXTERIOR PAINT COLORS						
WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	DSO
133	F252	LG4	F	342	U	2D29

BRONCO EXTERNAL TUTORNE BODY TAPE STRIPE CODES

CODE	TAPE STRIPE
A	BLACK/SILVER
B	DK SHAD BLUE/SILVER
D	CABERNET/SILVER
E	(SCARLET)/SILVER
G	SMOKE/SILVER
J	JEWEL GREEN/SILVER
L	BRT REG BLUE/SILVER
T	DK MOCHA/LT MOCHA
U	MED MOCHA/DK MOCHA

F-150-250-350, ALL TUTORNES STYLESIDE TAPE

CODE	TAPE STRIPE
A	BLACK/SILVER
B	DK SHADOW BLUE/SILVER
D	CABERNET/SILVER
E	VERMILION/SILVER
G	SMOKE/SILVER
J	JEWEL GREEN/SILVER
L	BRT REGATTA BLUE/SILVER
M	BIMINI BLUE/SILVER
N	TWILIGHT BLUE/SILVER
P	PLATINUM/SILVER
R	WILD STRAWBERRY/SILVER
T	DARK MOCHA/LT MOCHA
U	MED MOCHA/DARK MOCHA
Y	MOCHA C/C/DARK MOCHA

F-150-250-350 FLARESIDE LO-LINE TAPE

CODE	TAPE STRIPE
C	HOT PINK/LAVENDER
H	HOT PINK/SILVER
K	SEA GREEN/LAVENDER
O	MED AQUA/DKAQUA
SPORT PACKAGE	
7	SILVER

E-150-250-350 TAPE STRIPES — TUTORNE

CODE	TAPE STRIPE
1	RED/SILVER
2	PLATINUM/SILVER
3	DARK BLUE/LIGHT BLUE
4	MEDIUM MOCHA/PASTEL MOCHA
TAPE STRIPES — CHATEAU	
A	BLUE/RED
B	PLATINUM/RED
C	MOCHA/RED

CY2872-K

GENERAL INFORMATION (Continued)

SUSPENSION — SPRING IDENTIFICATION CODES
BRONCO, F-150-250-350, F-SUPER DUTY

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE:
FRONT GAWR:GVWR:
REAR GAWR:WITH
TIRES
RIMSWITH
TIRES
RIMS

AT PSI COLD

AT PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF
MANUFACTURE SHOWN ABOVE

VIN:

TYPE:

7N 9M
EXTERIOR PAINT COLORS

DSO

WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE	SPRING
133		F252	LG4	F	342	B	2D29

BRONCO SPRING IDENTIFICATION CODES

AUX/OPT. USAGE CODE (FRONT) — NOT APPLICABLE

AUX/OPT. USAGE CODE (REAR) — NOT APPLICABLE

FRONT SPRING CODES — BRONCO

CODE	PART NUMBER
B	E0TA-5310-BC
C	E0TA-5310-CC
G	E0TA-5310-GC
U	E0TA-5310-UC
V	E0TA-5310-VB

F-150-250-350, F-SUPER DUTY
FRONT SPRING CODES

CODE	PART NUMBER
B	E0TA-5310-BC
C	E0TA-5310-CC
D	E0TA-5310-DC
E	E0TA-5310-EC
F	E0TA-5310-FC
G	E0TA-5310-GC
H	E3TA-5310-XA
J	E3TA-5310-YA
K	E3TA-5310-ZA
M	E3TA-5310-AAA
N	E5TS-5310-BA
R	F1TA-5310-ANA
S	FITA-5310-APA
T	FITA-5310-ARA
U	E0TA-5310-UC
V	E0TA-5310-VB
5	FITA-5310-AHA
6	FITA-5310-AJA
7	FITA-5310-AKA
8	FITA-5310-AMA
9	FITA-5310-ALA
1	FITA-5310-ASA
P	F3TA-5310-SA

USAGE CODE (FRONT) 2

FRONT SPRING CODE D

USAGE CODE (REAR) 2

REAR SPRING CODE 9

REAR SPRING CODES — BRONCO

CODE	PART NUMBER
Z	E3TA-5560-ANA

F-150-250-350, F-SUPER DUTY
REAR SPRING CODE

CODE	PART NUMBER
A	E4TA-5560-SA
D	E7TA-5560-NA
F	E7TA-5560-FA
L	FITA-5560-PA
V	F2TA-5560-YA
Y	E7TA-5560-YA
6	FITA-5560-MA
7	FOTA-5560-LA
8	E9TA-6A975-AA
9	F2TA-5560-VA
J	F3TA-5560-LA
S	F2TA-5560-AA

CY2673-H

GENERAL INFORMATION (Continued)

SUSPENSION — SPRING IDENTIFICATION CODES

E-150-250-350

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE:	GVWR: LB/ KG
FRONT GAWR: LB	REAR GAWR: LB
KG	KG

WITH
TIRES
RIMS

AT PSI COLD

WITH
TIRES
RIMS

AT PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF
MANUFACTURE SHOWN ABOVE

VIN:

TYPE:

EXTERIOR PAINT COLORS

WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE	DSO
138	E112		EY	T	16	B	2C2D

USAGE CODE (FRONT)	2	C
FRONT SPRING CODE		
USAGE CODE (REAR)	2	D
REAR SPRING CODE		

E-150-250-350 FRONT SPRING CODES

CODE	PART NUMBER
A	F2UA-AA
B	F2UA-BA
C	F2UA-CA
D	F2UA-DA
E	F2UA-EA
F	F2UA-FA
G	F2UA-GA
H	F2UA-HA
J	F2UA-JA
K	F2UA-KA
L	F2UA-LA
M	F2UA-MA
N	F2UA-NA
P	F2UA-PA
R	R2UA-RA
S	F2UA-SA
T	F2UA-TA
U	F2UA-UA
V	F2UA-VA
Z	F2UA-ZA

E-150-250-350 FRONT SPRING CODES

CODE	PART NUMBER
A	F2UA-AB
C	F2UA-CA
D	F2UA-DF
F	F2UA-FF
G	F2UA-GF
H	F2UA-HF
J	F2UA-JF
K	F2UA-KF

CY2782-H

GENERAL INFORMATION (Continued)

**DISTRICT SALES OFFICE (DSO) AND WHEELBASE (WB) CODES
BRONCO, E-150-250-350, F-150-250-350, F-SUPER DUTY**

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE:
FRONT GAWR:GVWR:
REAR GAWR:WITH
TIRES
RIMSWITH
TIRES
RIMS

AT PSI COLD

AT PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF
MANUFACTURE SHOWN ABOVE

VIN:

TYPE:



7N

9M

21

EXTERIOR PAINT COLORS

WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE	DSO	SPRING
133		F252	LG4	F	342	B		2D29

DSO — FSO — PTO (DOMESTIC, FOREIGN AND SPECIAL ORDER)

THE D.S.O. SPACE WILL SHOW A TWO-DIGIT CODE NUMBER OF THE DISTRICT WHICH ORDERED THE UNIT (SEE CHART BELOW). THIS CODE WILL APPEAR ON ALL UNITS — DOMESTIC OR EXPORT. IF UNIT IS BUILT ON A D.S.O., F.S.O., P.T.O. (SPECIAL ORDERS), THE COMPLETE ORDER NUMBER IS UNDER THE D.S.O. SPACER AFTER THE DISTRICT CODE NUMBER.

WHEELBASE (INCHES)	
BRONCO	
105	
F-150-250-350	F-SUPER DUTY
117	137
133	155
137	161
139	168
	178
	208

E-150-250-350 (ECONOLINE AND CLUB WAGON)	
138	
158	
176	

CODE	DISTRICT
11	BOSTON
13	NEW YORK
14	PITTSBURGH
16	PHILADELPHIA
17	WASHINGTON
21	ATLANTA
22	CHARLOTTE
23	MEMPHIS
24	JACKSONVILLE
26	NEW ORLEANS
28	LOUISVILLE
41	CHICAGO
42	CLEVELAND
43	MILWAUKEE
46	INDIANAPOLIS
47	CINCINNATI
48	DETROIT

CODE	DISTRICT
52	DALLAS
53	KANSAS CITY
54	OMAHA
55	ST. LOUIS
57	HOUSTON
58	TWIN CITIES
71	LOS ANGELES
72	SAN JOSE
74	SEATTLE
75	PHOENIX
76	DENVER
83	GOVERNMENT
84	HOME OFFICE RESERVE
85	AMERICAN RED CROSS
86	RECREATION VEHICLES
87	BODY COMPANY
89	TRANSPORTATION SERVICES
90's	EXPORT
00	SPECIAL

FORD OF CANADA	
MERCURY REGIONS	FORD REGIONS
A1 CENTRAL	B1 CENTRAL
A2 EASTERN	B2 EASTERN
A3 ATLANTIC	B3 ATLANTIC
A4 MIDWESTERN	B4 MIDWESTERN
A6 WESTERN	B6 WESTERN
A7 PACIFIC	B7 PACIFIC
A8 GREAT LAKES	B8 GREAT LAKES
11 EXPORT	11 EXPORT

CY2392-L

SECTION 00-02 Hoisting, Jacking, Spare Tire Stowage and Emergency Towing

SUBJECT	PAGE	SUBJECT	PAGE
HOISTING	00-02-1	TOWING (Cont'd.)	
JACKING.....	00-02-1	Towing with T-Hooks, Rear Wheels Off the	
SPARE TIRE STOWAGE		Ground	00-02-7
Inside Spare Wheel Carrier, Bronco.....	00-02-18	Towing Four-Wheel Drive Vehicles Equipped	
Spare Tire Carrier, Under Frame.....	00-02-10	With Lever-Operated Transfer Case	00-02-2
Spare Wheel Carrier, Inside Box	00-02-15	Towing Four-Wheel Drive Vehicles With Touch	
Spare Wheel, F-250-350	00-02-17	Drive Electric Shift Transfer Case	00-02-2
Swing-Away, Bronco.....	00-02-17	Towing Slings/Chains/Hooks.....	00-02-3
SPECIFICATIONS.....	00-02-19	Towing Speeds	00-02-3
TOWING		Wrecker Towing Ford Vehicles With Air	
General Wrecker Towing Procedure.....	00-02-2	Bags	00-02-4
Towing Connections.....	00-02-4	VEHICLE APPLICATION	00-02-1
Towing with T-Hooks, Front Wheels Off the			
Ground	00-02-4		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and Bronco Vehicles

HOISTING

Damage to suspension and /or steering linkage components may occur when positioning hoist adapters. Front adapter pads should be positioned carefully to ensure maximum contact under the center of the lower suspension arms or spring supports as near wheels as practical. Rear suspension hoist adapters (forks) should be placed under spring mounting pads or rear axle housing, but adapters must not interfere with shock absorber mounting brackets.

When raising a vehicle on a twin post hoist, care should be taken to position the vehicle so that the hoisting forks do not damage the axle carrier casting or rear cover.

JACKING

WARNING: TO MINIMIZE THE RISK OF PERSONAL INJURY, DO NOT PUT ANY PORTION OF YOUR BODY UNDER THE VEHICLE WHILE THE VEHICLE IS ON THE JACK. THE JACK IS PROVIDED FOR EMERGENCY WHEEL AND TIRE CHANGING ONLY.

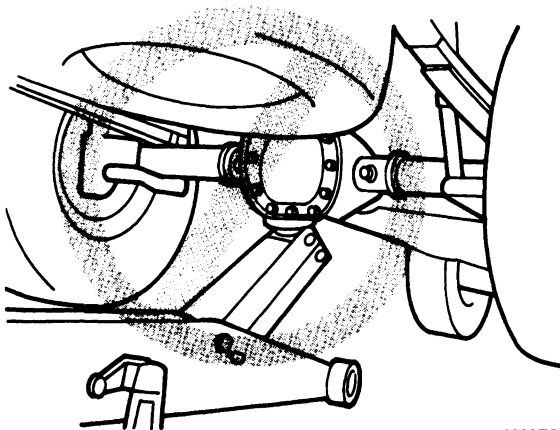
WARNING: ON VEHICLES EQUIPPED WITH A TRACTION-LOK AXLE, NEVER RUN THE ENGINE WITH ONE WHEEL OFF THE GROUND, SUCH AS WHEN CHANGING A TIRE. THE WHEEL STILL ON THE GROUND COULD CAUSE THE VEHICLE TO MOVE.

When lifting a vehicle with the vehicle jack or any floor jack, block the diagonally opposite wheel to prevent vehicle from moving.

CAUTION: On vehicles equipped with an under-chassis mounted spare tire, remove the tire, wheel or tire carrier from the vehicle before it is placed in a high lift position in order to avoid sudden weight release from the chassis.

JACKING (Continued)

CAUTION: Do not use the differential housing as a lift point. Leaks and/or damage to the rear axle cover and adjoining differential housing surface may occur if a floor jack or any lifting device is allowed to contact the cover at any point where the cover joins the housing.



Y5072-A

Position floor jacks under axles, radius arms or spring hangers as close to the wheels as possible. Refer to the owner's manual and jacking decal.

To raise heavy vehicles with floor jacks, follow the jack manufacturer's recommendations for placement of jack. Do not exceed the rated lift capacity of any jack.

TOWING

General Wrecker Towing Procedure

Preparatory Steps

Release the parking brake and place the transmission in neutral. As a general rule, towed vehicles should be pulled with the driving wheels off the ground. If the vehicle is to be towed on its drive wheels, the transmission and differential must be operable. If not, place the rear wheels on a dolly or disconnect the rear driveshaft.

When a vehicle is towed on its front wheels, the steering wheel must be clamped in the straight-ahead position with a steering wheel clamping device designed for towing service use, such as those provided by towing system manufacturers.

Do not use the vehicle's steering column lock to lock the wheels in a straight-ahead position when pulled from the rear. If the ignition key is not available, place a dolly underneath the driving wheels of the vehicle and tow with the non-driving wheels raised.

Towing Four-Wheel Drive Vehicles Equipped With Lever-Operated Transfer Case

CAUTION: Improper towing of the vehicle could result in transmission and/or transfer case damage. Always follow the outlined towing procedures. It is recommended that only an unloaded vehicle be towed when either the front or rear wheels are off the ground.

1. Transmission (automatic or manual) should be placed in N (neutral).
2. On vehicles equipped with manual hubs, place hubs in FREE position.
3. Place transfer case in N (neutral).

NOTE: The transfer case neutral setting is located between 4H (high) and 4L (low). In order to place the transfer case into neutral, first place the lever in the 4H (high) position, then push down on the shift knob, at the same time pulling it slightly rearward until the lever is between 4H (high) and 4L (low) position. With the ignition in the ON position, both 4x4 and LOW RANGE indicator lamp will be off when the transfer case is in neutral. These lamps will also be off when the transfer case is in the 2H (high) position.

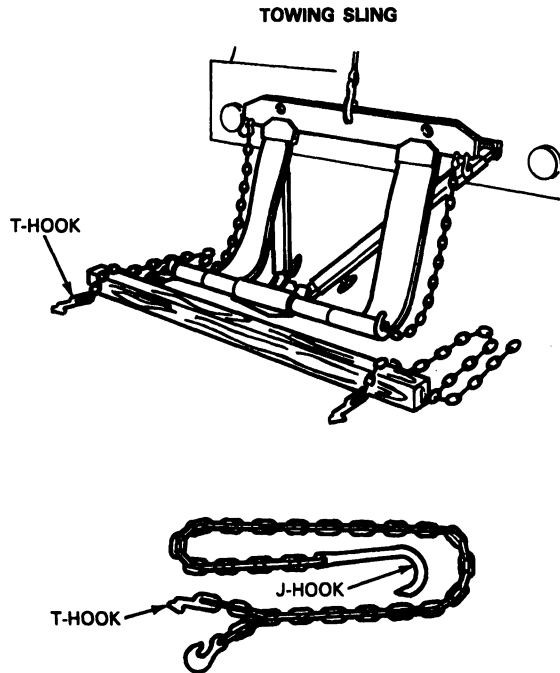
Towing Four-Wheel Drive Vehicles With Touch Drive Electric Shift Transfer Case

1. Transmission (automatic or manual) should be placed in N (neutral).
2. Transfer case should be in 2H (high).
3. Automatic locking hubs should be disengaged.
4. Once these three conditions are met, follow instructions for towing two-wheel drive vehicles.
5. Towing speed is limited to 35 mph (56 km/h) and 50 miles (80 km) with the drive wheels on the ground.

NOTE: If towing with a minimal load is unavoidable, care must be taken to properly restrain load from shifting and distribute the load evenly in the pickup box.

TOWING (Continued)

Towing Equipment

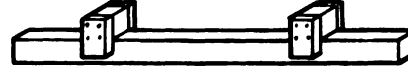


CROSSBEAM SPACER BLOCKS

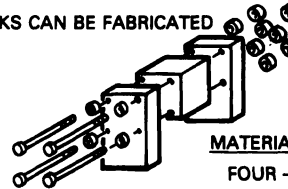
MATERIAL — CROSSBEAMS

ONE — 4 x 4 x 60" LONG

ONE — 4 x 4 x 48" LONG



SPACER BLOCKS CAN BE FABRICATED AS SHOWN.



MATERIAL SPACER BLOCKS

FOUR — 2 x 4 x 6" LONG

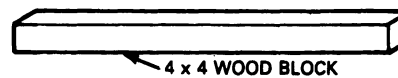
TWO — 4 x 4 x 3 1/2" LONG

EIGHT — 1/4" x 7" CARRIAGE BOLT

EIGHT — 1/4" NUT

SIXTEEN — 1/4" WASHER

CROSSBEAM — WITHOUT SPACER BLOCKS



4 x 4 WOOD BLOCK

NOTE: 2 x 4 LUMBER ACTUALLY MEASURES 1-1/2" x 3-1/2"
4 x 4 LUMBER ACTUALLY MEASURES 3-1/2" x 3-1/2"

Y4763-A

F-Super Duty Motorhome Chassis

For correct F-Super Duty motorhome chassis towing procedures, consult the particular body builder for your unit.

Towing Slings / Chains / Hooks

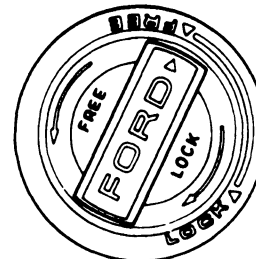
CAUTION: Use caution when attaching tow hooks and safety chains to vehicle. Position and remove hooks with care to avoid damage to brake hoses, brake lines and steering linkage components.

To avoid metal-to-metal contact and possible damage to chrome or lower body panels, a special wide-belt sling should be used to lift and tow ALL vehicles. When attaching towing slings, take care to avoid damage to the license plate and frame, and air dam.

NOTE: On vehicles equipped with bumper guards, make sure the towbar is under the bumper and the weight of the vehicle is not supported by the bumper guards.

UNLOCKING MANUAL HUBS

TWO-WHEEL DRIVE



FREE POSITION

Y3355-1A

Towing Speeds

4x2 Vehicles

On 4x2 vehicles, when towing with the rear wheels on the ground, or all four wheels on the ground, do not exceed a maximum speed of 56 km/h (35 mph) and a maximum distance of 80 km (50 miles).

On 4x2 vehicles, when towing with the rear wheels off the ground, do not exceed a maximum speed of 88 km/h (55 mph). There is no maximum distance for towing.

TOWING (Continued)**4x4 Vehicles**

On 4x4 vehicles equipped with a lever operated transfer case, do not exceed a maximum of 88.5 km/h (55 mph). There is no maximum distance for towing.

On 4x4 vehicles equipped with a touch drive electric shift transfer case, do not exceed a maximum speed of 56 km/h (35 mph) and a maximum distance of 80 km (50 miles).

Wrecker Towing Ford Vehicles With Air Bags**General Information**

An air bag is highly unlikely to deploy during wrecker towing. Standard wrecker towing or recovery procedures on an air bag-equipped vehicle should not cause air bag deployment. Only a significant frontal impact that closes two crash sensors will deploy an air bag.

How To Determine If a Ford Vehicle Has Air Bag

- The fourth position of all Ford Vehicle Identification Numbers (VINs) is the letter:
 - "C" if equipped with driver-side air bag only.
 - "L" if equipped with both a driver-side and a passenger-side air bag module; or
 - "B" or "P" if not equipped with an air bag module.
- The steering wheel hub will also be larger and more rectangular (about 6 inches x 9 inches). The passenger-side air bag module trim covers will be molded with "SRS".

Is it Necessary to Disable the Air Bag System for Wrecker Towing?

- Disabling the air bag system is **NOT** necessary in most cases.
- As a precaution, disconnect the battery in a safe manner, when the vehicle has significant damage to the front of the car and an undeployed air bag.

NOTE: Turning the ignition switch to OFF will **NOT** disable the Ford air bag system. The air bag deployment system operates independently of the ignition key position.

Wrecker Towing a Vehicle with Deployed Air Bag

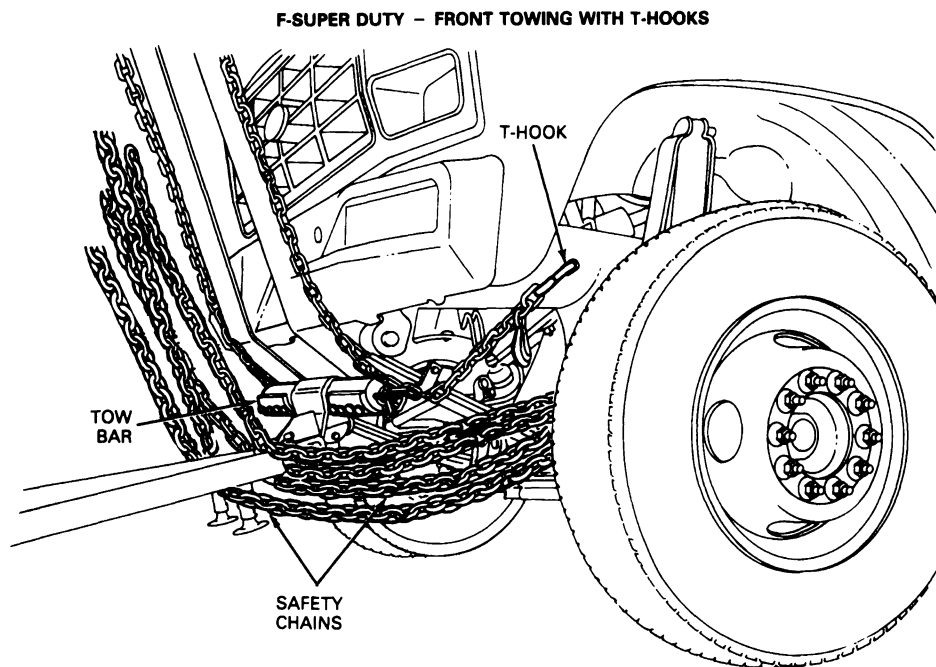
- Deployed air bags are **NOT** dangerous.
- Any powdery residue consists of corn starch or talcum powder and sodium compounds, mostly sodium carbonates (e.g., baking soda) accompanied by very minute deposits of sodium hydroxide that can be irritating to the skin and eyes, but poses no long-term health hazard.

Towing Connections**Towing with T-Hooks, Front Wheels Off the Ground****F-Super Duty (Except Commercial and Motorhome Chassis)**

1. Insert T-hooks in T-hook slots on frame forward of front wheel (as shown).
2. Position 4x4 crossbeam under leaf springs.
3. Position towbar in front of 4x4.

TOWING (Continued)

4. Attach safety chains around I-beam outboard of leaf springs.



F-150-250-350 4x2, F-150 4x4 and Bronco Vehicles Equipped with Bumper Mounted Air Dam

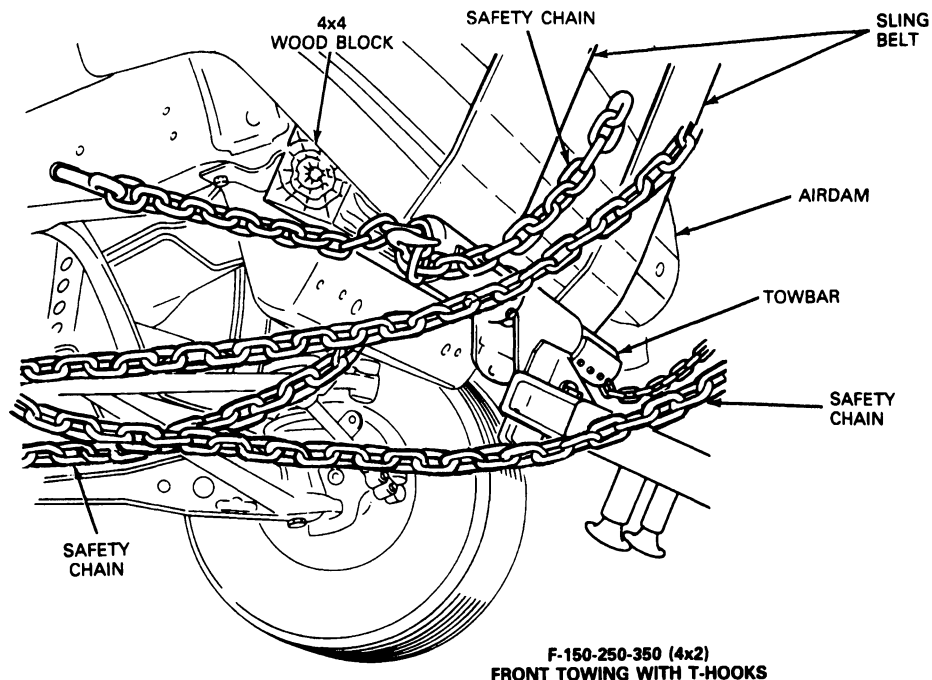
CAUTION: On vehicles equipped with an air dam, the towbar will deform the rubber air dam. Wheel lift equipment may be advisable.

CAUTION: When towing F-Series vehicles equipped with a bumper mounted air dam, it is necessary to use spacer blocks with a 4x4 crossbeam. On vehicles not equipped with a bumper mounted air dam, you may use a 4x4 without spacer blocks.

1. Insert T-hook in T-hook slot in frame.
2. Place spacer blocks and 4x4 on frame behind air dam. On F-150 Lightning Trucks, position 4x4 without spacer blocks under fog lamp brackets.
3. Position towbar in front of 4x4.

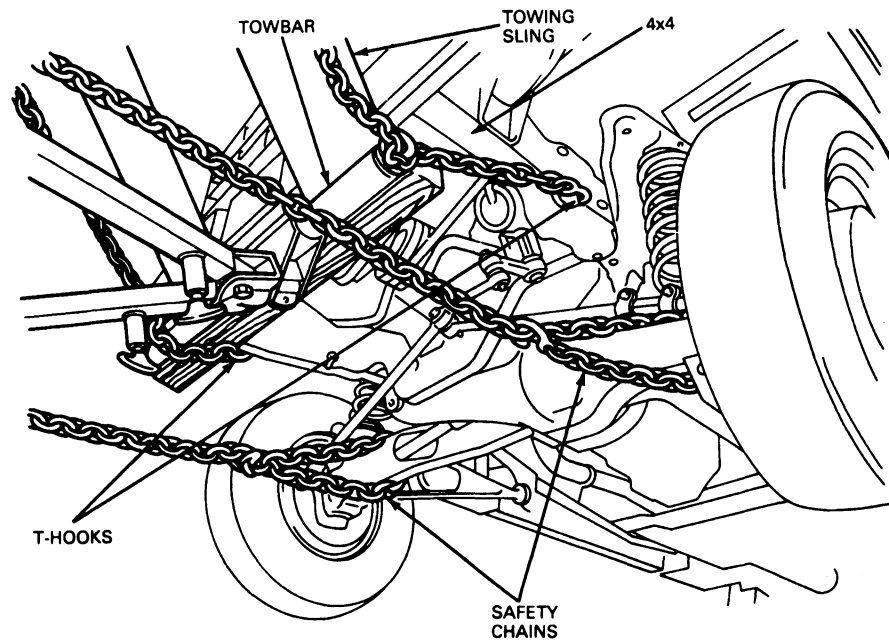
TOWING (Continued)

4. Attach safety chains around axle outboard of coil spring (for F-150 4x4 and Bronco, attach safety chains inboard of coil spring).



Y3358-C

F-150 (4x4) AND BRONCO — FRONT TOWING WITH T-HOOKS



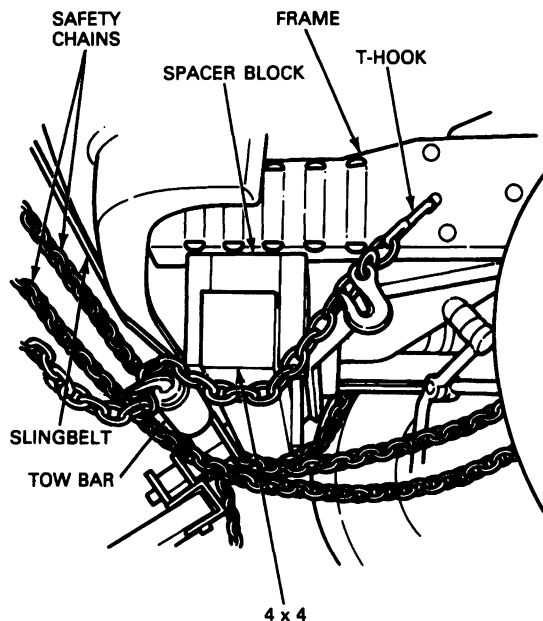
Y4368-2A

TOWING (Continued)**E-150-250-350**

CAUTION: On vehicles equipped with an air dam, the towbar will deform the rubber air dam. Wheel lift equipment may be advisable.

CAUTION: When towing Econoline Vehicles, spacer blocks must be used with a 4x4 crossbeam.

1. Insert T-hooks in horizontal T-hook slot in frame.
2. Position spacer blocks and 4x4 crossbeam behind air dam and across frame rails. Make sure that spacer blocks are under frame rails.
3. Position towbar in front of 4x4.
4. Attach safety chains around axle outboard of coil springs.

Front Towing with T-Hooks, E-150-250-350

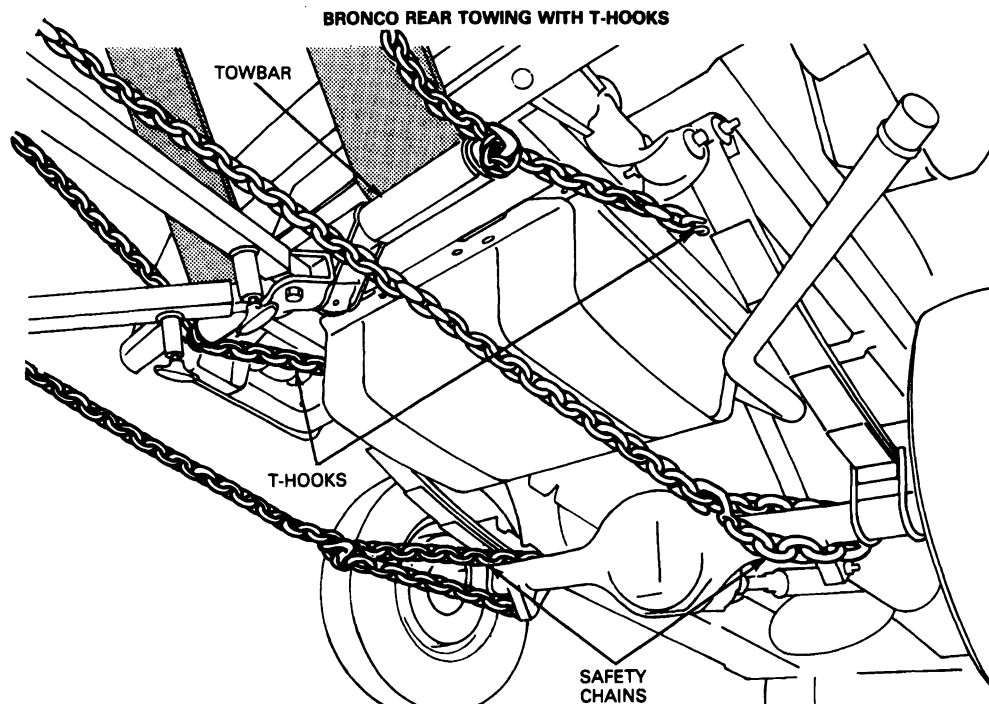
Y4764-A

Towing with T-Hooks, Rear Wheels Off the Ground**Bronco**

1. Insert T-hooks in horizontal T-hook slot in frame.
2. Position towbar under bumper.

TOWING (Continued)

3. Attach safety chains around rear axle inboard of leaf spring seat.



Y2096-2D

F-150-250-350 4x2 and 4x4 and F-Super Duty (Except Motorhome Chassis)

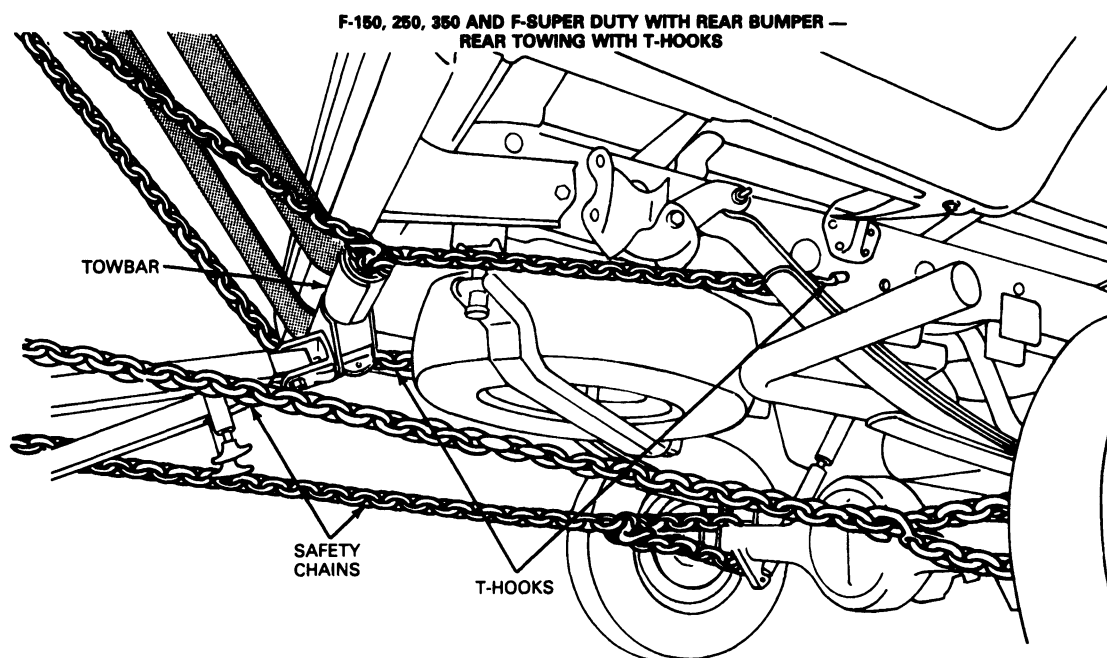
1. Position T-hooks in horizontal T-hook slot in frame.

NOTE: A 4x4 wood block is required to be placed against the rear spring brackets on vehicles not equipped with a rear bumper. If the vehicle is also equipped with an underframe spare tire, the tire must be removed to allow installation of the 4x4 wood block.

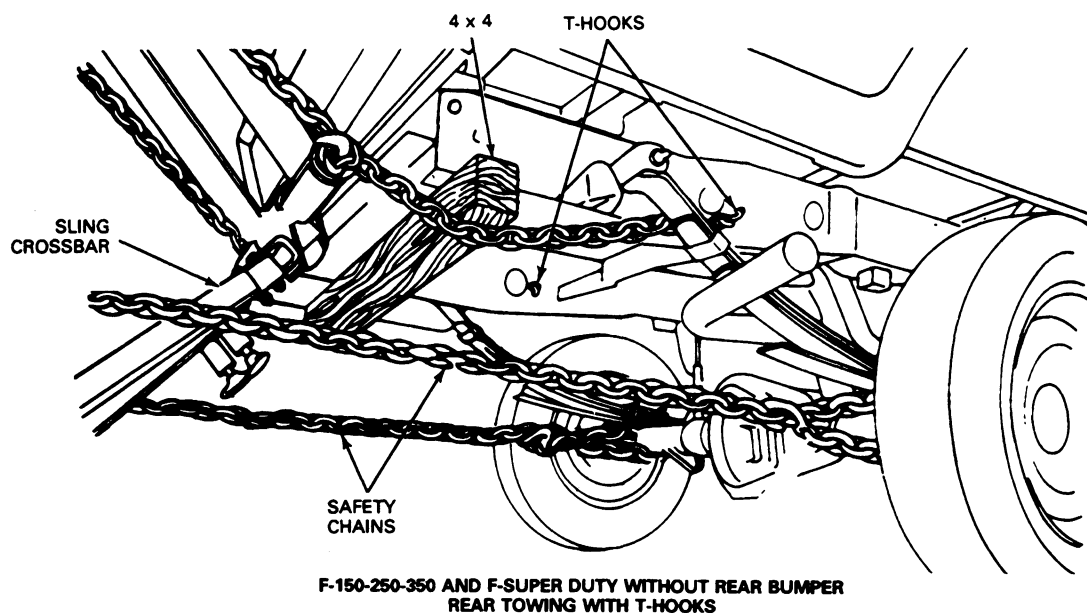
2. Place towbar against bumper or 4x4.

TOWING (Continued)

3. Attach safety chains around the axle inboard of the leaf spring seat.



Y2099-E



Y3359-2A

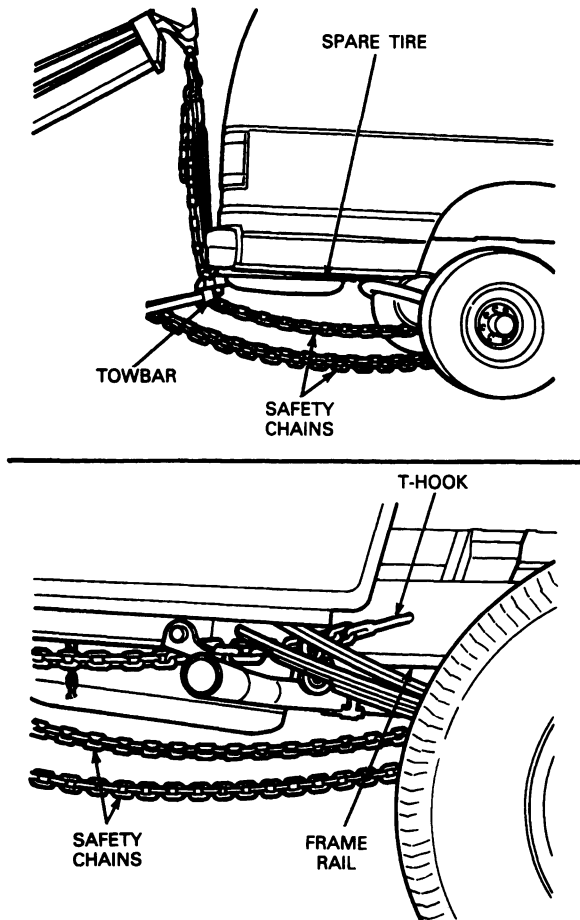
E-150-250-350 with Frame-Mounted Rear Bumper

1. Attach T-hook in T-hook slot on frame rail inside the leaf spring.
2. Route chains below spring shackles, on the right side route chain above tail pipe.

3. Place tow bar under rear bumper, missing spare tire.
4. Attach safety chains around rear axle. Route chain between axle and parking brake cable on right hand side.

TOWING (Continued)

Rear Towing with T-Hooks, E-150-250-350



Y4765-A

SPARE TIRE STOWAGE

Spare Tire Carrier, Under Frame

F-150-250-350, F-350 Chassis Cab and F-Super Duty Chassis Cab

The spare tire is stowed at the rear of the truck under the frame (standard location).

CAUTION: Due to possible air seepage at the tire rim or valve, the spare tire may lose air and become loose in the carrier. Therefore, check the spare tire at least twice a month for proper inflation. Any evidence of tire movement under hand pressure or foot kicking indicates that the spare tire requires air. Correct the cause for leakage and then inflate the air to the pressure recommended on the Safety Compliance Certification Label for original equipment tires located on the left side door pillar.

NOTE: The tire valve stem is on the top side of the tire to reduce the possibility of accidental valve stem air leakage through contact with mud, brush, snow, ice, or some other obstruction.

WARNING: TO AVOID POSSIBLE INJURY DO NOT PLACE ANY PART OF THE BODY UNDER THE CHANNEL WITH MOUNTED SPARE TIRE DURING ITS REMOVAL OR INSTALLATION.

Removal

1. Insert the tang of the lug nut wrench through the spare tire retaining eyebolt eye and turn the bolt until the tire is sufficiently loose from the upper retaining support. To avoid a sudden drop off of the tire do not turn the end of the eyebolt out of the retaining nut.
2. Align the eye of the eyebolt with the channel slot.
3. While holding the nut end of the wrench parallel to the ground, insert the tang of the wrench into the channel assembly tube. Lift up on the wrench and at the same time pull the eyebolt toward the tube and push on the wrench to pass the eyebolt shoulder through the channel keyhole.
4. Lower the spare tire assembly. Swing the channel to the rear of the vehicle and remove the wrench from the tube.
5. With the channel assembly end on the ground, remove the wheel retainer from the center bolt. If necessary insert the tang of the wrench into retainer to provide additional leverage to loosen the retainer from the center bolt.
6. Remove the spare tire from the channel assembly.

Installation

1. To replace the spare tire under the frame, center the tire on the channel assembly. Shift the tire as necessary until it is balanced on the channel. Install and always tighten the retainer on the center bolt until the wheel is tight to the channel.
2. Install the tang of the lug nut wrench into the channel assembly tube and swing the channel under the eyebolt.
3. Lift the channel and insert the shoulder of the eyebolt through the keyhole. Shift the channel and eyebolt until the shoulder of the eyebolt is pushed all the way into the slot.
4. Insert the tang of the wrench into the eyebolt and always tighten the eyebolt until the tire cannot be moved by hand pressure. Adjustment of the driver side channel ball end bolt is not normally required.

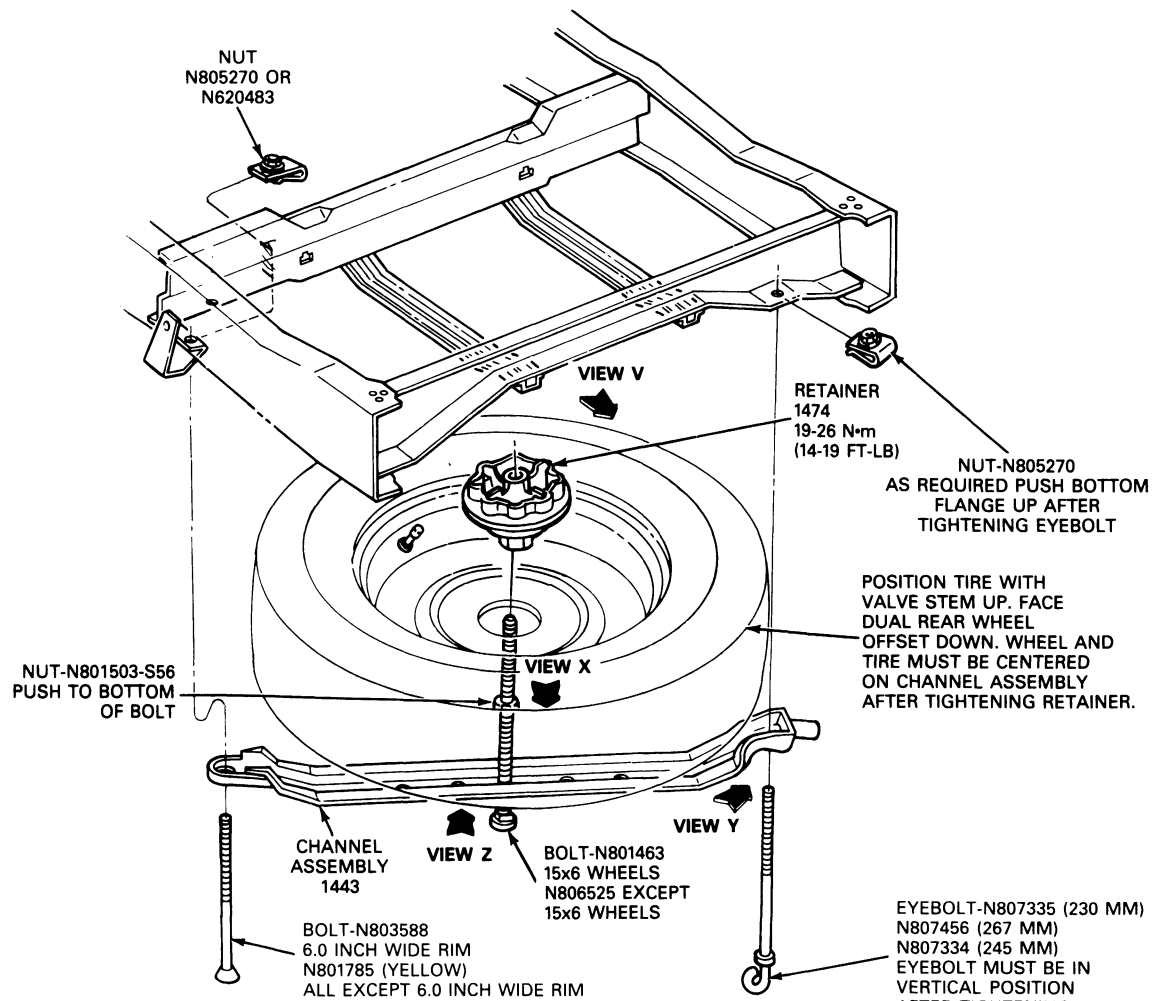
SPARE TIRE STOWAGE (Continued)

5. Refer to the View Y in the following illustrations for proper position of the eyebolt after it has been tightened to secure the spare tire in stowage position.

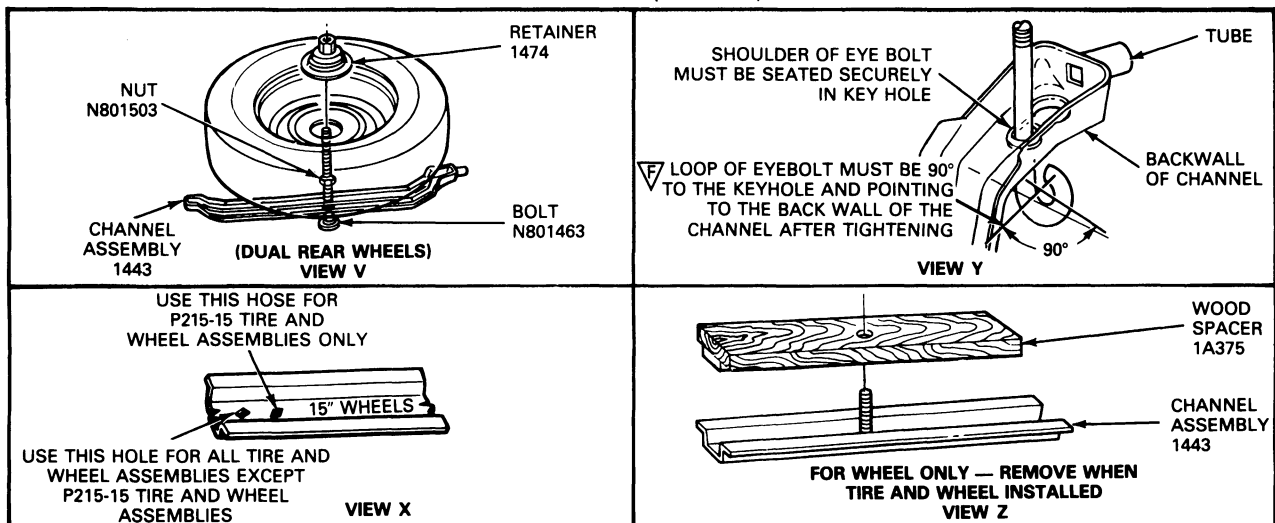
CAUTION: This eyebolt position is SPECIFIED to prevent possible channel separation and/or possible tire loss when the spare tire is loose in the channel. Tire looseness is caused by air leakage or by insufficient tightening of the eyebolt when installing the spare tire (flat or inflated).

SPARE TIRE STOWAGE (Continued)

Spare Tire Carrier, F-150-250-350 With Aft-of-Axle Tank



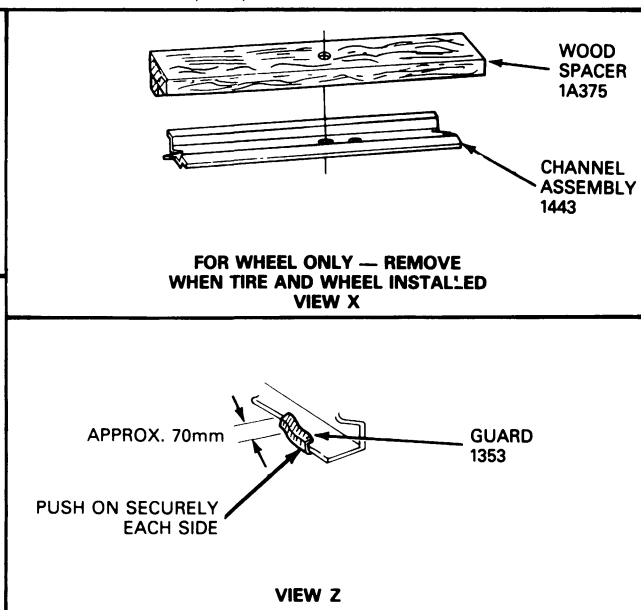
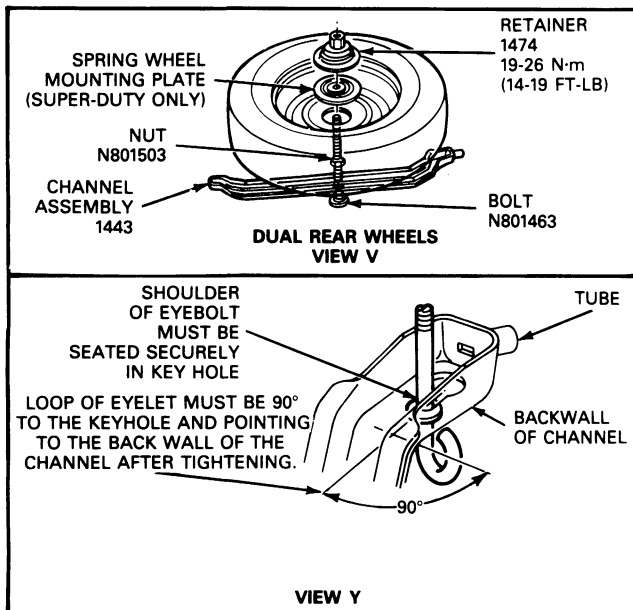
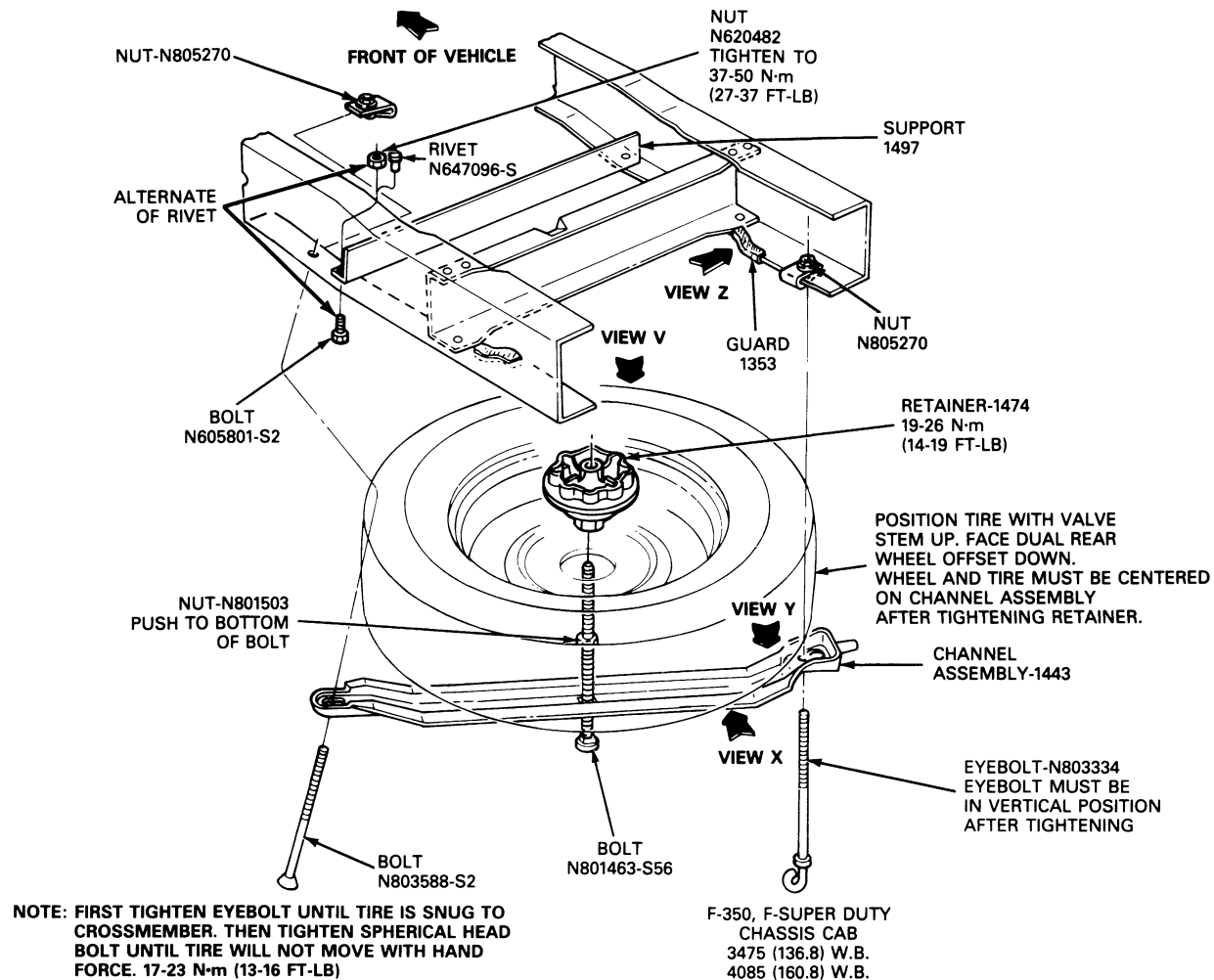
NOTE: FIRST TIGHTEN EYEBOLT UNTIL TIRE IS SNUG TO TANK THEN TIGHTEN BOLT UNTIL TIRE WILL NOT MOVE WITH HAND FORCE. 17-23 N·m (13-16 FT-LB)



N4812-J

SPARE TIRE STOWAGE (Continued)

Under Frame Spare Tire Carrier, F-350 Chassis Cab, F-Super Duty Chassis Cab



N4810-J

SPARE TIRE STOWAGE (Continued)**All E-150-250-350 Vehicles**

The spare tire is stowed at the rear of the truck under the frame (standard location).

CAUTION: Due to possible air seepage at the tire rim or valve, the spare tire may lose air and become loose in the carrier. Therefore, check the spare tire at least twice a month for proper inflation. Any evidence of tire movement under hand pressure or foot kicking indicates that the spare tire requires air. Correct the cause for leakage and then inflate the air to the pressure recommended on the Safety Compliance Certification Label for original equipment tires located on the left side door pillar. Tighten spare until mechanism "clicks".

CAUTION: Aluminum wheel to be installed with valve stem down. Be careful that the tire and rim pull straight up.

WARNING: TO AVOID POSSIBLE INJURY, DO NOT PLACE ANY PART OF THE BODY UNDER THE SPARE TIRE DURING ITS REMOVAL OR INSTALLATION.

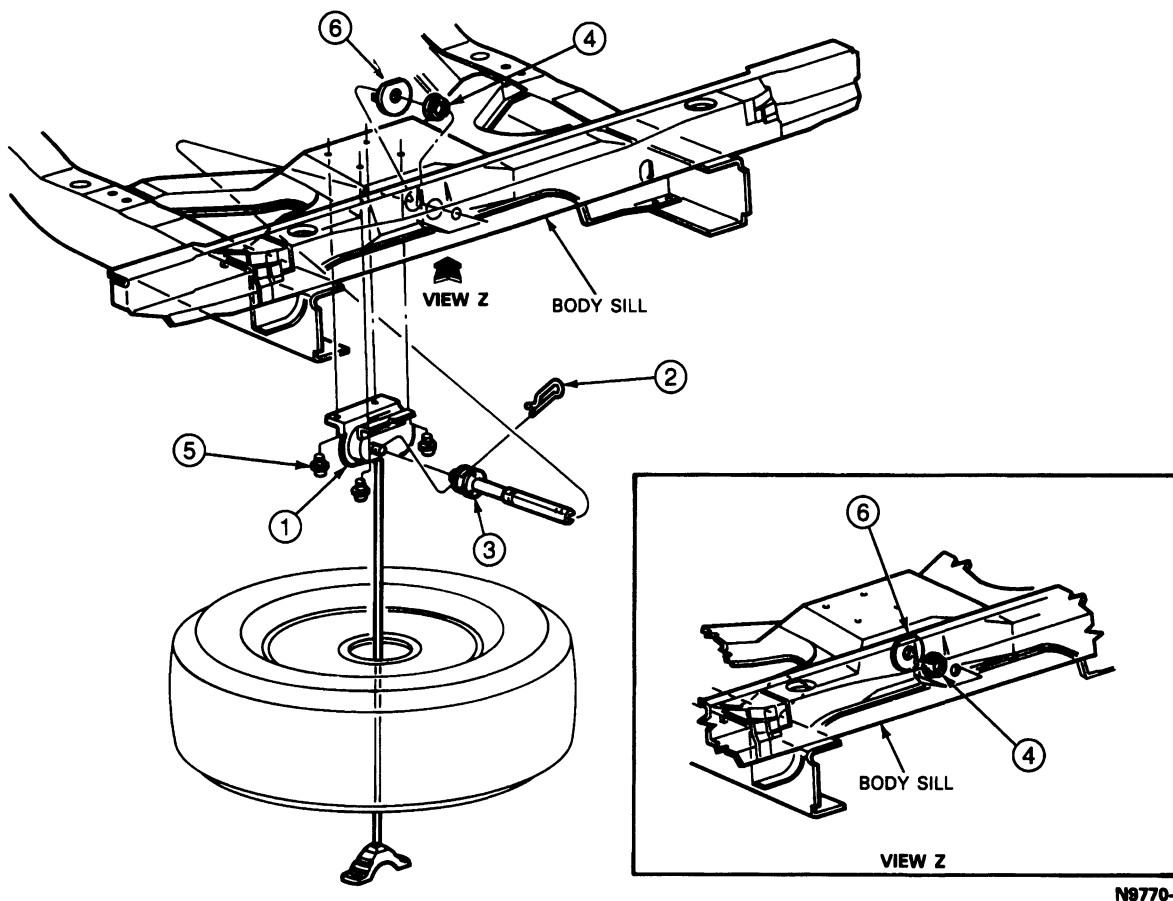
Removal

1. Open both of the rear doors. Insert tip of jack handle or tapered end of lug wrench through an access hole found behind the left door. Turn counterclockwise until the cable extends enough to allow the spare tire to be pulled rearward from under the vehicle.

2. Slide spare tire to the rear and remove the retainer from the wheel.
3. To stow cable / retainer with spare tire removed, turn jack handle or lugnut wrench clockwise until tight.
4. If required for service, the winch assembly can be removed from the vehicle by removing the four self-tapping screws that hold the winch to the frame.

Installation

1. If the winch assembly was removed, position the assembly to the vehicle's frame and install the four self-tapping screws. Tighten the screws to 23-32 N·m (17-23 ft-lb).
2. Insert jack handle or lugnut wrench into the actuator hole and turn counterclockwise until the cable / retainer is extended for insertion into the wheel.
3. Install retainer through wheel center with valve stem facing up.
NOTE: Stow aluminum wheel and tire with valve stem down.
4. Rotate handle clockwise to secure tire. Continue until lift mechanism "clicks".
5. Check for proper seating against underbody supports and retighten if necessary.

SPARE TIRE STOWAGE (Continued)**Spare Tire Carrier, Under Frame, All E-150-250-350 Vehicles**

Item	Part Number	Description
1	1A131	Winch Assembly
2	N806493-S55	Hairpin Retainer
3	1A132	Winch Drive Gear Assembly 46-64 N·m (34-47 Ft·Lb)

(Continued)

Item	Part Number	Description
4	N806927-S	Grommet
5	N611212-S2	Screw — Self-Tapping 23-32 N·m (17-23 Ft·Lb)
6	1A425	Grommet

Spare Wheel Carrier, Inside Box**F-150-250-350 116.8- and 138.8-Inch Wheelbase with 6-3/4- and 8.0-Foot Box**

The spare tire is stowed at the front left side of the pickup box.

Removal

1. Remove the wing nut from the carriage bolt and remove the spare wheel mounting plate from the wheel.
2. Lift the spare wheel from the carrier support.
3. If the spare wheel carrier support needs to be replaced, remove the five screws from the support and remove the support from the vehicle.

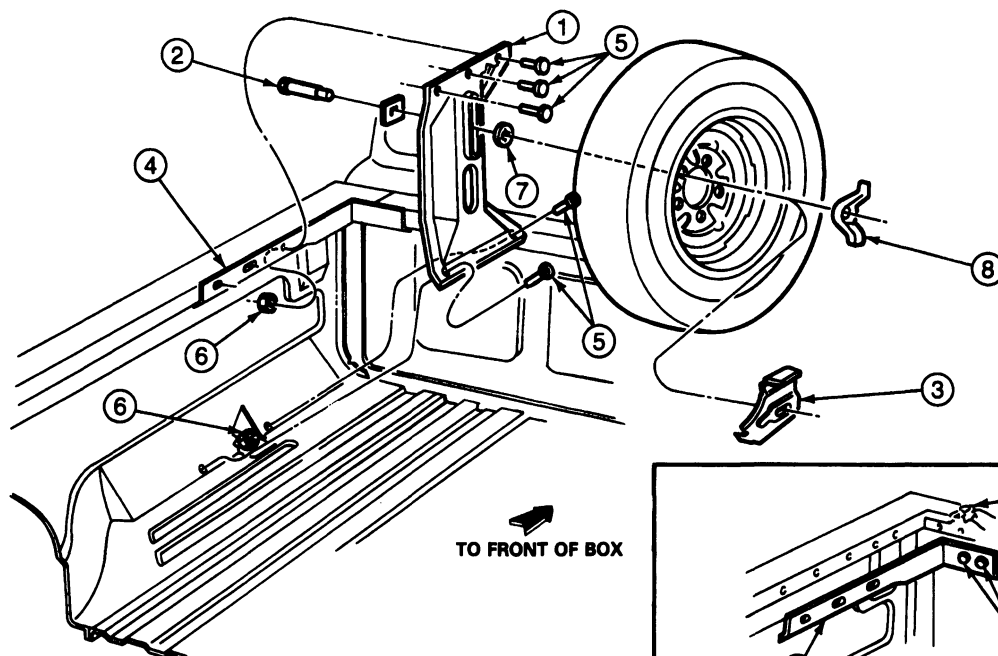
Installation

1. If the carrier support was removed, position it to the vehicle and install the five holding screws.
2. Position the spare wheel to the carrier support making sure the carriage bolt is positioned properly through the center of the wheel.
3. Install the spare wheel mounting plate on the carriage bolt making sure the retaining tabs are properly positioned on the spare wheel.
4. Install the wing nut and hand-tighten.

NOTE: Make sure the tire is properly secured before operating the vehicle.

SPARE TIRE STOWAGE (Continued)

Inside Box Spare Wheel Carrier, F-150-250-350 116.8- and 138.8-Inch Wheelbase with 6-3/4-Foot Box

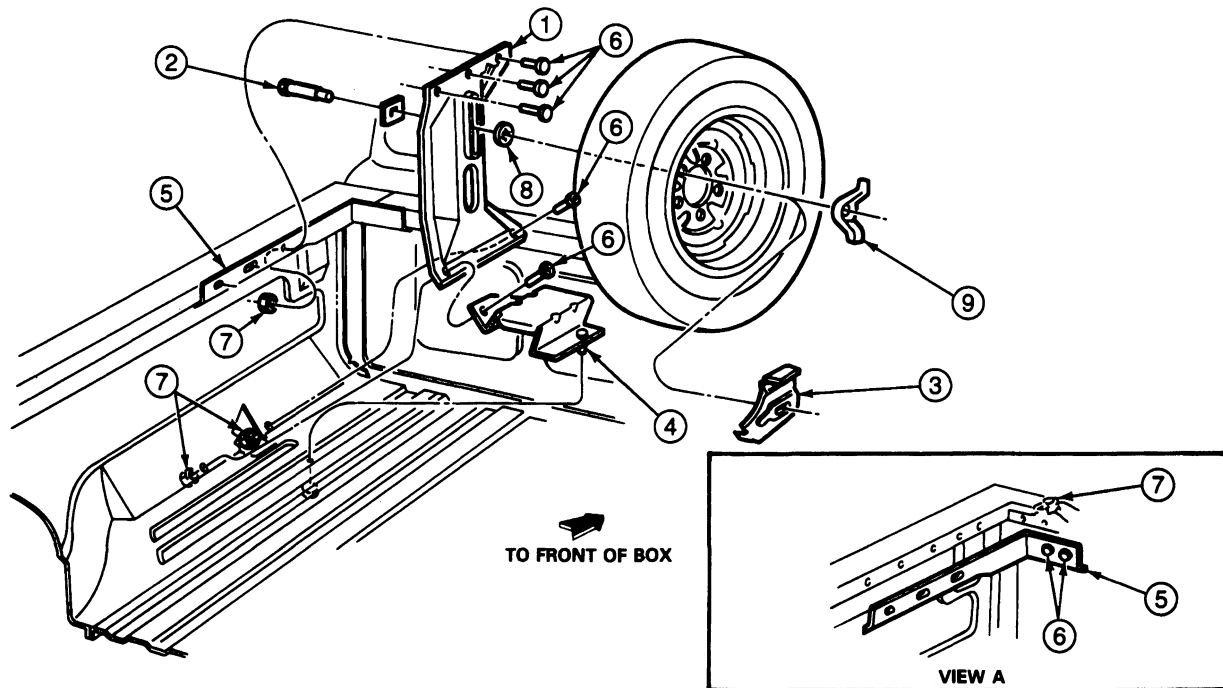


N9772-A

Item	Part Number	Description
1	1405	Spare Wheel Carrier Support
2	N802834-S2	Carriage Bolt
3	1424	Spare Wheel Mounting Plate
4	1407	Spare Wheel Carrier Support Reinforcement

(Continued)

Item	Part Number	Description
5	N801010-S40	Screw
6	N620481-S2	Nut 22-34 N-m (16-25 Ft-Lb)
7	W623485-S2	Nut 22-34 N-m (16-25 Ft-Lb)
8	N800344-S2	Wing Nut 4.1-4.7 N-m (36-41 In-Lb)

SPARE TIRE STOWAGE (Continued)**Inside Box Spare Wheel Carrier, F-150-250-350, 116.8- and 138.8-Inch Wheelbase with 8.0-Foot Box**

N9774-A

Item	Part Number	Description
1	1405	Spare Wheel Carrier Support
2	N802834-S2	Carriage Bolt
3	1424	Spare Wheel Mounting Plate
4	1A457	Spare Wheel Carrier Support Extension

(Continued)

Item	Part Number	Description
5	1407	Spare Wheel Carrier Support Reinforcement
6	N801010-S40	Screw
7	N620481-S2	Nut 22-34 N·m (16-25 Ft-Lb)
8	W623485-S2	Nut 22-34 N·m (16-25 Ft-Lb)
9	N800344-S2	Wing Nut

Spare Wheel, F-250-350

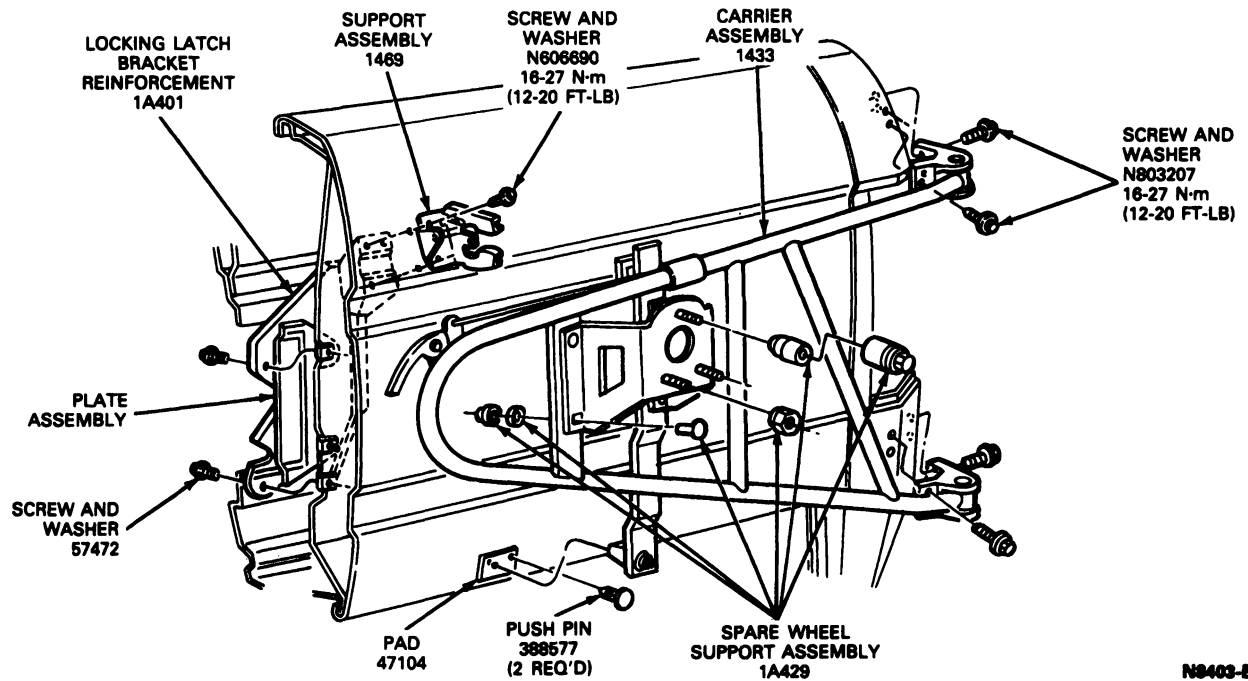
When the wheel only (without tire) is ordered, it is located at the rear of the truck under the frame.

CAUTION: The wood spacer is installed for shipment of the wheel only and must be removed when installing the tire.

After installing the wheel and tire in the carrying position, adjust the driver side channel ball and bolt and the eyebolt as necessary until the tire cannot be moved by hand pressure. Then tighten both bolts to 23-28 N·m (17-20 Ft-Lb).

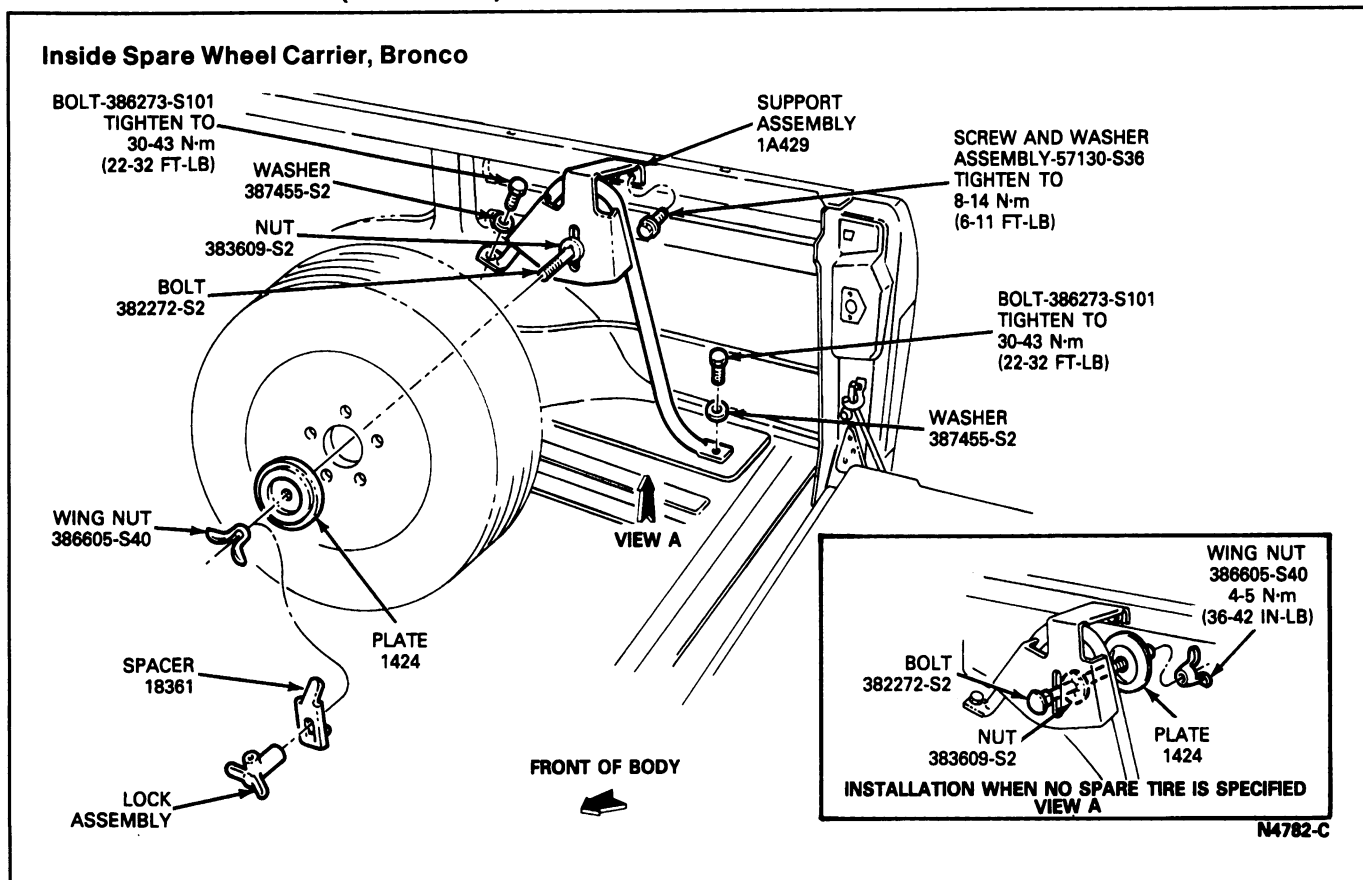
Swing-Away, Bronco**Removal and Installation**

For swing-away spare wheel carrier removal and installations, refer to the following illustration.

SPARE TIRE STOWAGE (Continued)**Swing-Away Spare Wheel Carrier, Bronco****Inside Spare Wheel Carrier, Bronco****Removal and Installation**

For inside spare wheel carrier removal and installation, refer to the following illustration.

SPARE TIRE STOWAGE (Continued)



SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N·m	Lb-Ft
Retainer, Spare Tire	19-23	14-19
Eyebolt, Spare Tire Channel Assembly	17-23	13-16
Screw, Spare Tire Carrier Frame	23-32	17-23
Winch Drive Gear Assembly, Spare Tire Carrier	46-64	27-47
Nut, Spare Tire Carrier Support	22-34	16-25

(Continued)

TORQUE SPECIFICATIONS (Cont'd)

Description	N·m	Lb-Ft
Wing Nut, Spare Tire Mounting	4.1-4.7	36-41 (In-Lb)
Bolt, Inside Spare Tire Support	30-43	22-32
Screw and Washer Assembly, Inside Spare Tire Support	8-14	7.1-12.3 (In-Lb)
Wing Nut, Spare Tire Mounting (Without Tire)	4-5	36-44 (In-Lb)

SECTION 00-03 Maintenance and Lubrication

SUBJECT	PAGE	SUBJECT	PAGE
MAINTENANCE		MAINTENANCE (Cont'd.)	
Lubrication	00-03-11	Scheduled Maintenance, Emissions	00-03-1
Maintenance Schedules	00-03-3	SPECIFICATIONS	00-03-24
Owner Maintenance Checks	00-03-10	VEHICLE APPLICATION	00-03-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and Bronco Vehicles

MAINTENANCE

The scheduled and non-scheduled maintenance recommendations are included in this section for reference. The emission systems scheduled maintenance services and the vehicle maintenance services are separated. Be sure to perform all maintenance services by referring to both sections of the schedule.

It should be noted, however, that any modification of the emission control systems could create liability under federal law (U.S.) if made prior to the first sale and registration and, under the laws of some states, if made thereafter. Further, federal law prohibits vehicle manufacturers or dealers and other persons engaged in the business of repairing, servicing, selling, leasing, or trading motor vehicles as well as fleet operations, from knowingly removing or rendering an emission control system inoperative after sale and delivery to an ultimate purchaser. In Canada, modifications of the emission control system could create liability under applicable federal or provincial laws.

Scheduled Maintenance, Emissions

An Emission Systems Required Maintenance Chart for each appear on the following pages.

The vehicle charts list the items required to maintain the vehicle emission systems at levels determined by the federal government (Environmental Protection Agency). Refer to the appropriate sections of the Powertrain/Drivetrain Manual and the Powertrain Control/Emissions Diagnosis Manual ¹ for the maintenance procedures, which are related to the items listed on the maintenance schedule. Use these procedures to perform the required emission system maintenance items listed on the maintenance charts.

Maintenance service adjustments must conform to specifications contained in the Powertrain Control/Emissions Diagnosis Manual, ¹ to those listed in the Truck Performance Specifications issue of the Technical Service Bulletin or shown on the Vehicle Emission Control Information Decal which is located on or near the engine, or the emission systems may become inoperative.



If an engine is equipped with an MFI ignition system and any high tension ignition wire was detached from a spark plug, the distributor cap or the coil to perform a maintenance operation, Silicone Dielectric Compound D7AZ-19A331-A (ESA-M1C171-A) or equivalent must be applied to the boot before reconnection. Using a small, clean screwdriver, apply a thin layer of Silicone Dielectric Compound on the entire interior surface of the boot.

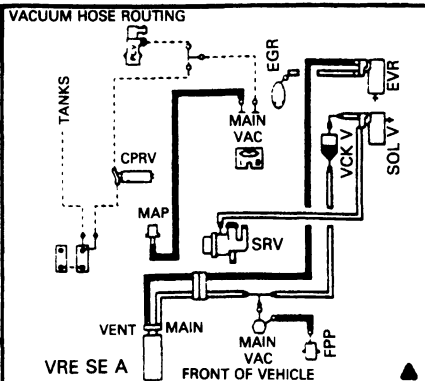
As a safety precaution, before starting the engine to perform maintenance, make sure the transmission selector is in park (automatic transmission) or neutral (manual transmission), the parking brake set and the wheels blocked.

¹ Can be purchased as a separate item.

MAINTENANCE (Continued)

TO ASSURE THE DURABILITY OF THE VEHICLE AND ITS EMISSION CONTROL SYSTEMS, IT IS NECESSARY THAT SCHEDULED MAINTENANCE BE PERFORMED AT THE DESIGNATED INTERVALS. FORD RECOMMENDS THE USE OF GENUINE FORD REPLACEMENT PARTS. THE MAINTENANCE, REPLACEMENT, OR REPAIR OF THE EMISSIONS CONTROL DEVICES AND SYSTEMS (THE COST OF WHICH IS NOT COVERED BY WARRANTY) MAY BE PERFORMED BY ANY AUTOMOTIVE REPAIR ESTABLISHMENT OR INDIVIDUAL AND MAY USE OTHER THAN FORD SERVICE PARTS FOR SUCH MAINTENANCE OR REPAIR. IF OTHER THAN FORD OR MOTORCRAFT PARTS OR FORD AUTHORIZED REMANUFACTURED PARTS ARE USED FOR MAINTENANCE REPLACEMENTS OR FOR THE SERVICE OF COMPONENTS AFFECTING EMISSIONS CONTROL, THE OWNER SHOULD ASSURE HIMSELF THAT SUCH PARTS ARE WARRANTED BY THEIR MANUFACTURER TO BE EQUIVALENT TO GENUINE FORD MOTOR COMPANY PARTS IN PERFORMANCE AND DURABILITY. PLEASE CONSULT THE WARRANTY BOOKLET FOR COMPLETE WARRANTY INFORMATION.

		Ford Motor Company IMPORTANT ENGINE INFORMATION	
THIS VEHICLE IS EQUIPPED WITH EEC-IV MFI SYSTEMS. ENGINE IDLE SPEED, IDLE MIXTURE, AND IGNITION TIMING ARE NOT ADJUSTABLE. SEE ENGINE/EMISSIONS DIAGNOSIS SHOP MANUAL FOR ADDITIONAL INFORMATION.			
To check engine timing set parking brake and block wheels. Engine must be at normal operating temperature, transmission in neutral, and accessories off.			
(1) Turn off engine. (2) Disconnect the in-line Spout Connector (). (3) Re-start previously warmed-up engine. (4) Verify that the ignition timing is 10° BTDC. If not see shop manual. (5) Turn engine off and restore electrical connection.			
Use SAE10W-30 Oil API Service SG — Energy Conserving II.			
THIS ENGINE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1993 MODEL YEAR NEW HEAVY-DUTY ENGINES. THIS ENGINE IS CERTIFIED FOR USE IN ALL HEAVY-DUTY VEHICLES.			
F2AE-9C485- H H P	Catalyst	Spark Plug: ASF-42C 7.5L 9HW NFM07 5BSA5-RDS/AIR/HO2S/EGR/MPi	Gap: 042-046

VACUUM HOSE ROUTING


A16408-B

MAINTENANCE (Continued)

ADJUSTMENT PROCEDURE NOTES

IGNITION TIMING SPECIFICATION

**FORD MOTOR COMPANY
IMPORTANT VEHICLE INFORMATION**

THIS VEHICLE IS EQUIPPED WITH EEC IV MFI SYSTEMS. IDLE SPEEDS AND IDLE MIXTURES ARE NOT ADJUSTABLE. SEE SHOP MANUAL FOR ADDITIONAL INFORMATION.

ADJUST IGNITION TIMING WITH THE TRANSMISSION IN NEUTRAL, PARKING BRAKE SET AND THE WHEELS BLOCKED. ENGINE MUST BE AT NORMAL OPERATING TEMPERATURE.

- (1) TURN OFF ENGINE.
- (2) DISCONNECT THE IN-LINE SPOUT CONNECTOR (\square - OR - \square).
- (3) RE-START PREVIOUSLY WARMED-UP ENGINE.
- (4) ADJUST IGNITION TIMING TO 10° BTDC.
- (5) TURN OFF ENGINE AND RESTORE ELECTRICAL CONNECTION.

FIRING ORDER - 15426378

THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1993 MODEL YEAR NEW LIGHT-DUTY TRUCKS. COMPLIANCE DEMONSTRATED AND DESIGNED FOR PRINCIPAL USE BELOW 4000 FEET. FOR NEW VEHICLE COMPLIANCE ABOVE 4000 FEET. SEE SERVICE PUBLICATIONS.

E7AE-9C485-
CCR **CATALYST**

SPARK PLUG: ASE-42C GAP - .042 - .046
5.0L - 7HM
HFM5.0TSHAGX - AIP/EG/EGS/TWC/F1

ENGINE TYPE

SPARK PLUG GAP SPECIFICATION

TYPICAL VEHICLE EMISSION CONTROL INFORMATION DECAL (UNDER 8500 GVW)

ENGINE VACUUM HOSE ROUTING (TYPICAL)

VACUUM HOSE ROUTING

Diagram labels: FUEL TANK, AIR FILTER, EGR, TAB, TAD, VACUUM HOSE, FRONT OF VEHICLE.

A10418-D

Maintenance Schedules

Three maintenance schedules are specified for the 1993 Bronco, Econoline and F-Series trucks. They are identified by the letters B, E and G. The application of the various maintenance schedules are as follows:

Maintenance Schedule B, Gasoline Engine Equipped Vehicles with Light Duty Emissions (Under 8500 Pounds GVWR)

The following catalyst-equipped vehicles, designated for use with unleaded fuel only should be maintained according to Maintenance Schedule B.

- F-150
- Lightning
- F-250
- E-150-250 and Club Wagon
- Bronco

Maintenance Schedule G, Gasoline Engine Equipped Vehicles with Heavy Duty Emissions (Over 8500 Pounds GVWR)

Maintenance Schedule G is used for the following unleaded fuel vehicles with 4.9L, 5.8L and 7.5L MFI engines.

- F-250-350
- F-Super Duty
- E-250-350 and Club Wagon

Maintenance Schedule E, 7.3L Diesel Engine Equipped Vehicles

Maintenance Schedule E is used for the following vehicles:

- F-250 Heavy Duty
- F-350
- F-Super Duty
- E-250 Heavy Duty
- E-350

Required Maintenance Service Procedures

Refer to the appropriate sections of the Powertrain / Drivetrain Manual and the Powertrain Control / Emissions Diagnosis Manual ² for the required maintenance service procedures.

² Can be purchased as a separate item.

MAINTENANCE (Continued)

MAINTENANCE SCHEDULE B – NORMAL DRIVING CONDITIONS

F-150/250 and Bronco Unleaded Fuel Vehicles with Light Duty Emissions (Under 8,500 lbs. GVWR)

B – Required for all vehicles.

b – Required for 49 States vehicles and recommended only for California and Canada vehicles.

Ford recommends that you perform maintenance on all designated items to achieve best vehicle operation.

NORMAL DRIVING SERVICE INTERVALS – PERFORM AT THE MONTHS OR DISTANCES SHOWN, WHICHEVER OCCURS FIRST.																	
MAINTENANCE OPERATION	MILES (Thousands)	7.5	15	22.5	30	37.5	45	52.5	60	67.5	75	82.5	90	97.5	105	112.5	120
	KILOMETERS (Thousands)	12	24	36	48	60	72	84	96	108	121	132	145	156	169	181	193
Emission Control Systems																	
Change Engine Oil and Oil Filter – every 6 months OR ^⑤		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Replace Spark Plugs – Standard					B				B				B				B
Replace Coolant – every 36 months OR					B				B				B				b
Check Cooling System, Hoses and Clamps ^④																	
Replace Frame-Mounted Fuel Filter			B		B		B		B		B		B		B		B
Replace Air Cleaner Filter ^⑥		B			B				b				b				b
Replace Crankcase Emission Air Filter ^⑥					B				b				b				b
Replace PCV Valve ^③									b								b
Check Secondary Air Injection Hoses and Clamps ^{①④}									b								b
Inspect Drive Belt Condition									b								b
Other Systems																	
Change Rear Axle Lube ^{⑦⑨}														B			
Check Wheel Lug Nut Torque ^②		B	B	B	B	B	B	B	B								
Check Clutch Reservoir Fluid Level		B	B	B	B	B	B	B	B								
Lubricate Transfer Case Shift Lever Pivot Bolt and Control Rod Connecting Pins			B		B		B		B								
Inspect and Lubricate Automatic Transmission Shift Linkage (Bellcrank System) and Inspect Fluid ^{⑦⑧}		B	B	B	B	B	B	B	B								
Inspect and Lubricate Front Wheel Bearings ^⑧					B				B								
Rotate Tires		B		B		B		B									
Inspect Disc Brake System and Lubricate Caliper Slide Rails			B		B		B		B								
Inspect Drum Brake Systems, Hoses, and Lines ^⑧			B		B		B		B								
Inspect Exhaust System for Leaks, Damage or Loose Parts ^⑧					B				B								
Inspect and Remove any Foreign Material Trapped by Exhaust System Shielding		B	B	B	B	B	B	B	B								
Inspect Parking Brake System for Damage and Operation					B				B								
Lubricate Throttle and Kickdown Lever Ball Studs					B				B								
Lubricate Steering Linkage, Driveshaft Slip Yoke if equipped with Grease Fittings ^⑧		B	B	B	B	B	B	B	B								
Lubricate Front Axle R.H. Axle Shaft Slip Yoke									B								
Inspect Spindle Needle Bearing Lubrication (4x4) ^⑧					B				B								
Inspect Hub Lock Lubrication (4x4)					B				B								
Change Transfer Case Oil (4x4)									B								
Change Manual Transmission Oil (HD M50D/55-42 and Warner T18)									B								

Beyond 60,000 miles/96 000 km
continue recommended maintenance
operations at intervals indicated for
0-60,000 miles/96 000 km

① Identifies emission related checks or inspections. Eligibility for emission control systems defect and performance warranties and emission recalls are not contingent upon the performance of emission related checks or inspections.

② Wheel lug nuts must be retightened to proper torque specifications at 500 miles/800 km of new vehicle operation. See your Owner Guide for proper torque specifications. Also retighten to proper torque specification at 500 miles/800 km after (1) any wheel change or (2) any other time the wheel lug nuts have been loosened.

③ At 60,000 miles/96 000 km, your dealer will replace the PCV Valve at no cost on 4.9L, 5.0L and 5.8L engines except California and Canada vehicles.

④ Check means a functional measurement of Systems' operation (performance, leaks or conditions of parts). Correct as required.
NOTE: Refer to page 2 of the Maintenance Schedule Record Log book for "NO COST PCV VALVE REPLACEMENT."

⑤ UNIQUE DRIVING CONDITIONS

If your driving habits **FREQUENTLY** include one or more of the following conditions:

- Short trips of **less** than 10 miles (16 km) when outside temperatures remain below freezing.
- Towing a trailer, using a camper, roof-top carrier or carrying maximum loads.
- Operating in severe dust conditions.
- Operating during **hot weather** in stop-and-go "rush hour" traffic.
- Extensive idling, such as police, taxi or door-to-door delivery use.
- Snow plowing.
- High speed operation with a fully loaded vehicle (Max. GVW).

⑥ AIR CLEANER and CRANKCASE EMISSION AIR FILTERS

– If operating in severe dust conditions, ask your dealer for proper replacement intervals.

⑦ AUTOMATIC/HD MANUAL TRANSMISSION FLUID – Change each 30,000 miles (48 000 km) – If your driving habits **frequently** include one or more of the following conditions:

- Operating during hot weather (above 90°F, 32°C) and carrying heavy loads and driving in hilly terrain.
- Operating at maximum loads.

- Towing a trailer or slide-in camper.
- Door-to-door delivery, police or taxi.
- Operating a transmission mounted PTO.

⑧ EXTREME SERVICE ITEMS

If your vehicle is operated **off-highway**, perform the following items every 1,000 miles (1 600 km). If your vehicle is operated in mud and/or water, perform the following items daily:

- Lubricate front axle spindle pins, steering and clutch linkages, axle and driveshaft U-joints and slip yoke if equipped with fittings.
- Inspect front wheel bearings and lubrication.
- Inspect disc brake system, lube caliper slide rails.
- Inspect drum brake system, hoses and lines.
- Inspect exhaust system for leaks, damage or loose parts and remove any foreign material trapped by shielding
- Lubricate clutch release lever pivot (7.3L and 7.5L).

- ⑨ All rear axle lube quantities must be replaced every 100,000 miles (160 000 km) or if the axle has been submerged in water. Otherwise, the lube should not be checked or changed unless a leak is suspected or repair required.

CA13378-E

MAINTENANCE (Continued)

MAINTENANCE SCHEDULE G – NORMAL DRIVING CONDITIONS

F-250 HD/350 and Super Duty Unleaded Fuel Vehicles with 4.9L, 5.8L, and 7.5L MFI Engines and Heavy Duty Emissions (Over 8,500 lbs. GVWR)

G – Required for all vehicles

g – Required for 49 States vehicles and recommended only for California and Canada vehicles.

Ford recommends that you perform maintenance on all designated items to achieve best vehicle operation.

(g) = This item not required to be performed. However, Ford recommends that you also perform maintenance on items designated by a "(g)" in order to achieve best vehicle operation. Failure to perform this recommended maintenance will not invalidate the vehicle emissions warranty or manufacturer recall liability.

NORMAL DRIVING SERVICE INTERVALS — PERFORM AT THE MONTHS OR DISTANCES SHOWN, WHICHEVER OCCURS FIRST.																											
MAINTENANCE OPERATION	MILES (Thousands)																										
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120			
	KILOMETERS (Thousands)																										
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	121	129	136	145	152	160	169	177	184	193			
Emission Control Systems																											
Change Engine Oil and Oil Filter — every 6 months OR③	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G		
Replace Spark Plugs							G					G							G						G		
Replace Engine Coolant — every 36 months OR							G					G							G						g		
Check Cooling System, Hoses and Clamps④	ANNUALLY																										
Replace Frame Mounted Fuel Filter			G				G			G			G			G			G			G			G		
Replace Air Cleaner Filter⑤							G					g							g						g		
Replace Crankcase Emission Air Filter							G					g							g						g		
Replace PCV Valve												g/1													g		
Replace Ignition Wires												g													g		
Check Secondary Air Injection Hoses and Clamps①④												g													g		
Inspect Drive Belt Condition			G				G			G			G			G			G			G			g		

① Identifies emission related checks or inspections. Eligibility for emission control systems defect and performance warranties and emission recalls are not contingent upon the performance of emission related checks or inspections.

② Wheel lug nuts must be retightened to proper torque specifications at 500 miles/800 km of new vehicle operation (100 miles/160 km and 500 miles/800 km for vehicles equipped with dual rear wheels or equipped for snowplowing). See your Owner Guide for proper torque specifications. Also retighten to proper torque specification at 500 miles/800 km after (1) any wheel change or (2) any other time the wheel lug nuts have been loosened.

③ At 60,000 miles/96 000 km, your dealer will replace the PCV Valve at no cost except Canada vehicles.

④ Check means a functional measurement of Systems' operation (performance, leaks or condition of parts). Correct as required.
NOTE: Refer to page 2 of the Maintenance Schedule Record Log book for "NO COST PCV VALVE REPLACEMENT."

⑤ UNIQUE DRIVING CONDITIONS

If your driving habits **FREQUENTLY** include one or more of the following conditions:

- Short trips of **less** than 10 miles (16 km) when outside temperatures remain below freezing.
- Towing a trailer, using a camper, roof-top carrier or carrying maximum loads.
- Operating in severe dust conditions.
- Operating during **hot weather** in stop-and-go "rush hour" traffic.
- Extensive idling, such as police, taxi or door-to-door delivery use.
- Snow plowing.
- High speed operation with a fully loaded vehicle (Max. GVW).

Change ENGINE OIL AND OIL FILTER every 3 months or 3,000 miles (4 800 km) whichever occurs first.

⑥ AIR CLEANER and CRANKCASE EMISSION AIR FILTERS

– If operating in severe dust conditions, ask your dealer for proper replacement intervals.

⑦ AUTOMATIC/HD MANUAL 5-SPEED (5S-42) TRANSMISSION FLUID and SUPER-DUTY REAR AXLE LUBE – Change each 30,000 miles (48 000 km) – if your driving habits **frequently** include one or more of the following conditions:

- Operating during hot weather (above 90°F, 32°C) and carrying heavy loads and driving in hilly terrain.
- Operating at maximum loads.
- Towing a trailer or slide-in camper.
- Door-to-door delivery, police or taxi.
- Operating a transmission mounted PTO.
- Sandy, dusty or wet conditions (F-Super Duty only)

⑧ EXTREME SERVICE ITEMS

If your vehicle is operated **off-highway**, perform the following items every 1,000 miles (1 600 km). If your vehicle is operated in mud and/or water, perform the following items daily:

- Lubricate front axle spindle pins, steering and clutch linkages, axle and driveshaft U-joints and slip yoke if equipped with fittings.
- Inspect front wheel bearings and lubrication.
- Lubricate automatic transmission external controls (Bellcrank system) (F-Super Duty only).
- Inspect disc brake system, lube caliper slide rails.
- Inspect drum brake system, hoses and lines.
- Inspect exhaust system for leaks, damage or loose parts and remove any foreign material.

⑨ SUPER DUTY REAR AXLES F-250 HD/F-350 With Ford Design Rear Axles

- The lube change interval should be shortened to 3000 miles, or 3 months, whichever occurs first, during extended trailer tow operation above 70°F ambient and wide open throttle for extended periods above 45 mph.
- The 3000 mile lube change interval may be waived if the rear axle has been filled with Ford approved 75W-140 synthetic gear lube meeting material specification WSL-M2C192-A.

CA13379-E

MAINTENANCE (Continued)

MAINTENANCE SCHEDULE G – NORMAL DRIVING CONDITIONS

F-250 HD/350 and Super Duty Unleaded Fuel Vehicles with 4.9L, 5.8L, and 7.5L MFI Engines and Heavy Duty Emissions (Over 8,500 lbs. GVWR)

G – Required for all vehicles

g – Required for 49 States vehicles and recommended only for California and Canada vehicles.

Ford recommends that you perform maintenance on all designated items to achieve best vehicle operation.

(g) = This item not required to be performed. However, Ford recommends that you also perform maintenance on items designated by a "(g)" in order to achieve best vehicle operation. Failure to perform this recommended maintenance will not invalidate the vehicle emissions warranty or manufacturer recall liability.

NORMAL DRIVING SERVICE INTERVALS – PERFORM AT THE MONTHS OR DISTANCES SHOWN, WHICHEVER OCCURS FIRST.																									
MAINTENANCE OPERATION	MILES (Thousands)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
	KILOMETERS (Thousands)	8	16	24	32	40	48	56	64	72	80	88	96	104	112	121	129	136	145	152	160	169	177	184	193
Other Systems																									
Change Rear Axle Lube ⁽⁷⁾⁽⁹⁾⁽¹⁰⁾																					G				
Check Wheel Lug Nut Torque ⁸		G	G	G	G	G	G	G	G	G	G	G	G												
Torque Front and Rear Spring U-Bolts (F-Super Duty Commercial and Motorhome Chassis ⁽¹⁾)		G		G			G			G			G												
Check and Lubricate Clutch Release Lever (7.5L)		G	G	G	G	G	G	G	G	G	G	G	G												
Check Clutch Fluid Reservoir Level		G	G	G	G	G	G	G	G	G	G	G	G												
Lubricate Transfer Case Shift Lever Pivot Bolt and Control Rod Connecting Pins				G			G			G			G												
Lubricate Automatic Transmission Linkage (Bellcrank System) and Inspect Fluid ⁽⁷⁾		G	G	G	G	G	G	G	G	G	G	G	G												
Lubricate Front Axle Spindle Pins, Steering Linkage, Driveshaft Slip Yoke if Equipped with Fittings		G	G	G	G	G	G	G	G	G	G	G	G												
Lubricate Front Axle Spindle Pins (F-Super Duty)				G			G			G			G												
Rotate Tires ⁽²⁾		G		G			G			G			G												
Inspect Disc Brake System, Lube Caliper Slide Rails and Knuckle Top and Bottom Inner Pad Slots				G			G			G			G												
Inspect Drum Brake System, Hoses and Lines				G			G			G			G												
Inspect and Lubricate Front Wheel Bearings							G						G												
Inspect and Remove any Foreign Material Trapped by Exhaust System Shielding		G	G	G	G	G	G	G	G	G	G	G	G												
Inspect Exhaust System for Leaks, Damage or Loose Parts							G						G												
Inspect Parking Brake System for Damage and Operation							G						G												
Inspect Parking Brake Fluid Level (F-Super Duty)				G			G			G			G												
Lubricate Throttle and Kickdown Cable Ball Studs							G						G												
Lubricate Front Drive Axle R.H. Axle Slip Yoke (4x4) (F250)							G						G												
Inspect Spindle Needle Bearing Lubrication (4x4)							G						G												
Inspect Hub Lock Lubrication (4x4)							G						G												
Change Transfer Case Oil (4x4)							G						G												
Change Manual Transmission Oil (HD M50D/S5-42) ⁽⁷⁾													G												

Beyond 60,000 miles/96 000 km
continue recommended maintenance operations at
intervals indicated for 0-60,000 miles/96 000 km

① Required at first 1,000 miles (1 600 km) for initial service.

② Wheel lug nuts must be retightened to proper torque specifications at 500 miles/800 km of new vehicle operation (100 miles/160 km and 500 miles/800 km for vehicles equipped with dual rear wheels or equipped for snowplowing). See your Owner Guide for proper torque specifications. Also retighten to proper torque specification at 500 miles/800 km after (1) any wheel change or (2) any other time the wheel lug nuts have been loosened.

③ At 60,000 miles/96 000 km, your dealer will replace the PCV Valve at no cost except Canada vehicles.

④ Check means a functional measurement of Systems' operation (performance, leaks or condition of parts). Correct as required.
NOTE: Refer to page 2 of the Maintenance Schedule Record Log book for "NO COST PCV VALVE REPLACEMENT."

⑤ UNIQUE DRIVING CONDITIONS

If your driving habits **FREQUENTLY** include one or more of the following conditions:

- Short trips of **less** than 10 miles (16 km) when outside temperatures remain below freezing.
- Towing a trailer, using a camper, roof-top carrier or carrying maximum loads.
- Operating in severe dust conditions.
- Operating during **hot weather** in stop-and-go "rush hour" traffic.
- Extensive idling, such as police, taxi or door-to-door delivery use.
- Snow plowing.
- High speed operation with a fully loaded vehicle (Max. GVW).

Change ENGINE OIL AND OIL FILTER every 3 months or 3,000 miles (4 800 km) whichever occurs first.

⑥ AIR CLEANER and CRANKCASE EMISSION AIR FILTERS

– If operating in severe dust conditions, ask your dealer for proper replacement intervals.

⑦ AUTOMATIC/HD MANUAL 5-SPEED (S5-42) TRANSMISSION FLUID, SUPERDUTY AND F-250 HD/F-350 WITH FORD DESIGN REAR AXLE LUBE – Change each 30,000 miles (48 000 km) – if your driving habits **frequently** include one or more of the following conditions:

- Operating during hot weather (above 90°F, 32°C) and carrying heavy loads and driving in hilly terrain.
- Operating at maximum loads.
- Towing a trailer or slide-in camper.
- Door-to-door delivery, police or taxi.
- Operating a transmission mounted PTO.
- Sandy, dusty or wet conditions (F-Super Duty Only)

⑧ EXTREME SERVICE ITEMS

If your vehicle is operated **off-highway**, perform the following items every 1,000 miles (1 600 km). If your vehicle is operated in mud and/or water, perform the following items daily:

- Lubricate front axle spindle pins, steering and clutch linkages, axle and driveshaft U-joints and slip yoke if equipped with fittings.
- Inspect front wheel bearings and lubrication.
- Lubricate automatic transmission external controls (Bellcrank system) (F-Super Duty only).
- Inspect disc brake system, lube caliper slide rails.
- Inspect drum brake system, hoses and lines.
- Inspect exhaust system for leaks, damage or loose parts and remove any foreign material.
- Lubricate clutch release lever pivot (7.5L).

⑨ SUPER DUTY REAR AXLES AND F-250 HD/F-350 WITH FORD DESIGN REAR AXLE

- The lube change interval should be shortened to 3000 miles, or 3 months, whichever occurs first, during extended trailer tow operation above 70°F ambient and wide open throttle for extended periods above 45 mph.
- The 3000 mile lube change interval may be waived if the rear axle has been filled with Ford approved 75W-140 synthetic gear lube meeting material specification WSL-M2C192-A.

⑩ Under normal driving conditions it is not necessary to check the rear drive axle lubricant. However, the lubricant should be changed every 100,000 miles (160 000 km) or if the rear axle has been submerged in water. OTHERWISE, THE REAR AXLE LUBRICANT SHOULD NOT BE CHECKED OR CHANGED UNLESS A LEAK IS SUSPECTED OR REPAIR IS REQUIRED.

CA15265-C

MAINTENANCE (Continued)

MAINTENANCE SCHEDULE B – NORMAL DRIVING CONDITIONS

E-150/250 and Club Wagon Unleaded Fuel Vehicles with Light Duty Emissions (Under 8,500 lbs. GVWR)

B – Required for all vehicles.

b – Required for 49 States vehicles and recommended only for California and Canada vehicles.

Ford recommends that you perform maintenance on all designated items to achieve best vehicle operation.

(b) = This item not required to be performed. However, Ford recommends that you also perform maintenance on items designated by a "(b)" in order to achieve best vehicle operation. Failure to perform this recommended maintenance will not invalidate the vehicle emissions warranty or manufacturer recall liability.

NORMAL DRIVING SERVICE INTERVALS – PERFORM AT THE MONTHS OR DISTANCES SHOWN, WHICHEVER OCCURS FIRST																				
MAINTENANCE OPERATION	MILES (Thousands)		7.5	15	22.5	30	37.5	45	52.5	60	67.5	75	82.5	90	97.5	105	112.5	120		
	KILOMETERS (Thousands)		12	24	36	48	60	72	84	96	109	121	133	145	157	169	181	193		
Emission Control Systems																				
Change Engine Oil and Oil Filter – every 6 months OR③			B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B		
Replace Spark Plugs – Standard						B				B				B				B		
Replace Coolant – every 36 months OR						B				B				B				b		
Check Cooling System, Hoses and Clamps④											ANNUALLY									
Replace Frame-Mounted Fuel Filter				B		B		B		B		B		B		B		B		
Replace Air Cleaner Filter④						B				b				b				b		
Replace Crankcase Emission Air Filter④						B				b				b				b		
Replace PCV Valve③										b								b		
Check Secondary Air Injection Hoses and Clamps①④										b								b		
Inspect Drive Belt Condition										B								B		
Other Systems																				
Change Rear Axle Lube④																B				
Check Wheel Lug Nut Torque②			B	B	B	B	B	B	B	B										
Rotate Tires②			B		B		B		B											
Inspect and Lubricate Automatic Transmission Shift Linkage (Bellcrank System) and Inspect FluidF			B	B	B	B	B	B	B	B										
Inspect and Lubricate Front Wheel Bearings						B				B										
Inspect Disc Brake System and Lubricate Caliper Slide Rails and Knuckle Top and Bottom Inner Pad Slots				B		B				B										
Inspect Drum Brake Systems, Hoses, and Lines				B		B		B		B										
Inspect Exhaust System for Leaks, Damage or Loose Parts						B				B										
Inspect and Remove any Foreign Material Trapped by Exhaust System Shielding			B	B	B	B	B	B	B	B										
Inspect Parking Brake System for Damage and Operation						B				B										
Lubricate Throttle and Kickdown Lever Ball Studs						B				B										
Lubricate Steering Linkage, Driveshaft Slip Yoke if Equipped with Grease Fittings			B	B	B	B	B	B	B	B										
Check Warning Lights and Gauges				B																
Beyond 60,000 miles/96 000 km, continue recommended maintenance operations at intervals indicated for 0-60,000 miles/96 000 km.																				

Beyond 60,000 miles/96 000 km, continue recommended maintenance operations at intervals indicated for 0-60,000 miles/96 000 km.

① Identifies emission related checks or inspections. Eligibility for emission control systems defect and performance warranties and emission recalls are not contingent upon the performance of emission related checks or inspections.

② Wheel lug nuts must be retightened to proper torque specifications at 500 miles/800 km of new vehicle operation. See your Owner Guide for proper torque specifications. Also retighten to proper torque specification at 500 miles/800 km after (1) any wheel change or (2) any other time the wheel lug nuts have been loosened.

③ At 60,000 miles/96 000 km, your dealer will replace the PCV Valve at no cost on 4.9L, 5.0L and 5.8L engines except California and Canada vehicles.

④ Check means a functional measurement of Systems' operation (performance, leaks or conditions of parts). Correct as required.

⑤ UNIQUE DRIVING CONDITIONS

If your driving habits **FREQUENTLY** include one or more of the following conditions:

- Short trips of **less** than 10 miles (16 km) when outside temperatures remain below freezing.
- Towing a trailer, using a camper, roof-top carrier or carrying maximum loads.
- Operating in severe dust conditions.
- Operating during **hot weather** in stop-and-go "rush hour" traffic.
- Extensive idling, such as police, taxi or door-to-door delivery service.
- High speed operation with a fully loaded vehicle (max. GVW).

Change ENGINE OIL AND OIL FILTER every 3 months or 3,000 miles (4 800 km) whichever occurs first.

⑥ AIR CLEANER and CRANKCASE EMISSION AIR FILTERS

– If operating in severe dust conditions, ask your dealer for proper replacement intervals.

⑦ AUTOMATIC TRANSMISSION FLUID – Change each 30,000 miles (48 000 km) – if your driving habits **frequently** include one or more of the following conditions:

- Operating during hot weather (above 90°F, 32°C) and carrying heavy loads and driving in hilly terrain.
- Operating at maximum loads.

- Towing a trailer or slide-in camper.

- Door-to-door delivery, police or taxi.

⑧ EXTREME SERVICE ITEMS

If your vehicle is operated **off-highway**, perform the following items every 1,000 miles (1 600 km). If your vehicle is operated in mud and/or water, perform the following items daily:

- Lubricate front axle spindle pins, steering and clutch linkages, axle and driveshaft U-joints and slip yoke if equipped with fittings.
- Inspect front wheel bearings and lubrication.
- Inspect disc brake system, lube caliper slide rails.
- Inspect drum brake system, hoses and lines.
- Inspect exhaust system for leaks, damage or loose parts and remove any foreign material trapped by shielding.
- Lubricate clutch release lever pivot (7.5L).

⑨ All rear axle lube quantities must be replaced every 100,000 miles (160 000 Km) or if the axle has been submerged in water. Otherwise, the lube should not be checked or changed unless a leak is suspected or repair required.

CY13380-E

MAINTENANCE (Continued)

MAINTENANCE SCHEDULE G – NORMAL DRIVING CONDITIONS

E-250/350 and Club Wagon Unleaded Fuel Vehicles with 4.9L, 5.8L, and 7.5L EFI Engines and Heavy Duty Emissions (Over 8,500 lbs. GVWR)

G – Required for all vehicles

g – Required for 49 States vehicles and recommended only for California and Canada vehicles.

Ford recommends that you perform maintenance on all designated items to achieve best vehicle operation.

(g) = This item not required to be performed. However, Ford recommends that you also perform maintenance on items designated by a "(g)" in order to achieve best vehicle operation. Failure to perform this recommended maintenance will not invalidate the vehicle emissions warranty or manufacturer recall liability.

NORMAL DRIVING SERVICE INTERVALS – PERFORM AT THE MONTHS OR DISTANCES SHOWN, WHICHEVER OCCURS FIRST.																									
MAINTENANCE OPERATION	MILES (Thousands)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
	KILOMETERS (Thousands)	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160	168	177	184	193
Emission Control Systems																									
Change Engine Oil and Oil Filter – every 6 months OR ⑤		G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Replace Spark Plugs								G					G						G						g
Replace Engine Coolant – every 36 months OR								G					G						G						g
Check Cooling System, Hoses and Clamps④																									
Replace Frame-Mounted Fuel Filter				G				G			G					G						G			G
Replace Air Cleaner Filter③								G					g						g						g
Replace Crankcase Emission Air Filter								G					g						g						g
Replace PCV Valve③													g												g
Replace Ignition Wires													g												g
Check Secondary Air Injection Hoses and Clamps①④													g												g
Inspect Drive Belt Condition				G				G			G			G			G			G			G		G
Other Systems																									
Change Rear Axle Lube③																					G				
Check Wheel Lug Nut Torque②		G	G	G	G	G	G	G	G	G	G	G	G												
Rotate Tires②		G		G				G			G		G												
Lubricate Automatic Transmission Linkage (Bellcrank System) and Inspect Fluid⑦		G	G	G	G	G	G	G	G	G	G	G	G												
Lubricate Steering Linkages, Driveshaft U-joint and Slip Yoke if Equipped with Fittings		G	G	G	G	G	G	G	G	G	G	G	G												
Inspect Disc Brake System and Lubricate Caliper Slide Rails and Knuckle Top and Bottom Inner Pad Slots				G				G			G														
Inspect Drum Brake Systems, Hoses and Lines				G				G			G														
Inspect and Lubricate Front Wheel Bearings								G					G												
Inspect Exhaust System for Leaks, Damage or Loose Parts								G					G												
Inspect and remove any foreign material trapped by exhaust system shielding		G	G	G	G	G	G	G	G	G	G	G	G												
Inspect Engine Air Induction System (E-350 over 10,000 lbs. GVWR only)								G					G												
Inspect Fan and Fan Shroud (E-350 over 10,000 lbs. GVWR only)								G					G												
Inspect Parking Brake System for Damage and Operation								G					G												
Lubricate Throttle and Kickdown Lever Ball Studs								G					G												

Beyond 60,000 miles/96 000 km
continue recommended maintenance operations at
intervals indicated for 0-60,000 miles/96 000 km

① Identifies emission related checks or inspections. Eligibility for emission control systems defect and performance warranties and emission recalls are not contingent upon the performance of emission related checks or inspections.

② Wheel lug nuts must be retightened to proper torque specifications at 500 miles/800 km of new vehicle operation (100 miles/160 km and 500 miles/800 km for vehicles equipped with dual rear wheels). See your Owner Guide for proper torque specifications. Also retighten to proper torque specification at 500 miles/800 km after (1) any wheel change or (2) any other time the wheel lug nuts have been loosened.

③ At 60,000 miles/96 000 km, your dealer will replace the PCV Valve at no cost on 4.9L, 5.8L and 7.5L engines except California and Canada vehicles.

④ Check means a functional measurement of Systems' operation (performance, leaks or conditions of parts). Correct as required.

⑤ UNIQUE DRIVING CONDITIONS

If your driving habits **FREQUENTLY** include one or more of the following conditions:

- Short trips of **less** than 10 miles (16 km) when outside temperatures remain below freezing.
- Towing a trailer, using a camper, roof-top carrier or carrying maximum loads.
- Operating in severe dust conditions.
- Operating during **hot weather** in stop-and-go "rush hour" traffic.
- Extensive idling, such as police, taxi or door-to-door delivery service.
- High speed operation with a fully loaded vehicle (Max. GVW).

Change ENGINE OIL AND OIL FILTER every 3 months or 3,000 miles (4 800 km) whichever occurs first.

⑥ AIR CLEANER and CRANKCASE EMISSION AIR FILTERS

– If operating in severe dust conditions, ask your dealer for proper replacement intervals.

⑦ AUTOMATIC TRANSMISSION FLUID – Change each 30,000 miles (48 000 km) – if your driving habits **frequently** include one or more of the following conditions:

- Operating during hot weather (above 90°F, 32°C) and carrying heavy loads and driving in hilly terrain.
- Towing a trailer.
- Door-to-door delivery, police or taxi.

⑧ EXTREME SERVICE ITEMS

If your vehicle is operated **off-highway**, perform the following items every 1,000 miles (1 600 km). If your vehicle is operated in mud and/or water, perform the following items daily:

- Lubricate front axle spindle pins, steering and clutch linkages, axle and driveshaft U-joints and slip yoke if equipped with fittings.
- Inspect front wheel bearings and lubrication.
- Inspect disc brake system, lube caliper slide rails.
- Inspect drum brake system, hoses and lines.
- Inspect exhaust system for leaks, damage or loose parts and remove any foreign material trapped by shielding.
- Lubricate clutch release lever pivot (7.5L).

⑨ Under normal driving conditions it is not necessary to check the rear drive axle lubricant. However, the lubricant should be changed every 100,000 miles (160 000 km) or if the rear axle has been submerged in water. OTHERWISE, THE REAR AXLE LUBRICANT SHOULD NOT BE CHECKED OR CHANGED UNLESS A LEAK IS SUSPECTED OR REPAIR IS REQUIRED.

CA13381-E

MAINTENANCE (Continued)

MAINTENANCE SCHEDULE E – VEHICLES EQUIPPED WITH 7.3L DIESEL ENGINES

SERVICE INTERVALS – PERFORM AT THE MONTHS OR THE DISTANCES SHOWN, WHICHEVER COMES FIRST																									
MAINTENANCE OPERATION	MILES (Thousands)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
	KILOMETERS (Thousands)	8	16	24	32	40	48	56	64	72	80	88	96	105	113	121	129	137	145	153	161	169	177	185	193
Emission Control Systems																									
Change Engine Oil and Replace Oil Filter – every 6 months or at Mileage ^①		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Check Engine Idle Speed (Adjust as Required) ^④			X		X			X			X			X		X			X			X			X
Check Throttle Operation and Idle Return Spring ^④		X		X			X			X			X			X			X			X			X
Check Coolant Level in the Radiator and Overflow Bottle		MONTHLY																							
Check Coolant Condition and Protection, Cooling System/Hoses/Clamps (Prior to Cold Weather)		ANNUALLY																							
Replace Coolant Every 36 Months or at Mileage							X						X						X						X
Check and Inspect Drive Belt Condition and Tension ^⑤							X						X						X						X
Replace Air Cleaner Element ^②							X						X						X						X
Inspect Engine Air Induction System							X						X						X						X
Replace Fuel Filter ^②													X						X						X
Drain Water from Fuel/Filter Bowl ^③		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

*Wheel lug nuts must be retightened to proper torque specification at 500 miles/800 km of new vehicle operation (100 miles/160 km and 500 miles/800 km for vehicles with dual rear wheels or vehicles equipped for snowplowing). See your Owner Guide for proper torque specification. Also retighten to proper torque specification at 500 miles/800 km, after any wheel change, or any other time the wheel lug nuts have been loosened.

① SEVERE SERVICE OPERATION

When operating your vehicle under any of the following conditions, change engine oil and filter every three months or 2500 miles (4 000 km) whichever occurs first (every 265 gallons [1000 liters] of fuel can be substituted for the 2500 miles [4 000 km]). Use an engine oil conforming to Ford Specifications or the equivalent oil conforming to API service categories of both SG and CD. Do not use oil labeled as only SG or only CD, as they could cause engine damage. The oil should be of the proper viscosity (thickness) as identified on page 29.

- Sustained high speed driving at GVWR during hot weather (over 90°F/32°C).
- Operation in severe dust conditions.
- Trailer towing for long distances (over 1,000 miles/1 600 km).
- Frequent or extended idling (over 10 minutes per hour of normal driving). If the idling time is greater than 50% of the engine operation time, the oil and filter should be changed every 125 to 150 hours of engine operation.

② More often if operated in severe service or dust conditions. An instrument panel warning light will glow during normal engine operation when filter replacement is required. On vehicles equipped with E4OD transmission, make sure that the Throttle Position Sensor (TP/FIPL) connector is properly seated and that the sensor, connector, or wiring have not been damaged during fuel filter service.

③ More frequent intervals may be required dependent on fuel quality and vehicle usage. An instrument panel warning light will glow when servicing is required, or when the ignition key is in the START position.

④ Every 12 months or at mileage.

⑤ For severe service only change fluid every 30,000 miles. The definition of severe service for automatic transmission is as follows:

The automatic transmission fluid should be changed every 30,000 miles (48 000 km) if your vehicle(s) operate under any of the following conditions:

- Sustained high speed driving during hot weather (+90°F, +32°C).
- Towing a trailer for long distances.
- Accumulating 5,000 miles (8 000 km) or more per month.
- Continuous running service.

⑥ Inspect belt and check tension every 5000 miles on ambulance units.

⑦ HD MANUAL 5-SPEED (S5-42) TRANSMISSION FLUID – Change each 30,000 miles (48,000 km) – If driving habits frequently include one or more of the following conditions:

- Operating during hot weather (above 90°F, 32°C) and carrying heavy loads and driving in hilly terrain.
- Operating at maximum loads.
- Towing a trailer or slide in camper.
- Operating a transmission mounted PTO.

⑧ For F-Super Duty, F-250 HD/F-350 with Ford Design rear axles, refer to the unique driving conditions noted in Maintenance Schedule G which creates the need for a 30,000 mile lube change interval; note also the extreme service conditions in Schedule G which create the need for a 3,000 mile/3 month lube change interval or the alternative use of synthetic 75W-140 rear axle lube meeting material specification WSL-M2C192-A.

⑨ Automatic C-6 Transmission: Vacuum Regulator Valve must be adjusted to specifications. Any setting outside the specified range may lead to transmission malfunction. Automatic E4OD transmission: Throttle Position Sensor (TP/FIPL) must be checked and adjusted to specifications every 50,000 miles. Any setting outside the specified range may lead to transmission malfunction.

CA13382-E

MAINTENANCE (Continued)

MAINTENANCE SCHEDULE E – VEHICLES EQUIPPED WITH 7.3L DIESEL ENGINES (Continued)

SERVICE INTERVALS — PERFORM AT THE MONTHS OR THE DISTANCES SHOWN, WHICHEVER COMES FIRST																										
MAINTENANCE OPERATION	MILES (Thousands)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
	KILOMETERS (Thousands)	8	16	24	32	40	48	56	64	72	80	88	96	105	113	121	129	137	145	153	161	169	177	185	193	
Other Systems																										
Change Rear Axle Lube ^⑥																					X					
Check and Adjust Wheel Lug Nut Torque*	X	X	X	X	X	X	X	X	X	X	X															
Torque Front and Rear Spring U-Bolts (F-Super Duty Commercial and Motorhome Chassis)	@		X				X			X										X						
Inspect Exhaust System/Shields/Joints for Leaks, Breakage, Looseness, and Corrosive Damage							X							X												
Inspect Diesel Engine Mounted Noise Hardware for Damage or Oil/Fuel Saturation (i.e., Block Panels, Oil Pan Covers, Treated Valve Covers)							X							X												
Inspect the Vehicle for Missing, Damaged, or Mislocated Chassis and Body Mounted Noise Shields							X							X												
Inspect Fan and Fan Shroud (E- and F-350 Over 10,000 lbs. GVWR Only)			X				X			X				X												
Lubricate Driveshaft Slip Yoke if Equipped with Grease Fittings	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lubricate Steering Linkage (Only if Equipped with Grease Fittings)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lubricate Front Axle Spindle Pins (Econoline Only)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Inspect and Lubricate Automatic Transmission Shift Linkage (Bellcrank System) ^{③⑦}	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lubricate Transfer Case Shift Lever Pivot Bolt and Control Rod Connecting Pins		B		B		B		B		B		B		B		B		B								
Check Clutch Reservoir Fluid Level	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Lubricate Clutch Release Lever Pivots	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Check Brake Master Cylinder Fluid Level							X													X						
Inspect Disc Brake System, Lube Caliper Slide Rails and Knuckle Top and Bottom Inner Pads			X				X			X				X					X							
Inspect Parking Brake System for Damage and Operation			X				X			X				X					X							
Inspect Drum Brake Linings, Lines, Hoses			X				X			X				X					X							
Rotate Tires	X		X				X			X				X					X							
Lubricate Throttle Ball Stud							X													X						
Inspect and Lubricate Front Wheel Bearings							X													X						
Inspect Hub Lock Lubrication (4x4)							X													X						
Inspect (4x4) Spindle Needle Bearing Lubrication							X													X						
Change Transfer Case Oil (4x4)																				X						
Check Parking Brake Fluid Level (F-Super Duty Only)			X				X			X				X			X		X			X		X		
Change Manual Transmission Lube ^⑦														X												

NOTE: Checks, Inspections and Lubrication Intervals on Non-Emission Items (Other Systems) Should Be Continued at the Same Mileage Intervals

NOTE: Checks, Inspections and Lubrication Intervals on Non-Emission Items (Other Systems) Should Be Continued at the Same Mileage Intervals

*Wheel lug nuts must be retightened to proper torque specification at 500 miles/800 km of new vehicle operation (100 miles/160 km for vehicles with dual rear wheels or vehicles equipped for snowplowing). See your Owner Guide for proper torque specification. Also retighten to proper torque specification at 500 miles/800 km, after any wheel change, or any other time the wheel lug nuts have been loosened.

① Required at first 1,000 miles (1600 km) for initial service.

① SEVERE SERVICE OPERATION

When operating your vehicle under any of the following conditions, change engine oil and filter every three months or 2500 miles (4 000 km) whichever occurs first. Use an engine oil conforming to Ford Specifications or the equivalent oil conforming to API service categories of *both* SF and CD. Do not use oil labeled as *only* SF or *only* CD, as they could cause engine damage. The oil should be of the proper viscosity (thickness) as identified on page 29.

- Sustained high speed driving at GVWR during hot weather (over 90°F/32°C).
- Operation in severe dust conditions.
- Trailer towing for long distances (over 1,000 miles/1 600 km).
- Frequent or extended idling (over 10 minutes per hour of normal driving).

② More often if operated in severe service or dust conditions. An instrument panel warning light will glow during normal engine operation when filter replacement is required. On vehicles equipped with E4OD transmission, ensure that the Throttle Position Sensor (TP/FIPL) connector is properly seated and that the sensor, connector, or wiring have not been damaged during fuel filter service.

③ More frequent intervals may be required dependent on fuel quality and vehicle usage. An instrument panel warning light will glow when servicing is required, or when the ignition key is in the START position.

④ Every 12 months or at mileage.

⑤ For severe service only change fluid every 30,000 miles. The definition of severe service for automatic transmission is as follows:

The automatic transmission fluid should be changed every 30,000 miles (48 000 km) if your vehicle(s) operate under any of the following conditions:

- Sustained high speed driving during hot weather (+90°F, +32°C).
- Towing a trailer for long distances.
- Accumulating 5,000 miles (8 000 km) or more per month.
- Continuous running service.

⑥ Inspect belt and check tension every 5000 miles on ambulance units.

⑦ HD Manual 5-speed (55-42) Transmission Fluid – Change each 30,000 miles (48,000 km) – if driving habits frequently include one or more of the following conditions:

- Operating during hot weather (above 90°F, 32°C) and carrying heavy loads and driving in hilly terrain.
- Operating at maximum loads.
- Towing a trailer or slide in camper.
- Operating a transmission mounted PTO.

⑧ For F-Super Duty F-250 HD/F-350 with Ford Design rear axles, refer to the unique driving conditions noted in maintenance Schedule G which creates the need for a 30,000 mile lube change interval; note also the extreme service conditions in Schedule G which create the need for a 3,000 mile/3 month lube change interval or the alternative use of synthetic 75W-140 rear axle lube meeting material specification WSL-M2C192A.

⑨ Automatic C-6 Transmission: Vacuum Regulator Valve must be adjusted to specifications. Any setting outside the specified range may lead to transmission malfunction. Automatic E4OD transmission: Throttle Position Sensor (TP/FIPL) must be checked and adjusted to specifications every 50,000 miles. Any setting outside the specified range may lead to transmission malfunction.

CA15266-C

Owner Maintenance Checks

Listed below are vehicle maintenance checks and inspections that should be performed by the owner or qualified service technician at the indicated intervals. The Owner Guide contains supporting specifications and service information.

Any adverse conditions should be brought to the attention of the dealer or qualified service technician as soon as possible.

These owner maintenance checks are generally not covered by warranties and the owner may be charged for labor, parts and lubricants used.

MAINTENANCE (Continued)**When Stopping for Fuel**

- Check the engine oil level.
- Check the windshield washer fluid level.
- Look for low or under-inflated tires.
- Check coolant fill in recovery reservoir.

While Operating the Vehicle

- Note any changes in the sound of the exhaust or any smell of exhaust fumes in the vehicle.
- Check for vibrations in the steering wheel. Notice any increased steering effort or looseness in the steering wheel, or change in its straight ahead position.
- Notice if the vehicle constantly turns slightly or "pulls" to one side when traveling on smooth, level road.
- When stopping, listen and check for strange sounds, pulling to one side, increased brake pedal travel or "hard to push" brake pedal.
- If any slipping or changes in the operation of the transmission occurs, check the transmission occurs, check the transmission fluid level.
- Check automatic transmission PARK function.
- Check parking brake.
- Verify proper "Brake" and "Rear AntiLock" bulb check response when starting vehicle.

At Least Monthly

- Check and adjust tire pressure (cold).
- Check coolant level in the coolant recovery reservoir.
- Check operation of lights, horn, turn signals, windshield wipers and washers, and hazard warning flasher.
- Check for fluid leaks by inspecting the surface beneath the vehicle for oil, coolant, or other fluid drips. Clean water from the air conditioning system is normal.

At Least Twice a Year — Spring and Fall

- Check power steering reservoir fluid level.
 - Check radiator, heat and air-conditioning hoses for leaks or damage.
 - Check fluid level in clutch master cylinder.
 - Clean body and door drain holes.
 - Flush complete underside of vehicle.
 - Inspect underbody components for damage.
 - Check exhaust system for leaks or damage.
- NOTE: It is normal for a certain amount of moisture and staining to be present around the muffler seams. The presence of soot, light surface rust or moisture does not indicate a faulty muffler.
- Check parking brake system.

- Check headlamp alignment.
- Check seat and shoulder belt webbing, buckles and release mechanisms.
- Inspect seat back latches for proper operation.
- Check air pressure in spare tire.

At Least Once a Year

- Lubricate door hinges and checks and hood hinges.
- Lubricate door, hood and tailgate locks, and latches, including swing-away spare tire carrier latch and striker.
- Lubricate door rubber weatherstrips.
- Inspect and lubricate automatic transmission linkage / cable.
- Clean battery and terminals, check electrolyte level on low maintenance (auxiliary and replacement) batteries.
- Check manual transmission, 4x4 transfer case, and front drive axle. Rear axle fluid levels on Ford design rear axles should not be checked unless a leak is suspected or a repair is required.
- Check parking brake fluid level (F-Super Duty).

Tire Rotation

Tire rotation is recommended by all tire and vehicle manufacturers to improve wear life and to avoid abnormal wear.

- Rotate tires the first time between 5,000 and 7,500 miles (8,000-12,000 km) or earlier if there is any sign of uneven treadwear. The first rotation is most important.
- Subsequent tire rotations should be performed at 15,000 miles (24,000 km) maintenance intervals.

Lubrication

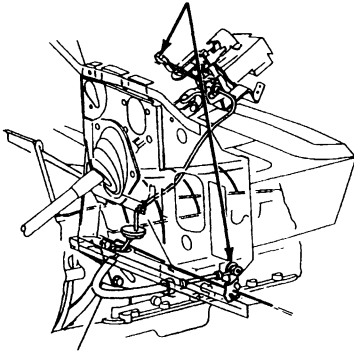
Important lubrication points for typical chassis and engines are shown in the following illustrations. Vehicles with optional equipment may have slightly different or additional lubrication points. When special equipment or accessories are installed on the truck, consult the manufacturer's literature for lubrication procedures. A table of recommended lubricants is included at the end of this section.

WARNING: THE AMERICAN PETROLEUM INSTITUTE (API) HAS ANNOUNCED THAT CONTINUOUS CONTACT WITH USED MOTOR OIL HAS CAUSED SKIN CANCER IN LABORATORY MICE. THE EFFECTS OF USED MOTOR OIL ON HUMANS HAS NOT BEEN ESTABLISHED. IT IS RECOMMENDED, HOWEVER, THAT AS A PRECAUTIONARY MEASURE, HUMANS PROTECT THEIR SKIN BY WASHING WITH SOAP AND WATER AFTER COMING IN CONTACT WITH USED MOTOR OIL.

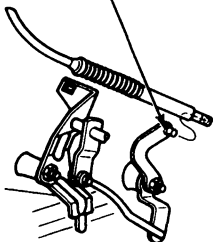
MAINTENANCE (Continued)

Lubrication Points, F-150-250-350 4x4 and Bronco Chassis

LUBRICATE WITH MULTI-PURPOSE GREASE
D7AZ-19584-AA (ESR-MIC59-A) OR PREMIUM
LONG-LIFE GREASE XG-1-C OR -K
(ESA-M1C75-B) OR EQUIVALENT



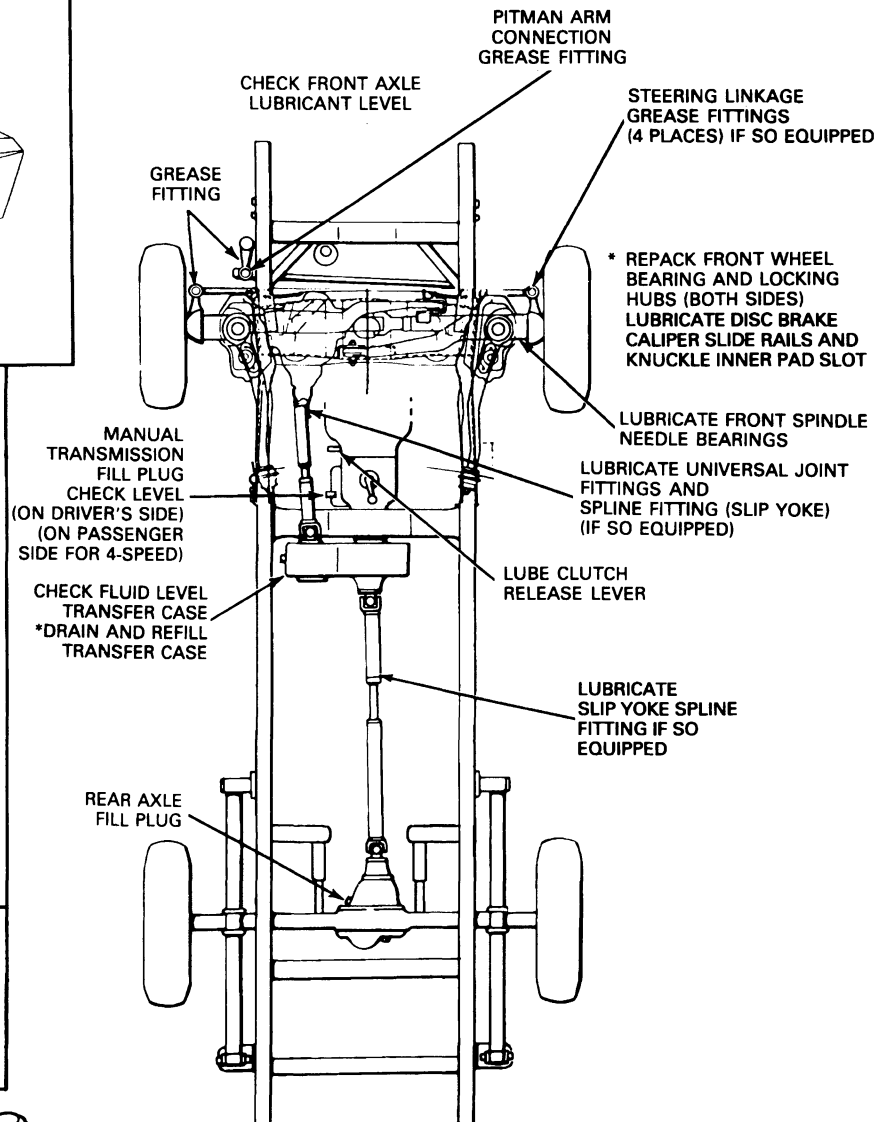
BALL STUD — LUBRICATE WITH
MULTI-PURPOSE GREASE
D7AZ-19584-AA OR
PREMIUM LONG-LIFE GREASE
XG-1-C (ESA-MIC75-B)
OR EQUIVALENT



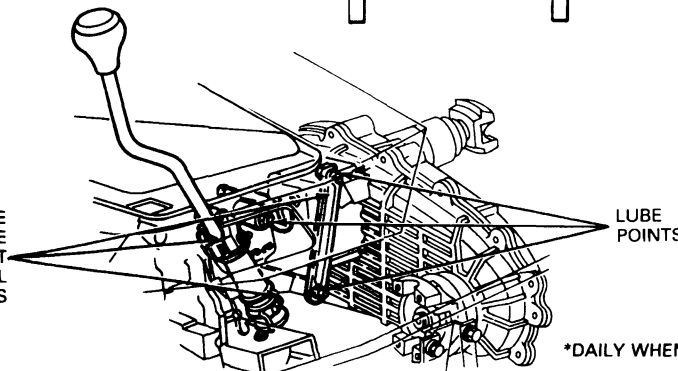
THROTTLE VALVE (TV)
CABLE LINKAGE 5.0L
MFI AOD TRANSMISSION ONLY
KICKDOWN CABLE LINKAGE
4.9L MFI AND 7.5L MFI
C-6 TRANSMISSION ONLY



TRANSMISSION
DIPSTICK
(AUTOMATIC)



*LUBRICATE
TRANSFER CASE
SHIFT LEVER PIVOT
BOLT AND CONTROL
ROD CONNECTING PINS



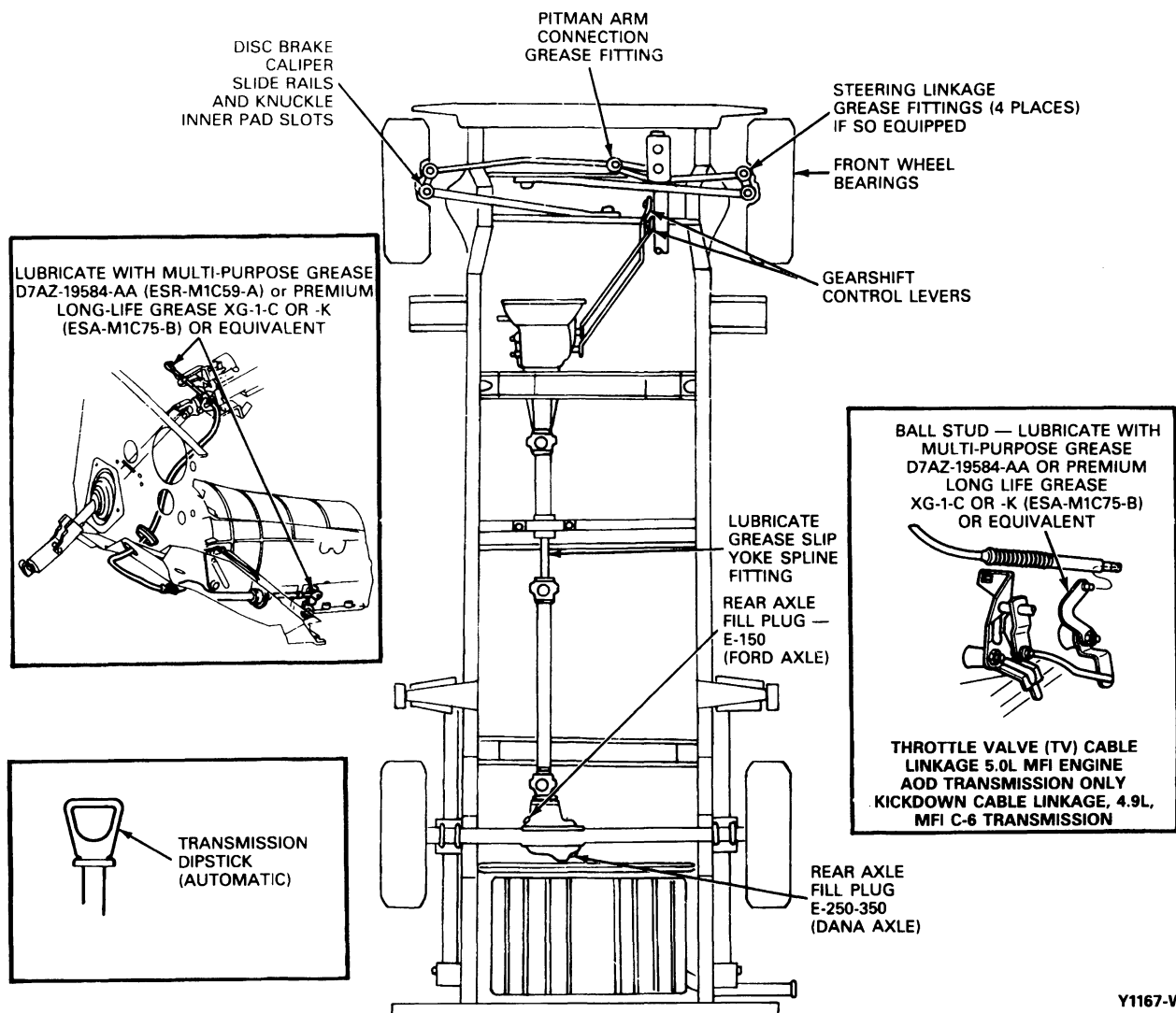
LUBE
POINTS

*DAILY WHEN OPERATING IN DEEP WATER

Y1031-Z

MAINTENANCE (Continued)

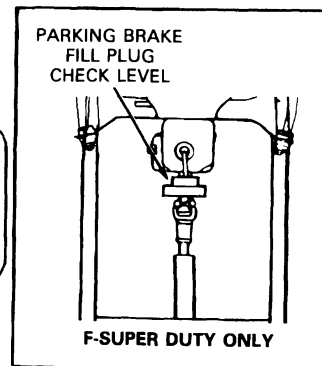
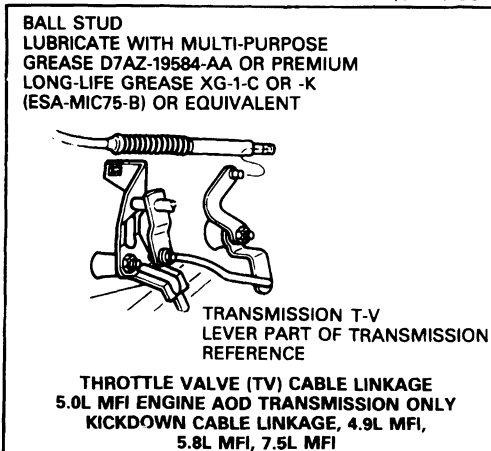
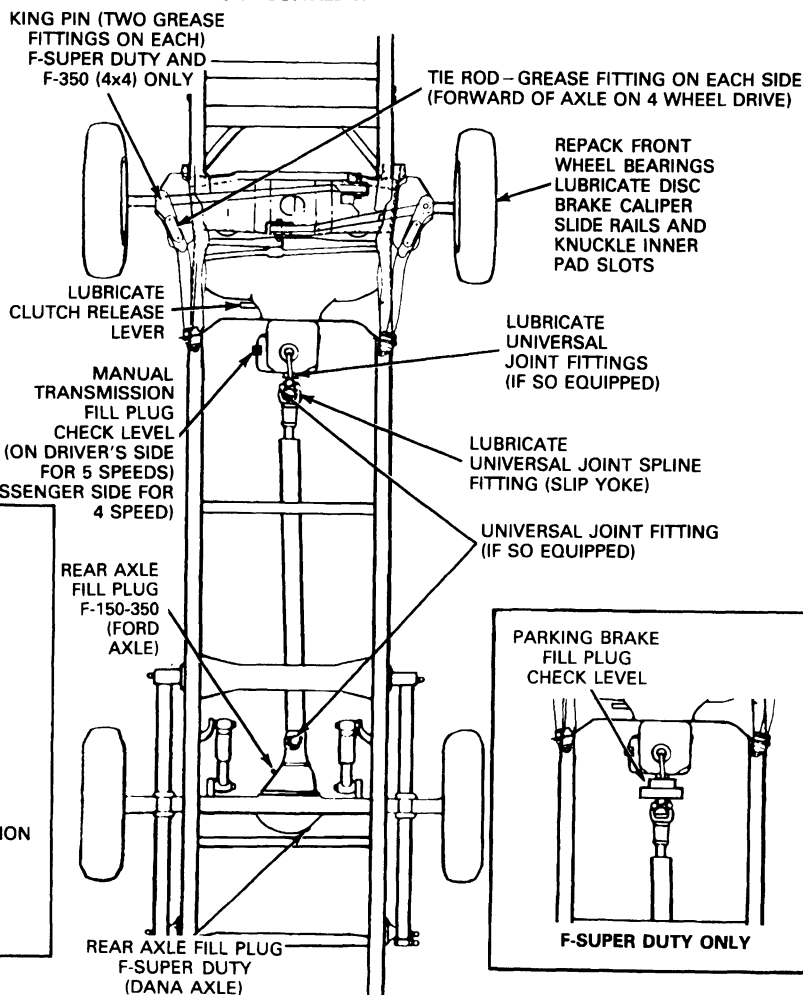
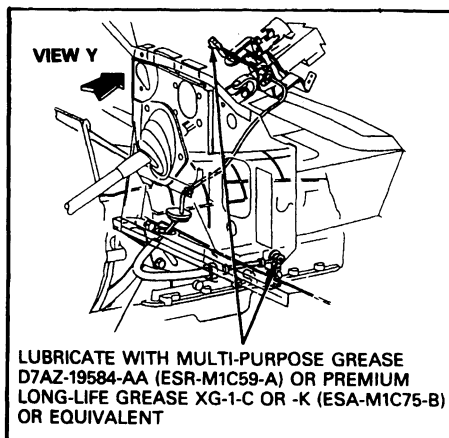
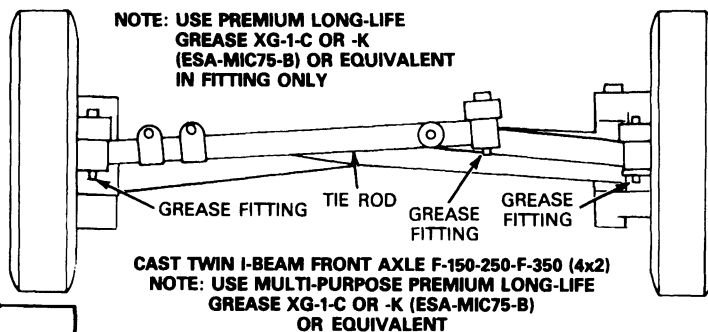
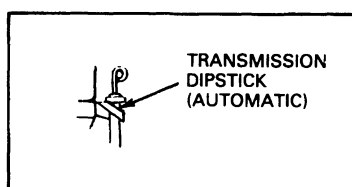
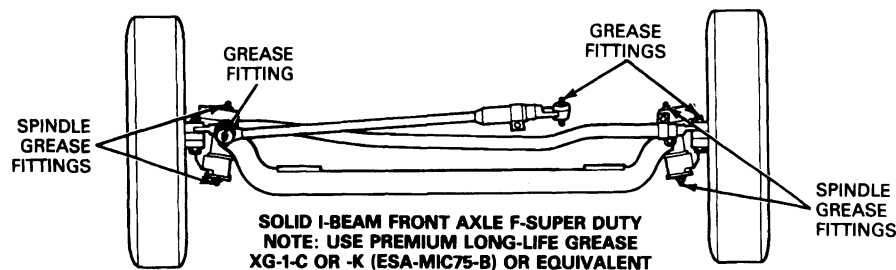
Lubrication Points, E-150-250-350 Typical Chassis



Y1167-W

MAINTENANCE (Continued)

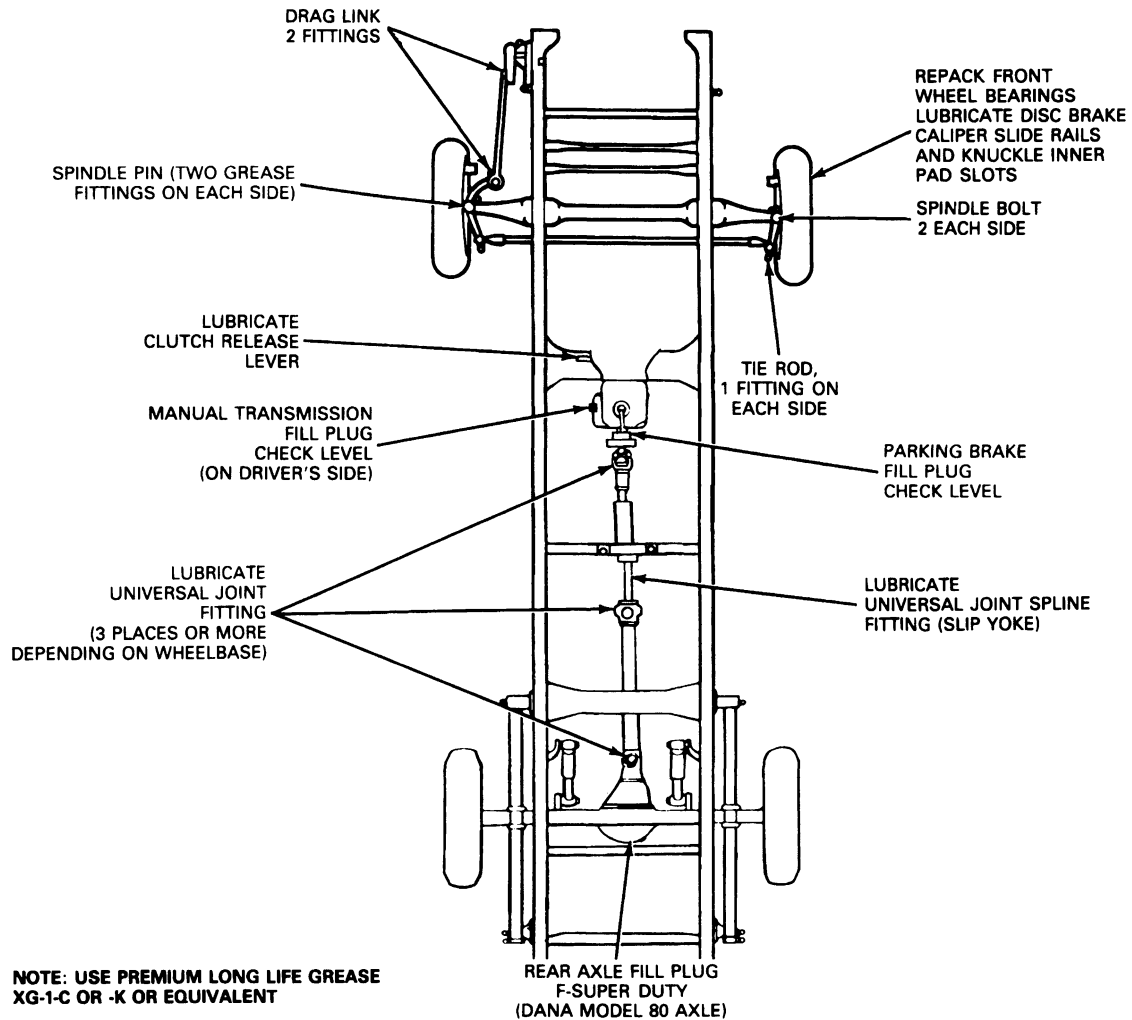
Lubrication Points, F-150-250-350 4x2 and F-Super Duty Chassis



Y1026-R

MAINTENANCE (Continued)

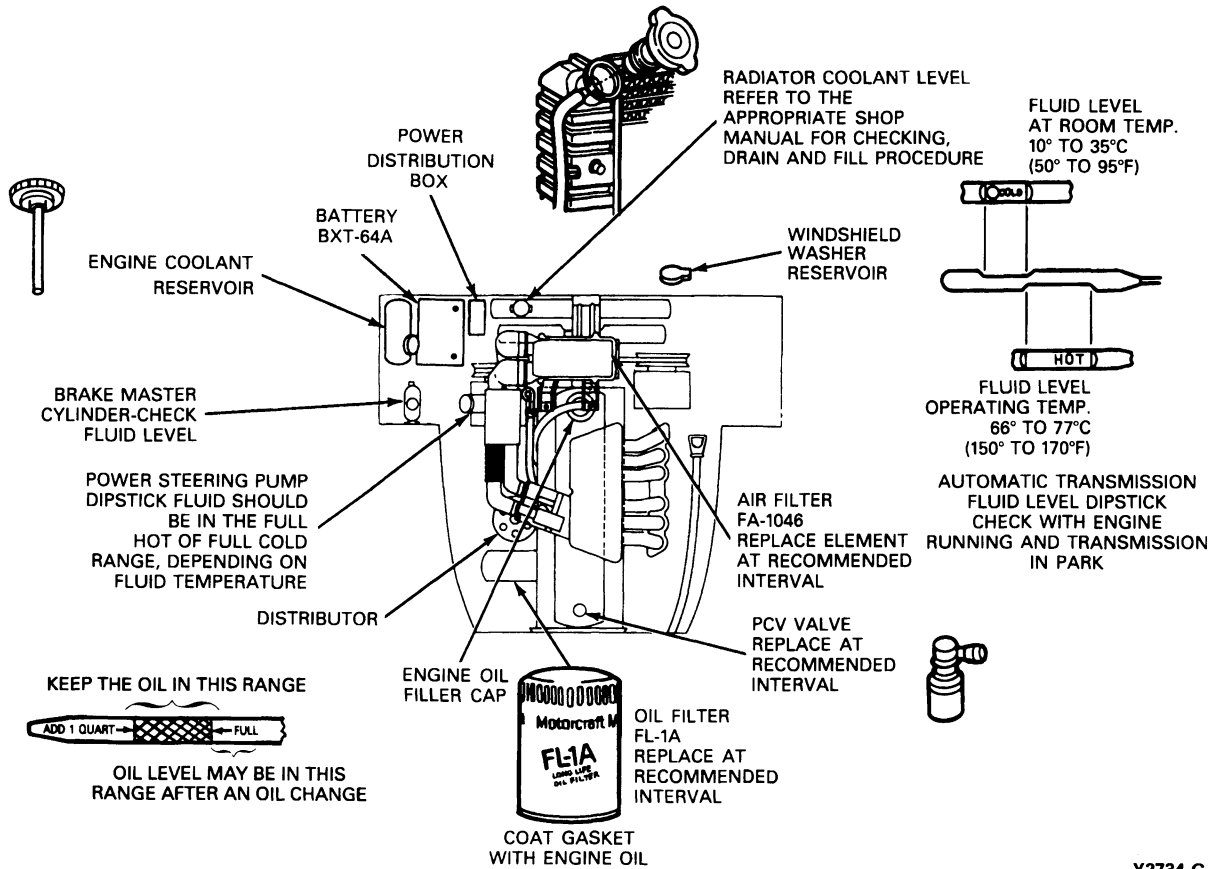
Lubrication Points, F-Super Duty Commercial and Motorhome Chassis



Y4153-F

MAINTENANCE (Continued)

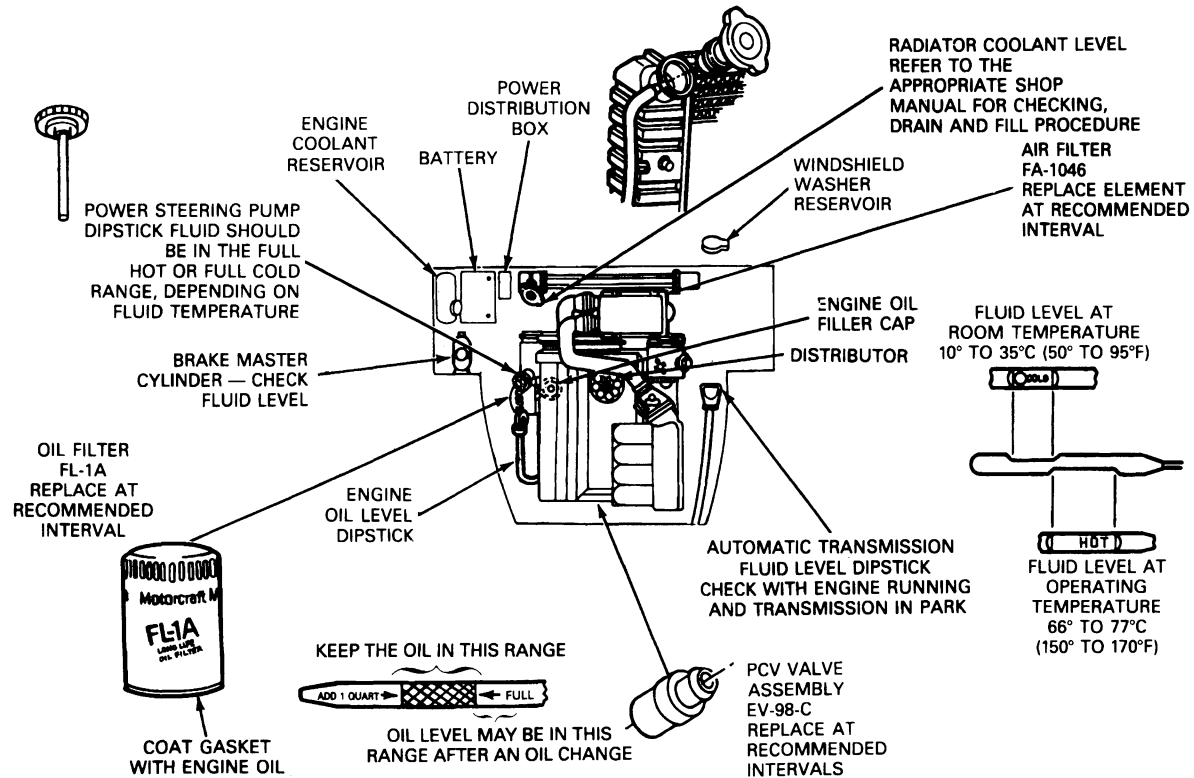
Service Points, 4.9L Engine, Econoline



Y2734-G

MAINTENANCE (Continued)

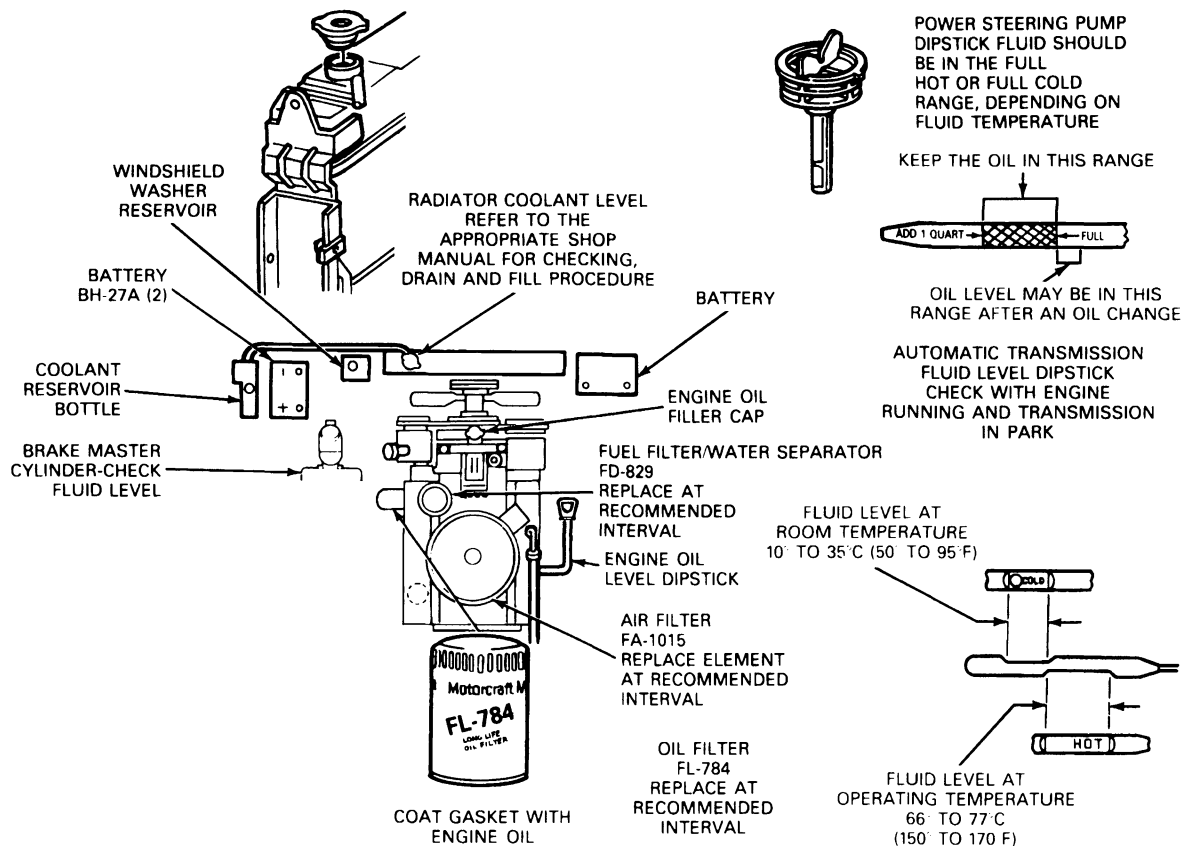
Service Points, 5.0L and 5.8L Engine, Econoline



Y2735-H

MAINTENANCE (Continued)

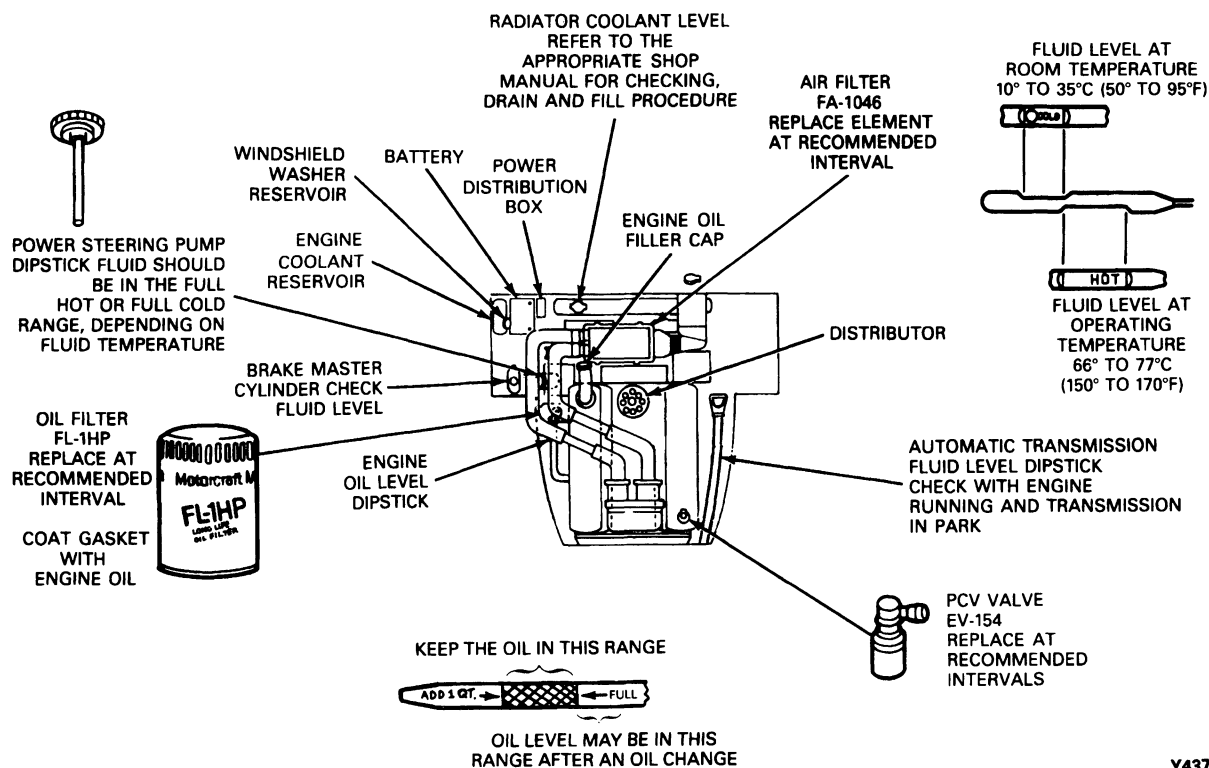
Service Points, 7.3L Diesel Engine, Econoline



Y2736-H

MAINTENANCE (Continued)

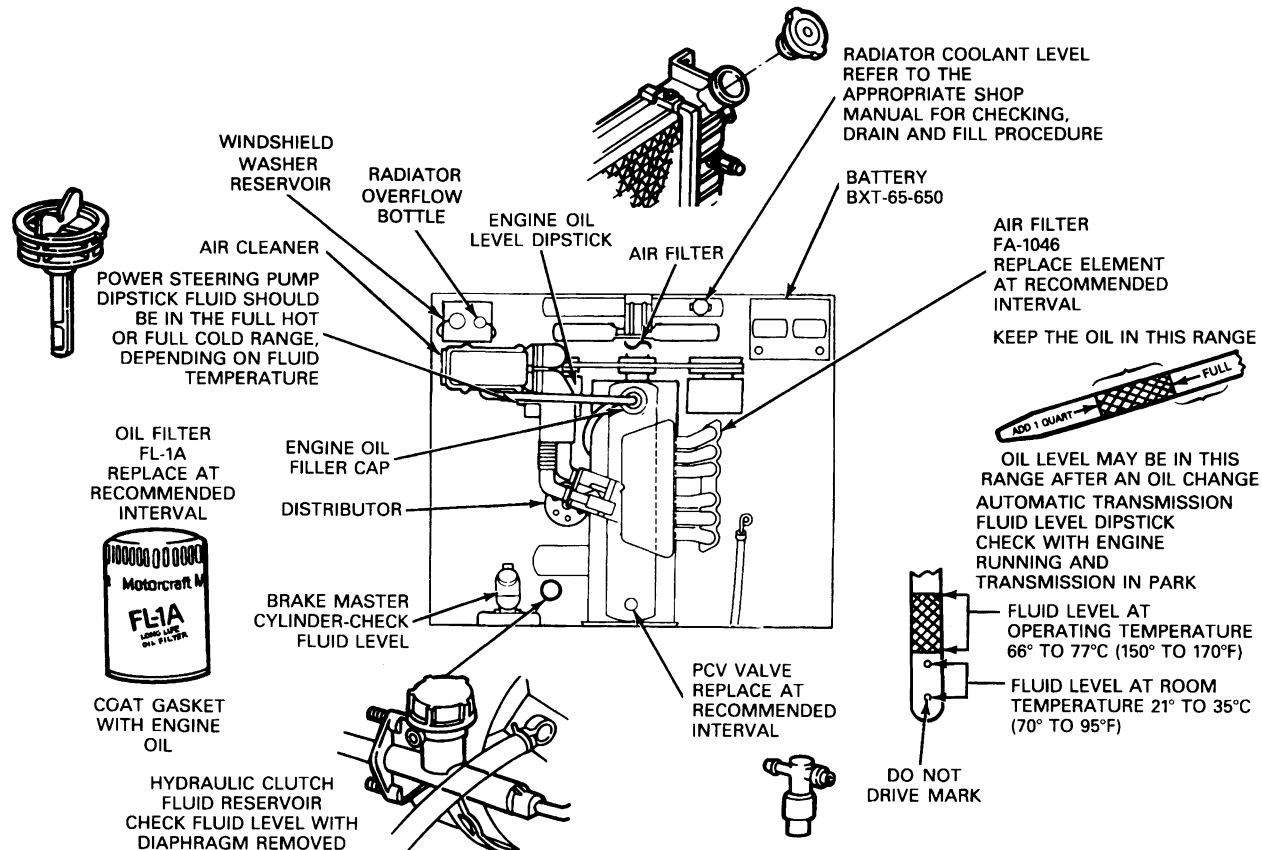
Service Points, 7.5L Engine, Econoline



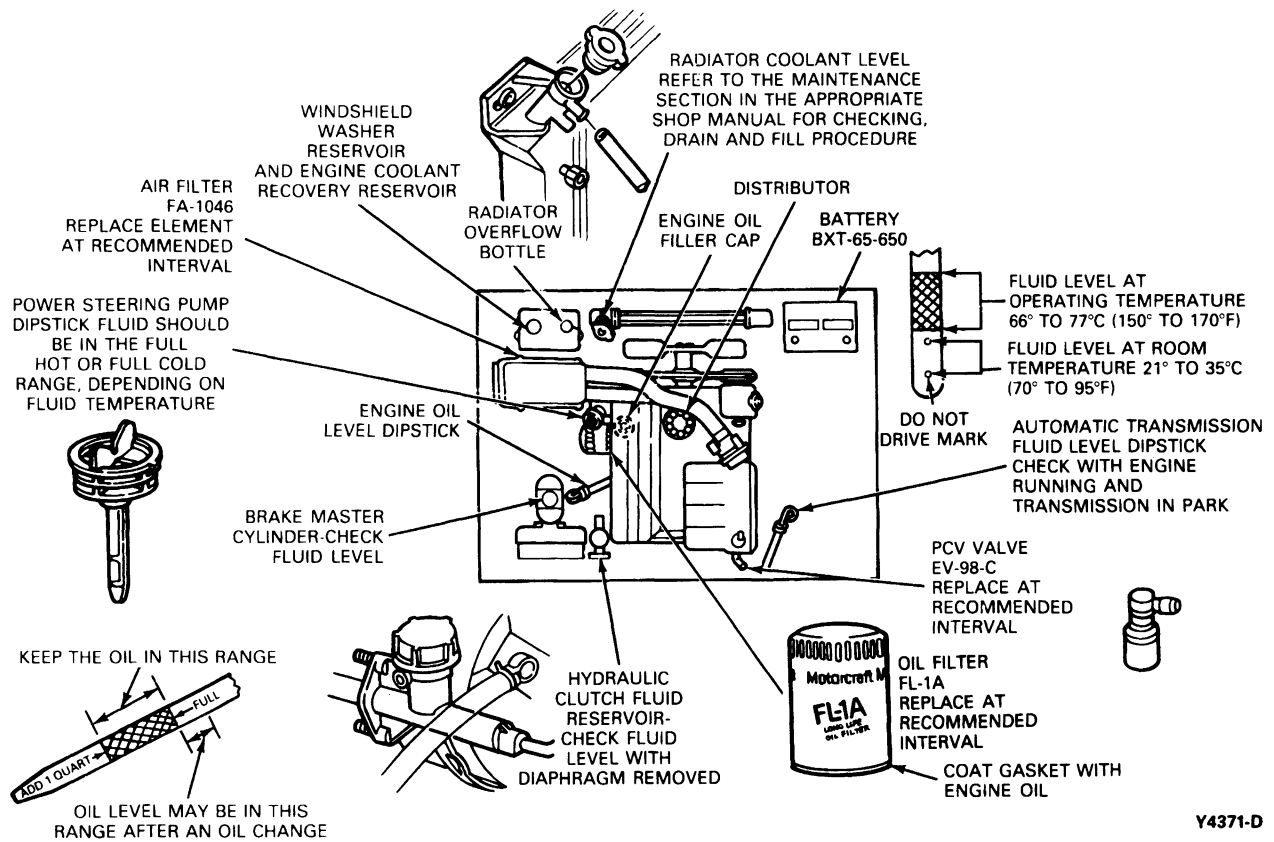
Y4370-D

MAINTENANCE (Continued)

Service Points, 4.9L Engine, F-Series



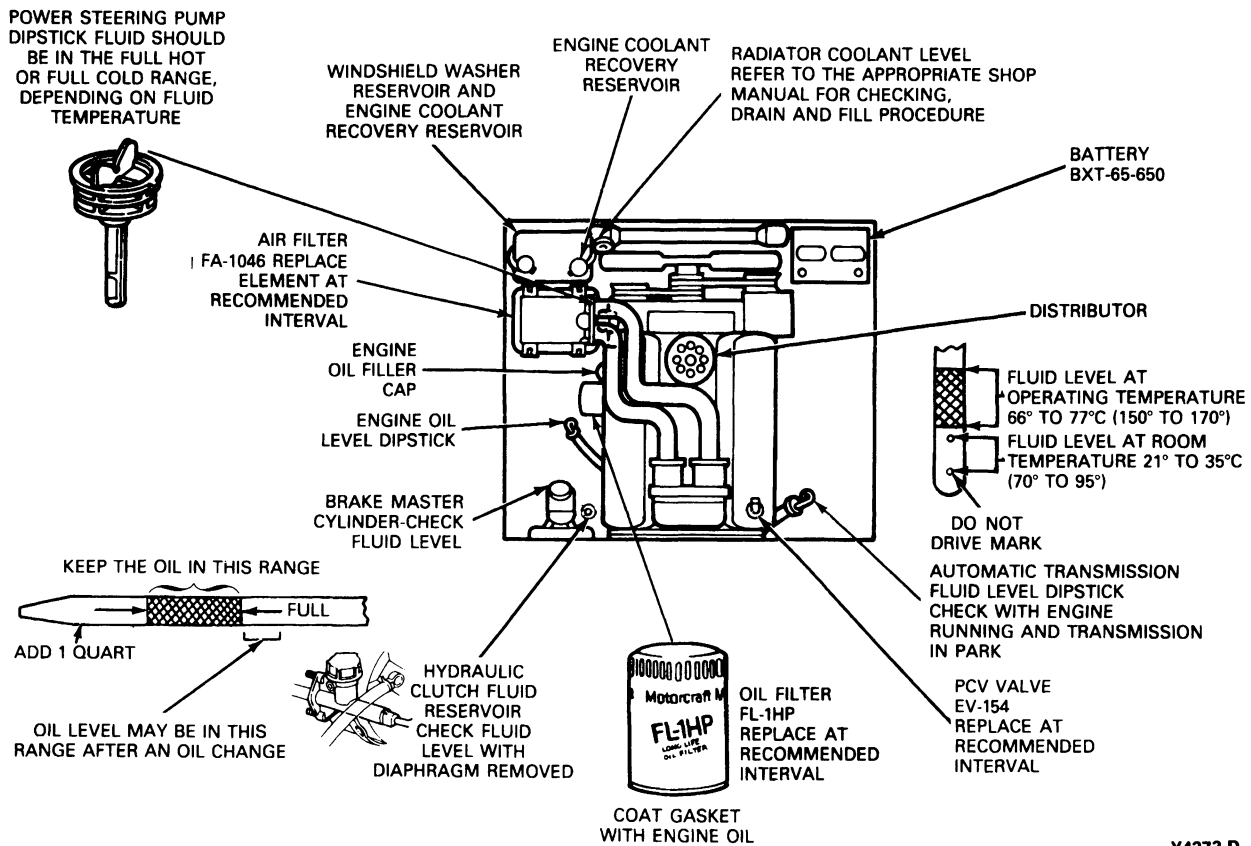
Y2737-H

MAINTENANCE (Continued)**Service Points, 5.0L and 5.8L Engine, F-Series and Bronco (5.8 Lightning, Similar)**

Y4371-D

MAINTENANCE (Continued)

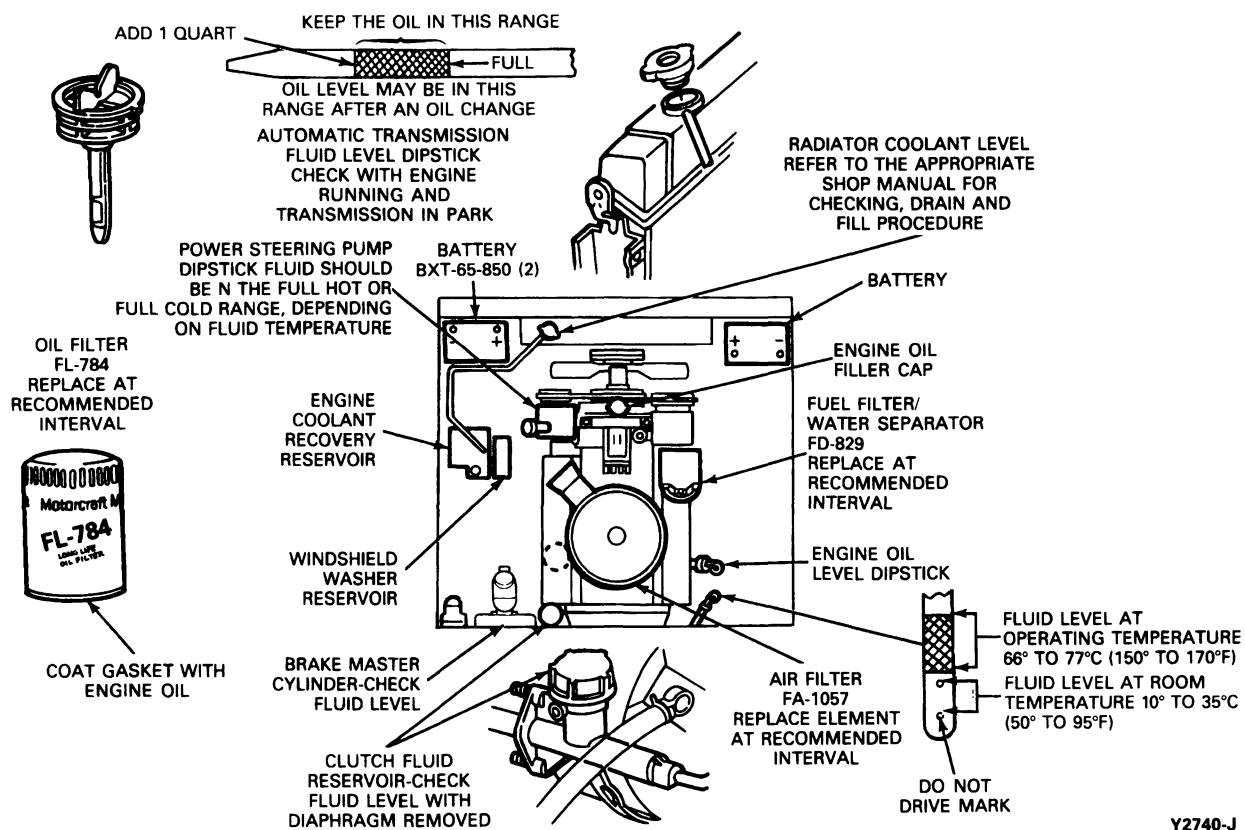
Service Points, 7.5L Engine, F-Series



Y4372-D

MAINTENANCE (Continued)

Service Points, 7.3L Diesel Engine, F-Series



Y2740-J

SPECIFICATIONS

Refer to the following charts for lubricant specifications.

LUBRICANT SPECIFICATIONS – E-150-250-350, F-150-250-350, F-SUPER DUTY AND BRONCO

Item	Ford Part Name	Ford Part Number	Ford Specification
Windshield Washer Reservoir	Ultra-Clear Windshield Washer Solvent	C9AZ-19550-AA or BA	ESR-M17P5-A
Body Hinges, Latches, Door Striker Plates and Rotor, Seat Tracks, Door Tracks and Checks, Hood Latch and Auxiliary Latch, Spare Tire Carrier Latch	Multi-Purpose Grease	D7AZ-19584-AA	ESR-M1C159-A
Lock Cylinders, Outside Spare Tire Lock	Lock Lubricant	D8AZ-19587-AA	ESB-M2C20-A
Front Axle Spindle Pins, Front and Rear Spring Shackles, Steering Column U-Joints, Clutch Linkage Fittings, Universal Joints, Joints with Zerk Fittings, and Slip Yoke Pivots, Parking Brake Linkage Pivots and Clevises, Transmission Control Linkage Pivots	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Front Wheel Bearings and Rear Wheel Bearings Brake and Clutch Pedal Shaft	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
4x4 Front Drive Axle, U-Joints, Wheel Bearings and Spindle Needle Bearings	High Temperature 4x4 Front Axle and Wheel Bearing Grease	E8TZ-19590-A	ESA-M1C198-A
Power Steering Reservoir	Premium Power Steering Fluid	E6AZ-19582-AA	ESW-M2C33-F
Clutch Release Lever at Pivots	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Engine Oil – All Gasoline Engines	Motorcraft Motor Oil 5W30 and 10W30 Super Premium	XO-5W30-QSP XO-10W30-QSP	ESE-M2C153-E and API SG/CC, SG/CD or SG/CC
Engine Oil – Diesel ⁽²⁾ (Consult respective engine owners guide for recommendations)	Motorcraft Motor Oil 15W40 Super Duty SAE-30 Super Duty	XO-15W40-QSD XO-30-QSD	API SG/CE or SG/CD and ESE-M2C153-E
Engine Oil Filter – Diesel (7.3L)	Oil Filter	E3TZ-6731-A (FL-784)	–
Engine Oil Filter – Gasoline, 4.9, 5.0, 5.8L	Motorcraft Long-Life Oil Filter	D9AZ-6731-A (FL-1A)	ES-E1ZE-6714-AA
Engine Oil Filter – Gasoline, 7.5L		7.5L – E7TZ-6731-A (FL-1HP)	
C6, E4OD and AOD Automatic Transmission	Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid	XT-2-QDX or DDX E4AZ-19582-B	MERCON® ESP-M2C166-H
Accelerator Control Kickdown (Automatic 6 Cyl.)	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Speedometer, Parking Brake Cable	Speedometer Cable Lubricant	E6TZ-19581-A	ESF-M1C60-A
Steering Linkage – Lubricate only where equipped with grease fittings	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Accelerator Linkage – Ball Socket	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Ford Axles (Conventional and Limited-Slip) ⁽³⁾⁽⁵⁾	Premium Rear Axle Lubricant	XY-90-QL	ESP-M2C154-A
Transfer Case – Four-Wheel Drive	Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid	XT-2-QDX or DDX E4AZ-19582-B	MERCON® ESP-M2C166-H
Transfer Case Shift Lever Pivot Bolt and Control Rod Connecting Pins	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Rear Dana Axles and Dana Limited Slip Rear Axles ⁽¹⁾	Premium Rear Axle Lubricant	C6AZ-19580-E	ESW-M2C105-A
Front Dana Axles 44 and 55	4x4 Gear Oil	F1TZ-19580-A	WSL-M2C191-A
Service Fill for Severe Use Dana Econoline and F-Super Duty Rear Axles	75W-140 Synthetic Rear Axle Lube	F1TZ-19580-B	WSL-M2C192-A
4-Speed Manual Transmission – Warner T18 ⁽⁴⁾	MERCON®	XT-2-QDX	MERCON®
Release Bearing for Clutches with Concentric Slave Cylinders	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Release Bearing for Conventional Systems	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
5-Speed Manual Overdrive Transmission – Mazda	Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid	XT-2-QDX or DDX E4AZ-19582-B	MERCON® ESP-M2C166-H

⁽¹⁾ Add 4 oz. of Friction Modifier C8AZ-19B546-A (EST-M2C118-A or equivalent) to refill Dana limited slip axles.

⁽²⁾ For arctic winter operation below –25°C (–10°F) but not above –7°C (20°F), use engine oil SAE 5W-30 SG/CD or SG/CE.

⁽³⁾ For Ford design rear axles: Add 4 oz. of Friction Modifier C8AZ-19B546-A (EST-M2C118-A) for complete refill of 8.8 inch ring gear limited slip rear axles. For F-250, F-350 with 10.25 inch ring gear limited slip rear axles add 8 oz. of Friction Modifier C8AZ-19B546-A (EST-M2C118-A).

⁽⁴⁾ Requires 6.5 pints.

⁽⁵⁾ Synthetic High Performance Rear Axle Lubricant F1TZ-19580-B (WSL-M2C192-A) may be substituted but only after axle assembly is completely drained.

CY4689-C

SPECIFICATIONS (Continued)

LUBRICANT SPECIFICATIONS – E-150-250-350, F-150-250-350, F-SUPER DUTY AND BRONCO (Cont'd.)

Item	Ford Part Name	Ford Part Number	Ford Specification
5-Speed Manual Overdrive Transmission ZF(S5-42)①	Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid	XT-2-QDX or DDX E4AZ-19582-B	MERCON® ESP-M2C166-H
Automatic Transmission Shift Linkage (F-Super Duty)	Multi-Purpose Grease	D7AZ-19584-AA	ESR-M1C159-A
Transmission Throttle Valve (TV) Lever – AOD Only Transmission Kickdown Lever C6 (MFI Engines)	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Disc Brake, Caliper Slide Rails and Knuckle Inner and Outer Pad Slots	Disc Brake Caliper Slide Grease	D7AZ-19590-A	ESA-M1C172-A
F-Super Duty Parking Brake	Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid	XT-2-QDX or DDX E4AZ-19582-B	MERCON® ESP-M2C166-H
Hydraulic Brake Master Cylinder – Hydraulic Clutch Master Cylinder②	Heavy-Duty Brake Fluid	C6AZ-19542-AA or BA	ESA-M6C25-A
Brake and Clutch Pedal Pivots and Clevises	Engine Oil SAE-10W	–	ESE-M2C153-E API-SG
Manual Locking Hubs On 4x4	Steering Gear Grease	C3AZ-19578-A	ESW-M1C87-A
Driveshaft, Slip Yoke and Spring Stud Shackles Except Stripped Chassis and Motorhome Chassis	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Driveshaft, Universal Joints and Slip Yoke F-Super Duty Stripped Chassis and Motorhome Chassis	High Temperature Grease NLGI, No. 2	–	ESL-M1C173-A
Exhaust Control Valve	Rust Penetrant and Inhibitor	D7AZ-19A501-AA	ESR-M99C56-A
Engine Coolant	Premium Cooling System Fluid	E2FZ-19549-AA	ESE-M97B44-A
Door Weatherstrips	Silicone Lubricant Jell	C0AZ-19553-AA	ESR-M13P4-A
Driveshaft, Slip Yoke, Double Cardan Joint Center Ball	Premium Long-Life Grease	XG-1-C	ESA-M1C75-B
Automatic Locking Hubs – 4x4	Automatic Hublock Grease	E1TZ-19590-A	ESL-M1C193-A

① Synthetic MERCON (E6AZ-19582-B) should be considered when operating under the following extreme conditions:

- Extensive idle time with transmission temperatures below –20°F (–29°C).
- Operating at maximum GCW (F-Super Duty) in hilly terrain with temperatures above 100°F (38°C).
- Continuous (30 minutes) PTO operations.

② As the clutch disc wears, the fluid level in the reservoir will rise. Fluid level above the “step” is an indication of disc wear, NOT overfill.

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SECTION 00-04 Noise, Vibration and Harshness Diagnosis

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS AND SERVICE		DIAGNOSIS AND TESTING	
Brake Drum Balancing	00-04-23	Brake Squeal, Vibration	00-04-22
Crossmember Noise	00-04-25	Diagnosis	00-04-4
Distorted Wheels, 16x6 Inch Single Steel Wheel.....	00-04-24	Diagnosis Guides.....	00-04-8
Driveshaft Balancing	00-04-24	Road Test Diagnostic Guidelines.....	00-04-2
Match Mounting Tires.....	00-04-24	Testing	00-04-12
DESCRIPTION		GLOSSARY OF TERMS	00-04-25
Harshness	00-04-2	SPECIAL SERVICE TOOLS/EQUIPMENT	00-04-27
Noise.....	00-04-1	SPECIFICATIONS	00-04-27
Noise Acceptability.....	00-04-1	VEHICLE APPLICATION	00-04-1
Vibration	00-04-2		

VEHICLE APPLICATION

Bronco, E-150-250-350, F-150-250-350 (4x2 / 4x4)
and F-Super Duty Vehicles

DESCRIPTION

Noise

Noise, defined as any unpleasant sound, may be described in a variety of ways such as tapping, chirping, squealing, whistling, buzzing, humming, clunking or booming. You can associate these various descriptions of noise with a probable cause. Based on experience, these descriptions will assist in isolating the condition and correcting it. Generally recognizable concern areas are engine, drivetrain, wind and road surface noises. Other less obvious areas that should be considered as noise concern sources are any of the conditions that cause the vibrations described in this section.

Noise Acceptability

A gear driven mechanism, especially a drive axle, will produce a certain amount of noise. Some noise is acceptable and may be audible at certain speeds or under various driving conditions: for example, tire noise on a newly paved blacktop road. Such noise is in no way detrimental to the operation of the vehicle and must be considered normal.

Also, Traction-Lok or Limited-Slip axles may produce a slight chatter on slow turns after extended highway driving, which is normal.

DESCRIPTION (Continued)

Noise from the transfer case in four-wheel drive may be the result of transfer case chain noise. This noise may take the form of a high or low frequency whine or growl and is normal in four-wheel drive vehicles. The noise is most pronounced when driving on hard surfaced roads in four-wheel drive and is due to driveline binding between the front and rear axles causing the chain to contact the front or rear of the sprocket teeth depending on whether the vehicle is accelerating or coasting. In addition, this noise may be present in two-wheel drive with the manual hubs in the LOCK position or with the automatic locking hubs engaged, but to a lesser degree. To improve this noise, rotate the tires per the frequency and method directed by the owner guide, adjust the individual tire pressure as specified on the safety compliance certification label and confirm that the front-to-rear axle ratio difference is not greater than 0.01.

NOTE: It is important that the rear axle noise on vehicles equipped with either a manual or automatic overdrive transmission be evaluated in both direct drive and overdrive.

- Tire roughness due to high non-uniformity (force variation).
- Driveline slip-yoke U-joints, automatic transmission clutch slippage.

Typical High-Speed Vibrations (Above 72 km/h [45 mph])

- Companion flange (end yoke) runout or imbalance.
- Driveshaft imbalance.
- Excessive tire-wheel and drum assembly imbalance.
- Rear axle pinion gear pitch line runout.
- Excessive tire and wheel runout.
- Worn suspension components.
- Front end accessory vibrations.
- Exhaust vibration.

Vibration

Vibration, technically, is a high-frequency trembling, shaking or grounding condition, felt or heard, that is constant or variable in intensity and occurs during a portion of the total operating speed range. The types of vibrations that can be felt in the vehicle can be divided into three groups:

1. Vibrations of various unbalanced rotating parts of the vehicle.
2. Body and frame vibrations excited by powertrain, wind or road inputs.
3. Tip-in moans or resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

These vehicle vibrations can also be subdivided into those that occur at low speeds and those that are most noticeable at higher speeds. Since the dividing line between low and higher speed vibrations is not clear, there will be vibrations that overlap the two ranges.

Typical Low-Speed Vibrations (Less than 72 km/h [45 mph])

- Driveline vibrations due to driveline angles.
- Engine harshness.
- Power steering pump disturbances.
- Air conditioner compressor or drive belt vibrations.
- Take-off shudder (clutch or driveline problems).
- Brake roughness or harshness.
- Driveline roughness.
- Clutch torsion vibration.
- Manual transmission gear rattle.
- Exhaust vibration.

Harshness

Harshness is the term commonly used to describe the ride quality of the vehicle. Hard ride or harshness is usually caused by the tires or suspension system, namely:

- Over-inflated, wrong size or wrong type tire or wheel installed on the vehicle.
- Worn suspension components.
- Suspension components installed with preload on pivot points, bearings and bushings.
- Units equipped with tires not specified by the manufacturer. (Different brand tires often give different ride qualities to vehicle.)
- Bent or bound-up shock absorbers.
- Heavy-duty components installed on vehicle.
- Improper installation of body or cab mounts (groundings).

Other vehicle ride motions may be summarized as follows:

- Vehicle bounce — the vertical motion of a vehicle on its suspension system, front and rear in phase. A low frequency "float," an intermediate frequency "kick."
- Vehicle pitch — the out-of-phase vertical motion of the front and rear of the vehicle. A flat ride would be considered the opposite of a pitch ride.
- Vehicle roll — the side-to-side rotation of the vehicle body about the front and rear axles.

DIAGNOSIS AND TESTING

Road Test Diagnostic Guidelines

Noise, vibration, and harshness (NVH) usually occurs in four areas: tires, engine accessories, suspension and driveline.

DIAGNOSIS AND TESTING (Continued)

It is important, therefore, that an NVH condition be isolated into its specific area as soon as possible. The easiest and quickest way is to perform a thorough road test if a visual inspection does not readily pinpoint the condition. After performing the road test, isolate the probable cause of the condition using the Road Test Diagnosis Chart. Use the appropriate diagnostic procedure chart and/or guide to determine the area of investigation.

Some hints on performing a road test for the diagnosis of NVH complaints follow.

Neutral Engine Run-Up Test (NERU)

1. A very useful first step in the road test is a neutral engine run-up test (NERU). It identifies engine related vibrations and helps in sorting out vibrations that are found in the road test.
2. If the vehicle is equipped with a tachometer, it can be used. Otherwise, a tach should be connected. A tach is absolutely necessary in both the NERU test and the road test.
3. Locate the vehicle away from other vehicles and walls which may reflect sound differently than a road reflects sound.
4. Put the vehicle in neutral (an automatic transmission may be tested in Park) and do not set the parking brake or press on the service brake since these are not engaged in a road test. Pressing on the service brake puts forces into the brake and clutch pedal support and into the instrument panel that are not present in driving. A similar situation arises with the parking brake.
5. Run the engine up slowly from idle to approximately 3500 rpm and note any moans, vibrations, noises, etc., and the rpm at which they occur. Sometimes it is possible to "tune in" on these by running up and down in rpm and to determine a precise rpm at which they occur; in other cases they will fall over a broad range of rpm. This establishes a baseline against which driving vibrations can be measured.
6. If you suspect that the exhaust system is vibrating, hang a ring of keys or something similar from the tailpipe and listen for the rattling of the keys as the engine is run up and down. Sometimes it is very clear with just this simple test that the exhaust system is responsible.
NOTE: Some exhaust systems contain flexible couplings and may not require evaluation unless the exhaust system is damaged.
7. If you suspect the air conditioning system or drive belt, turn on the air conditioning system before performing the NERU test. If a noise occurs at a specific rpm, turn the air conditioning system off and on to see if the noise is connected to the air conditioning compressor or lines.

8. When conducting the road test, refer to the results of the NERU test to sort out vibrations and noises caused by the engine from those caused by the transmission, driveshaft or axle. If a vibration or noise occurs at a particular road speed, try operating in another gear at the same speed. Changing the engine rpm helps to sort out engine induced vibrations and noises. If the noise occurs at a particular rpm, use different gears to test at the same rpm at different road speeds. Turn the air conditioning system off and on at road speeds where noise occurs to isolate air conditioning compressor or hose problems.

The NERU test takes only a minute or two and represents time well spent in testing.

Drive Engine Run-Up Test (DERU)

If the vehicle has an automatic transmission, a drive engine run-up test (DERU) can be conducted.

1. Both the parking brake and service brake should be set and care should be taken to perform the test with enough space ahead of the vehicle to eliminate the possibility of an accident should the vehicle unintentionally lurch forward.
2. Put the transmission in drive and run the engine up and down between idle and approximately 2000 rpm and note the nature of any vibrations and noises and the rpm. This test is particularly good for exciting the exhaust system, and hanging keys on the tailpipe to serve as a "telltale" is useful.

CAUTION: Do not conduct this test for over 30 seconds, or without periodic driving or shifting to neutral to circulate transmission lubricant; otherwise the transmission will overheat causing severe damage to the automatic transmission.

Road Conditions

The road is an important factor in the road test and a smooth asphalt road that allows driving over a range of speeds is best. The brushed concrete road surface found on many expressways and the coarse aggregate sometimes found in concrete can mask many vehicle noises and make diagnosis difficult.

If the customer complains of a noise or vibration on a particular road and only on a particular road, the source of the problem may be the road surface. If possible, try to test on the same type of surface. In this case, a smooth asphalt road may not be the best.

Vehicle Preparation

1. Check and verify if vehicle is equipped with original equipment (O.E.), type, size and brand wheels and tires. If non-original equipment (O.E.) wheels and or tires are installed, it may be necessary to substitute original equipment (O.E.) level tire / wheel assemblies for diagnosis.
2. Check and set tire pressure.
3. Unlock the front hubs and back up approximately 20 feet to make sure of hub disengagement if the vehicle is a 4x4.

DIAGNOSIS AND TESTING (Continued)

4. Remove any externally mounted accessories such as luggage racks, or magnetic base antenna, etc., which may cause wind noise that interferes with NVH diagnosis.
5. A tachometer should be used as noted above.
6. Note the fuel level. Some vehicles change in their response to various excitations when the fuel level changes. If the customer mentions that the problem does not occur all the time, this might be a factor.
7. Try to duplicate the conditions with the customer present, particularly the speed and throttle operation. It is not uncommon to find problems which the customer didn't notice so it is important to identify the problem causing the complaint.

When diagnosing driveline NVH complaints, the following procedure is useful.

1. Find the speed where the problem is most severe.
2. Turn the air conditioning system off and on to isolate air conditioning system impact on the noise. Accelerate gently through this speed to a few mph above it and then coast back down a few mph below it and note if the problem changes character when driving through or coasting down.
3. Repeat this procedure if necessary to get a feeling for the behavior. Then drive about five mph above the speed, put the transmission in neutral and coast down. Note any change in behavior.
4. Try "floating" the driveline by backing off ever so slightly on the throttle at the problem speed. The idea is to unload the axle gears and the universal joints as much as possible. This test is difficult to master and sometimes it helps to test on a slight downgrade so that gravity is counteracting the aerodynamic drag. The throttle should be operated in much the same way it is operated when shifting out of gear without using the clutch. In that case, the throttle is used to unload the transmission gears; here it is used to unload the driveline in general.

If the problem does not change in all these modes of operation, the cause may well be driveline imbalance since the imbalance is not changed by the throttle position.

If there is a distinct change in the character or intensity between the drive and coast modes of operation, the problem is most likely not imbalance but is most likely due to the axle or the universal joints since they are sensitive to the load on the driveline. (The axle pinion gear teeth are machined on two separate machines. One machine does the drive side of the teeth, another does the coast side. Hence there can be a great difference in performance between driving and coasting in gear.) If the noise and/or vibration goes away when the driveline is "floated" or when coasting through the speed in neutral, the diagnosis is strengthened. Driveline imbalance does not go away in a neutral coast, but axle and joint problems may.

To become familiar with the symptoms of imbalance and to determine if driveline imbalance exists on the vehicle, intentionally imbalance the driveline. This can be done by installing three hose clamps with screw heads aligned on the rear of the driveshaft. Test drive the vehicle again. If the same vibration is still present but now intensified, the concern is driveline imbalance. If a new vibration is now present as a result of the intentional imbalance, the original condition would not be caused by driveline imbalance.

Hoist Test

After a road test, but only after a road test, it is sometimes useful to do a similar test on a hoist. (Use an axle hoist, not a frame hoist. An axle hoist will not change the driveline angles. If only a frame hoist is available, short axle stands should be used.)

1. Elevate the rear wheels slightly, check to make sure that both are turning, and run the engine up with the vehicle in gear.
2. Explore the speed range of interest using the drive/cruise/coast/float tests as described above.
3. A coast down in neutral should also be conducted. If the vehicle is free of vibration when operating at a steady indicated speed and behaves very differently in drive and coast, an axle concern is likely.

Note, however, that a test on the hoist may produce different vibrations and noises than a road test because of the effect of the hoist on the rear axle. It is not unusual to find vibrations on the hoist that were not found in the road test and many times these may be ignored. If the condition that was found on the road can be duplicated on the hoist, a great deal of time can be saved by doing experiments on the hoist.

NVH Tests and Operations

A gradual appearance of the condition indicates a deterioration of a component, such as tires, U-joints, an accessory drive belt, or a wheel bearing.

A sudden appearance of the condition could indicate a lost wheel balance weight or lost driveshaft balance weight.

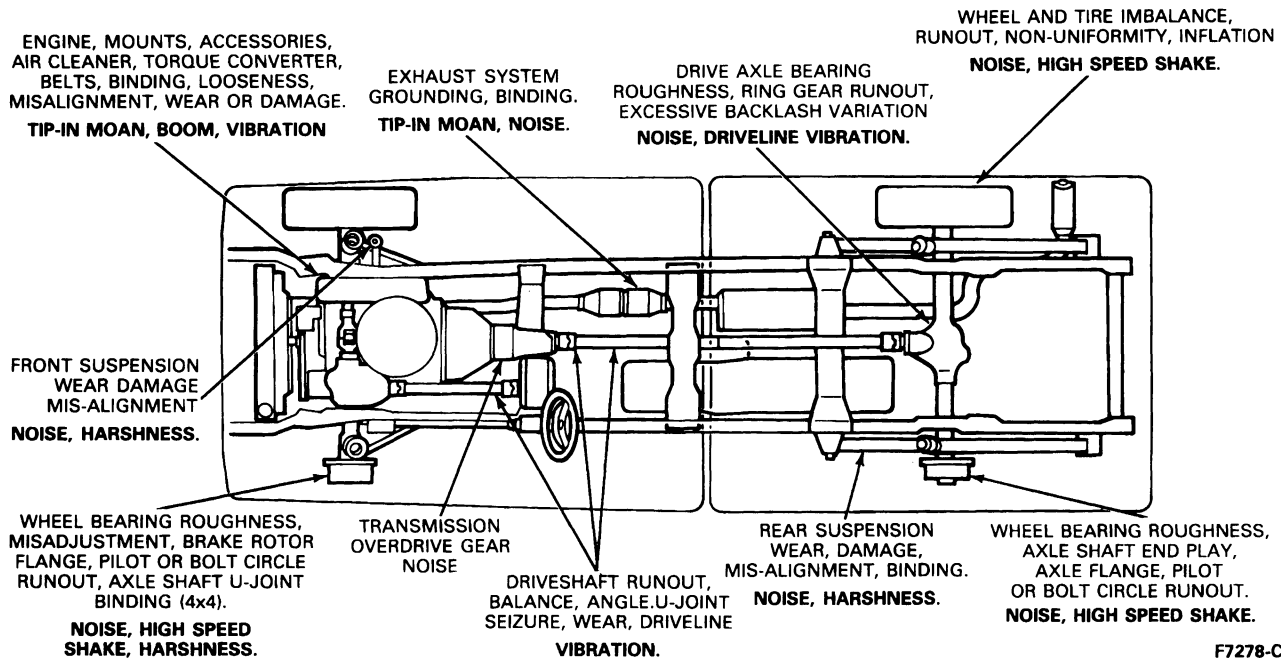
NOTE: Information gained from the concern description should never be used in place of facts gained from diagnosis, nor should it be used in an attempted short-cut fix. In the long run, time will be saved by adhering to the diagnostic procedures shown in this section.

Diagnosis

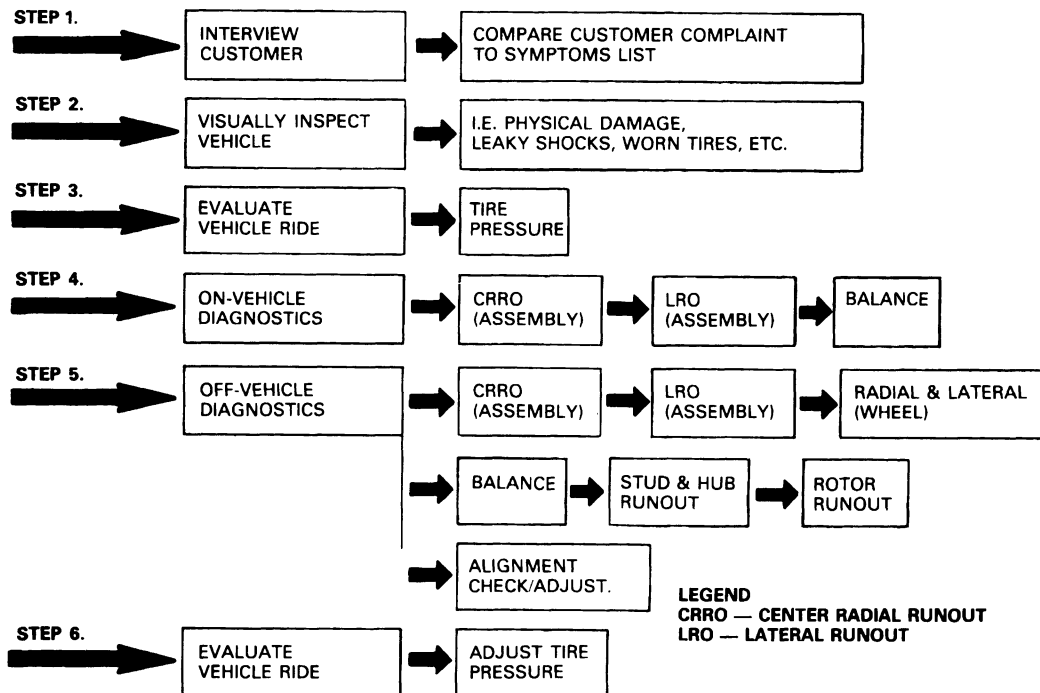
Use the following NVH Diagnostic Locator, road test form, charts and diagnosis guides to identify the Noise, Vibration or Harshness condition. When the condition is isolated, refer to the appropriate portion of Testing in this section.

DIAGNOSIS AND TESTING (Continued)

NVH Diagnostic Locator



DIAGNOSTIC PROCEDURES FOR TIRE/WHEEL RELATED VIBRATIONS



NOTE: EACH STEP HAS ITS OWN DIAGNOSTIC SHEETS.

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DIAGNOSIS AND TESTING (Continued)

NVH WORKSHEET

Dealer: _____ Date: _____
 P.A. Code: _____ Order No. _____ Technician: _____
 Owner's Name: _____ Address: _____
 Phone: H) _____ W) _____
 Vehicle Make: _____ Year: _____ Model: _____
 VIN: _____ Mileage: _____ Engine: _____ Trans: _____ Axle: _____

OWNER'S DESCRIPTION OF COMPLAINT:

Did Condition Exist When Vehicle Was New? Y / N

How Did Condition Begin? ☐ Gradually Mileage _____
☐ Suddenly Mileage _____

Which Driving Conditions Affect The Vehicle? ☐ Light to Medium Accel ☐ Heavy Accel ☐ Brakes Applied/Released?
☐ Decel (foot off acc. pedal) ☐ Const. Speed

Where Is The Vibration Noticed? ☐ Seat ☐ Steering Wheel ☐ Inst. Panel ☐ Floor ☐ Fenders

Is There A Sound Or Sensation Of Sound? Y / N

If Yes, Describe It: ☐ Boom ☐ Drone ☐ Hum ☐ Tip-In Moan ☐ Whining

Further Descriptions: _____

PRELIMINARY INSPECTION:

Tire Size: Front: _____ Tire Mfg: _____
 Rear: _____ Tire Mfg: _____

Tire Pressure: LF: _____ RF: _____ LR: _____ RR: _____

Tire Condition: LF: _____ RF: _____ LR: _____ RR: _____

Body Damage Evident? Y / N

If Yes, Where? _____

ROAD TEST:

Vibration Occurs At _____ to _____ MPH, at _____ RPM

Vibration Occurrence

☐ Vibration occurs in drive only/not neutral (not wheel-end related).

☐ Vibration occurs in both drive and neutral position.

Vibration is driveline related or wheel-end related.

NOTE: If vibration does not occur while in neutral coast, vibration is not caused by wheel/tire/rotor or brake drum.

Indicates: ☐ Tire/Wheel/Brakes ☐ Pinion Angle ☐ Driveshaft
☐ Tip-In Moan ☐ Engine/Acc. ☐ Other

If "Other", Specify: _____

WHEEL/TIRE/BRAKES CHECK:

Max. Runout Allowed Tire/Wheel _____" radial _____" lateral

Wheel Only: _____" radial _____" lateral

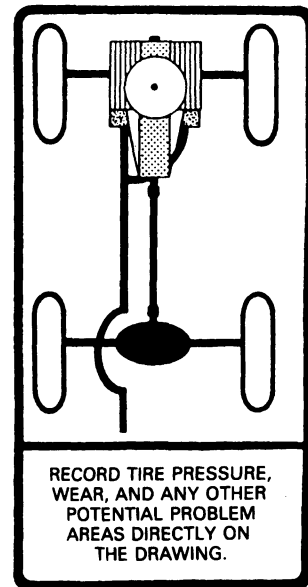
Runouts Measured:

	LF	RF	LR	RR
Tire and Wheel: Radial/	_____	_____	_____	_____
Lateral/	_____	_____	_____	_____
Wheel Only: Radial/	_____	_____	_____	_____
Lateral/	_____	_____	_____	_____

Brake Components: Runout OK? Y / N

ROAD TEST: Improved? Y / N Vehicle Acceptable? Y / N

COMMENTS: _____



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DIAGNOSIS AND TESTING (Continued)**DRIVESHAFT BALANCE:**

Maximum Runout Allowed: _____" Runouts Measured **Front** _____"
Middle _____" **Rear** _____"

Reindex Driveshaft? **Y/N** Balance Driveshaft? **Y/N**

Other Repairs Performed: _____

ROAD TEST: Improved? **Y/N** Vehicle Acceptable? **Y/N**

PINION ANGLE: **Spec** **Actual** **Repair Performed**

Ride Height: _____

Pinion Angle: _____

ROAD TEST: Improved? **Y/N** Vehicle Acceptable? **Y/N**

Neutral Run-up Test: Vibration Evident? **Y/N** If Yes: _____ To _____ RPM.

ENGINE ACCESSORY CHECK:

Visual Inspection/Comments: _____

Component Isolation:	Belt Removed	Result
	_____	_____
	_____	_____
	_____	_____
	_____	_____
A/C Compressor:	Turn ON/OFF	_____
A/C Lines:	Check for Ground-outs	_____
	_____	_____

Other Repairs Performed: _____

ROAD TEST: Improved? **Y/N** Vehicle Acceptable? **Y/N**

TIP-IN-MOAN CHECK:

Check Performed	Result
Air Intake	_____
Neutralize Exhaust	_____
A/C System	_____
Neutralize Converter	_____
Neutralize Mounts	_____
Other	_____

ROAD TEST: Improved? **Y/N** Vehicle Acceptable? **Y/N**

COMMENTS: _____

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DIAGNOSIS AND TESTING (Continued)**Diagnosis Guides****ROAD TEST DIAGNOSIS**

CONDITION	POSSIBLE SOURCE	ACTION
Visible shake in floor pan, seats, steering column and/or front end sheet metal at highway speed, 72 km/h (45 mph) and up. NOTE: If vibration disappears while in neutral coast, then vibration is NOT caused by wheel-end components.	<ul style="list-style-type: none"> Wheel/tire/axle/brake imbalance or run-out. 	<ul style="list-style-type: none"> Refer to High-Speed Shake.
Vibration felt or heard at highway speed, 72 km/h (45 mph) and up. Evident at steady speed, or under light acceleration or deceleration.	<ul style="list-style-type: none"> Driveline or drive axle imbalance or run-out. Engine mounts grounded. Exhaust system bound-up. 	<ul style="list-style-type: none"> Refer to Driveline Vibration. Refer to Tip-In Moan, Step #2. Refer to Tip-In Moan, Step #3.
Shudder or rumble on heavy acceleration or deceleration, 0-72 km/h (45 mph).	<ul style="list-style-type: none"> Incorrect driveline angle(s). 	<ul style="list-style-type: none"> Refer to Driveline Angles Check.
Moaning noise, and possible belt vibrations, on light acceleration or deceleration between 40 and 104 km/h (25-65 mph).	<ul style="list-style-type: none"> Engine or exhaust mounts bound up, powertrain components grounding, or undamped powertrain resonance or A/C compressor pulses. Misaligned center bearing on two-piece driveshaft. 	<ul style="list-style-type: none"> Refer to Tip-In Moan. Refer to Realign.
Engine-rpm-related vibration or noise that disappears in neutral-coast drive mode, and appears in standstill engine run-up at specific rpm.	<ul style="list-style-type: none"> Engine accessory drive or mount not properly adjusted or tightened, not running true, or accessory malfunction. 	<ul style="list-style-type: none"> Refer to Engine Accessory Vibration.
Various hums, howls, whines or knocking noises that vary in intensity and pitch with road speed, and may or may not respond to drive mode changes.	<ul style="list-style-type: none"> Tire noise, windnoise, driveaxle gear or bearing wear, damage or improper adjustment. Transmission overdrive gear noise. 	<ul style="list-style-type: none"> Refer to Drive Axle Noise.
Low frequency booming noise or pressure felt in ear drums, which occurs at or just above idle.	<ul style="list-style-type: none"> Engine or exhaust mounts bound-up. 	<ul style="list-style-type: none"> Refer to Tip-In Moan, Steps #2 & #3.

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DIAGNOSIS AND TESTING (Continued)**GENERAL NOISE DIAGNOSTIC PROCEDURE**

CONDITION	POSSIBLE SOURCE	
• Noise is the same on drive or coast.	<ul style="list-style-type: none"> • Road noise • Tire noise • Front wheel bearing noise 	<ul style="list-style-type: none"> • Pinion Bearings • Rear wheel bearings
• Noise changes with type of road surface.	<ul style="list-style-type: none"> • Road noise 	<ul style="list-style-type: none"> • Tire noise
• Noise tone lowers as vehicle speed is lowered.	<ul style="list-style-type: none"> • Tire noise • Driveline noise 	
• Similar noise is produced with vehicle standing and driving.	<ul style="list-style-type: none"> • Engine noise • Accessory Noise 	<ul style="list-style-type: none"> • Transmission noise
• Noise most pronounced on turns.	<ul style="list-style-type: none"> • Differential side gears and pinion gears 	<ul style="list-style-type: none"> • Wheel Bearings
• Drive noise, coast noise, or float noise.	<ul style="list-style-type: none"> • Wheel bearings • Ring and pinion gear 	<ul style="list-style-type: none"> • Axle shaft surface finish at bearing bore
• Clunk on acceleration or deceleration.	<ul style="list-style-type: none"> • Inoperative throttle damper • Excessive differential gear backlash • Excessive ring and pinion gear backlash • Transmission backlash 	<ul style="list-style-type: none"> • Loose engine mounts • Worn driveshaft U-joints • Worn driveshaft slip yoke splines • Loose suspension components • Sticking slip yoke
• Noise is different driving and coasting and coasting in neutral	<ul style="list-style-type: none"> • Axle • Transmission overdrive gear noise 	

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DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS GUIDE	
Non-Axle Noises	
<ul style="list-style-type: none"> ● Grille Whistle ● Trim Moulding ● Roof Top Luggage Rack ● Belt Chirp ● A/C System Pulses ● Belt Squeal 	<ul style="list-style-type: none"> ● Exhaust ● Tires ● After Market Add On's. Running Boards, Grounding Body to Frame, Antennas, Visors, Bug Deflectors, etc.
Noise Conditions	
<ul style="list-style-type: none"> ● Gear Howl and Whine <ul style="list-style-type: none"> — Inspect Gear Set for Damage or Contact Pattern — Check Gear Set Backlash 	<ul style="list-style-type: none"> — Check Ring Gear Run-out — Check Bearing Preload
<ul style="list-style-type: none"> ● Chuckle Noise <ul style="list-style-type: none"> — Differential Gear Clearance 	<ul style="list-style-type: none"> — Broken Gear Teeth
<ul style="list-style-type: none"> ● Knock Noise <ul style="list-style-type: none"> — Gear Tooth Mutilation — Ring Gear Bolts 	<ul style="list-style-type: none"> — Axle Shaft End Play
<ul style="list-style-type: none"> ● Clunk Noise <ul style="list-style-type: none"> — Total Axle Backlash — Worn Driveshaft U-joints — Loose or Broken Engine Mounts 	<ul style="list-style-type: none"> — Driveshaft Splines Need Lube — Worn Driveshaft Slip/Yoke Splines — Axle Shaft Spline Fit — Inoperative Throttle Damper
<ul style="list-style-type: none"> ● Bearing Noise <ul style="list-style-type: none"> — Pinion Bearing — Wheel Bearing — Differential Thrust/Washer Bearing 	<ul style="list-style-type: none"> — Limited-Slip Operation — Click on Equipment
Vibration Conditions	
<ul style="list-style-type: none"> ● Tires ● Driveline Angle ● Universal Joint ● Driveshaft Balance ● Axle Flange Runout 	<ul style="list-style-type: none"> ● Axle Shaft ● Drive Pinion Stem and Flange ● Wheel Nuts ● Transfer Case Flange Runout ● Incorrectly Installed Running Boards
Leakage Conditions	
<ul style="list-style-type: none"> ● Drive Pinion Seal ● Drive Pinion Nut ● Axle Cover Gasket ● Axle Shaft Seals 	<ul style="list-style-type: none"> ● Casting Porosity (Holes in Casting) ● Weld Leaks ● Axle Vent and/or Hose
Inoperative Conditions	
<ul style="list-style-type: none"> ● Broken Axle Shaft ● Broken Pinion Stem ● Broken Welds 	<ul style="list-style-type: none"> ● Wheel Bearing ● Axle Lock-Up ● Broken End Yoke ● Broken U-Joint ● Broken Gear Teeth

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DIAGNOSIS AND TESTING (Continued)**REAR AXLE DIAGNOSIS CHART**

CONDITION	POSSIBLE SOURCE	ACTION
Excessive vibration and boom.	<ul style="list-style-type: none"> ● Ring gear and pinion. 	<ul style="list-style-type: none"> ● Refer to the appropriate axle section in Group 05-00 for detection of high-pitch line run-out.
Excessive rear axle noise.	<ul style="list-style-type: none"> ● Differential carrier. 	<ul style="list-style-type: none"> ● Road test vehicle to assure problem is rear axle noise rather than other system noise. Refer to General Diagnostic Procedure. Service and replace parts as required.
Excessive vibration and boom.	<ul style="list-style-type: none"> ● Ring gear and pinion. 	<ul style="list-style-type: none"> ● Refer to the respective axle section in Group 05 for detection of High Pitch Line Run-out.
Excessive rear axle noise.	<ul style="list-style-type: none"> ● Differential carrier. 	<ul style="list-style-type: none"> ● Road test vehicle to assure problem is rear axle noise rather than other system noise. Refer to General Diagnostic Procedure. Service and replace parts as required.
Loud "clunk" in the driveshaft when shifting from reverse to forward.	<ul style="list-style-type: none"> ● Driveshaft. ● Rear axle shaft or carrier. 	<ul style="list-style-type: none"> ● Raise vehicle, rotate driveshaft by hand to isolate problem as driveshaft or rear axle problem. Service or replace as required. ● Inspect and service as necessary.
On turns, the rear axle has a chattering noise. (Limited-slip or Traction-Lok axles only). Slight chatter noise on slow turns after extended highway driving is considered acceptable and has no detrimental effect on the limited-slip axle functions.	<ul style="list-style-type: none"> ● Lubricant. ● Differential. 	<ul style="list-style-type: none"> ● Road test vehicle. Drive vehicle in tight circles, five clockwise and five counterclockwise. If chatter is still evident, add specified amount of Additive Friction Modifier C8AZ-19B546-A (EST-M2C 118-A) or equivalent to the rear axle lube and repeat tight circle road test. ● Remove differential, service as required if condition is still evident.

ACCESSORY DRIVE DIAGNOSIS GUIDE

CONDITION	POSSIBLE SOURCE	ACTION
Excessive noise ● Belt squeal.	<ul style="list-style-type: none"> ● Seized accessory. ● Loose belt. 	<ul style="list-style-type: none"> ● Check all accessories for free rotation and replace accessory if necessary. Replace belt. ● Check condition and tension of all belts. Replace belts or adjust tension of manually tensioned belts as necessary. Check that automatic tensioner is within the indicator marks. Check for correct belt length if tensioner is out of operating range. Refer to Section 03-05.
● Noisy accessory.	<ul style="list-style-type: none"> ● Worn accessory bearings. ● Loose bolts / brackets. 	<ul style="list-style-type: none"> ● Isolate noisy accessory by listening with a short rubber hose or other stethoscope-type device. Replace accessory if necessary. If noise is found in fan area recheck with fan removed. If noise improves, check for fan runout or a bent fan blade. ● Tighten bolts to specification. Refer to Section 03-05.
● Rattle.	<ul style="list-style-type: none"> ● Loose pulley, accessory or bracket. 	<ul style="list-style-type: none"> ● Isolate rattle by listening with a short rubber hose or other stethoscope-type device. Tighten pulley, accessory and bracket bolt if found to be loose.
● Noisy tensioner pulley bearing.	<ul style="list-style-type: none"> ● Worn bearing. 	<ul style="list-style-type: none"> ● Replace pulley per replacement procedure. Refer to Section 03-05.

DIAGNOSIS AND TESTING (Continued)**ACCESSORY DRIVE DIAGNOSIS GUIDE (Continued)**

CONDITION	POSSIBLE SOURCE	ACTION
● Belt chirp.	● Misaligned PS pulley.	● Align PS pulley per Section 03-05.
Severe belt flutter.	<ul style="list-style-type: none"> ● Loose belt. ● Binding tensioner arm. 	<ul style="list-style-type: none"> ● Check belt tension and adjust if necessary. Check condition of belt and replace if necessary. Refer to Section 03-05. ● Remove belt from automatic tensioner and verify that tensioner arm is not frozen in position or that arm does not bind when manually moved throughout its operating range.

Testing**Noise or Vibration, Four-Wheel Drive Vehicles**

Verify the condition by road testing.

NOTE: For four-wheel drive vehicles, verify concern with known quality conventional tires. If symptom still exists:

1. Shift transfer case into two-wheel drive.
2. Unlock front hublocks (or remove front driveshaft).
3. If condition disappears, concern is in front axle or driveshaft.
4. If condition persists, remove rear driveshaft and road test using front drive.
5. If condition disappears, concern is in rear driveline or axle.
6. If condition persists, see driveline chart or other sources.

For front wheel tire concerns refer to the Wheel-end Vibration Analysis Procedure and Match Mounting Tires under Testing in this section.

Wheel-End Vibration Analysis Procedure

1. Concern definition:
 - a. Ask the customer to explain the concern.
 - b. Neutral engine run-up. Run engine up, slowly increasing rpm's, so any engine accessory concern can be determined. Turn air conditioner off and on to isolate air conditioning compressor and lines.
 - c. Ride in vehicle and experience the vibration described by owner (with owner if possible). Note speed and examine neutral coast. If vibration disappears while in neutral coast, skip Wheel-End Vibration Analysis Procedure.
2. Initial checks:
 - a. Tire matching — tire size and tire / wheel compatibility.
 - b. Inflation pressure — correct inflation pressure.
 - c. Appearance — check for wear and condition of tires and wheels.

- d. Rim centering — check that tire beads are properly seated.

3. Tire runout check on vehicle:

- a. Runout okay — go to dynamic balance check below.
- b. Excessive runout — refer to match mounting procedure (Steps 1-4 under Match Mounting Tires).
- c. High runout still present — refer to wheel stud runout procedure (Step 7 under High Speed Shake).
- d. Replace high runout wheels or tires when required — go to static balance check below.

4. Static Balance:

Mark a wheel stud and the corresponding position on the rim to make sure that the assembly can be replaced on the vehicle in its original position. Do not remove existing balance weights. If rebalance only requires 1/2 oz. or less on either flange, the condition is not tire / wheel imbalance; proceed to ride test.

If condition is balance, rebalance and continue to road test.

Never add more than 5 oz. of weight per flange on a Ford Light Truck tire. If more weight is required:

- a. Spin the assembly on the balancer in static mode.
- b. Mark the location and amount of weight required on the sidewall. Do not balance assembly.
- c. Remove assembly from the balancer, deflate and rotate tire halfway around (180 degrees) as in matching for runout.
- d. Reinflate, replace on balancer and respin a second time in static mode.
- e. Mark location and amount of weight required on sidewall.
- f. If your two marks are within 4 inches of each other, it is the tire that is the major contributor to imbalance. (The marks followed the tire when it was rotated.) If out of balance cannot be corrected to within 3 oz. or less, then replace tire.

DIAGNOSIS AND TESTING (Continued)

- g. If your two marks are within 4 inches of being opposite each other on the tire, then the wheel is out of balance. If out of balance cannot be corrected to within 3 oz. or less, then replace wheel.
- h. If the two marks are neither opposite nor together, then the assembly can be match mounted for static balance. Refer to match mounting procedure.

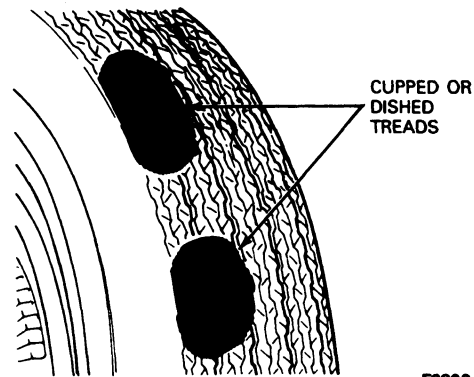
5. Road Test:

- a. If concern is eliminated, stop.
- b. If vibration is still present or rotor check:
 - Brake drum imbalance
 - Engine or transmission mounts
 - Excessive driveshaft runout or imbalance
 - Improper pinion angle
 - Faulty universal joints
 - Worn or damaged wheel bearings
 - Brake rotor imbalance

High-Speed Shake

This is a low-frequency, high-amplitude, **visible** vibration felt in floor pan, seats and steering column at speeds above 72 km/h (45 mph), and may be visible in front end sheet metal. The cause is usually found in the wheel / tire / rotor / drum / axle area, arising from imbalance, runout, bearing play, tire irregularities, etc. Visible sheet metal shake, though usually just another symptom of wheel-and-tire problems, may be indicative of improper tightening or adjustment of sheet metal mounting hardware. This condition, in conjunction with aerodynamic buffeting forces in some vehicles, especially trucks, can be a primary source of shake. If such shake is observed, inspection and tightening of sheet metal mountings may correct the problem.

1. After verifying the shake condition on the road test (at least 10 miles to remove flat spots from nylon cord tires), promptly raise the vehicle on a twin-post hoist or axle jack stands so that the tires do not develop flat spots while cooling off. Inspect tires for extreme wear or damage, or irregularities such as cupping or flat spots. If found, check the suspension components for misalignment, abnormal wear, or damage that may have contributed to the tire condition. Correct any suspension condition, and replace the damaged tires.

**F3396-1B**

2. Spin the front wheels by hand to check for wheel bearing roughness. Also check for end play. If bearings are loose or rough, adjust or replace and lubricate as necessary. On 4x4 models equipped with locking front hubs, unlocking the hubs will free wheels for bearing checks. Without unlockable hubs, removal of the hub cover is necessary to disengage the axle shafts.
3. Spin the non-driving wheels at low speed with a wheel balance spinner, observing for visible wheel / tire runout. If runout is evident, proceed to wheel / tire runout checks, Steps 8 and 9. If runout is not evident, balance the non-driving wheels and proceed to Step 4. Front wheels on 4x4's, if equipped with locking hubs, can be spun with hubs unlocked, or engine-driven with front drive engaged, for runout checks.
4. With drive train engaged, carefully accelerate the drive wheels until shake is felt. Without road load, the shake may be aggravated, and become extreme at lower speeds than observed in the road test. Accelerate up to the road test speed if necessary to bring out the shake. For 4x4's, run the test with front drive both engaged and disengaged, and note any difference. If shake appears, proceed to Step 5. If little or no shake is evident and a front-wheel condition has been found and corrected, repeat the road test to see if the condition still exists. If it does, check wheel / tire runout (Steps 8 and 9).
5. If shake is evident on the hoist run-up, mark the positions of the drive wheels relative to the wheel studs. Remove the wheels, secure the brake drums, if so equipped, by installing all lug nuts (if one piece cone style), reversed, and repeat the run-up to road speed. If shake is eliminated, the condition is probably wheel imbalance or runout. Before proceeding to runout checks, verify that rear axle shaft runout is within limits (Step 7).

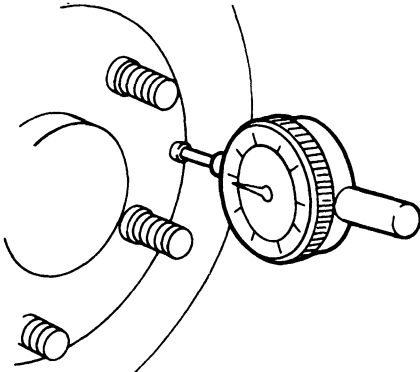
DIAGNOSIS AND TESTING (Continued)

6. If vibration is evident with the rear wheels off, remove the brake drums and repeat the road-speed run-up. If the shake is gone, brake drum imbalance or runout is indicated, but brake runout may be caused by axle runout, which should be checked (Step 7). Check brake drum balance on a bubble-type static balancer, and replace or machine out-of-balance drums. If loss of balance weight is evident, and re-balancing is warranted, refer to brake drum balancing in this section. If shake persists in the drums-off test, refer to Driveline Vibration in this section under testing.
7. Remove brake drums, if not already removed, to expose the axle shaft flange. Indicate the flange face lateral runout, the drum / rotor pilot radial runout, and the wheel bolt circle radial runout. (Read each wheel bolt in turn with a broad-foot indicator as close to the axle flange as possible, being careful not to jar the indicator out of position from one reading to the next. Note the highest and lowest readings.) Compare Total Indicator Readings (T.I.R.'s) with the runout.

If any runout value exceeds specification limit, replace the axle shaft or hub. Check for radial play in rear axle bearings, or evidence of roller damage to bearing inner race surfaces on the axle shafts. Replace axle shaft if bearing journal is damaged. Replace bearings if loose or rough. Refer to the following chart for axle runout limits.

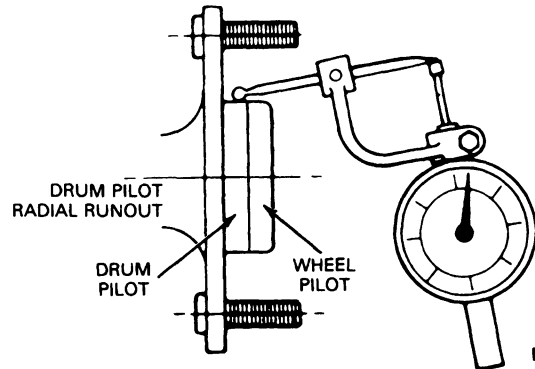
Run-out Limits	Flange Face Lateral	Drum / Rotor Pilot Radial	Wheel Bolt Circle Radial
Dana Axle	0.13mm (0.005 Inch)	0.8mm (0.003 Inch)	0.13mm (0.005 Inch)
Ford Axle	0.13mm (0.005 Inch)	0.10mm (0.004 Inch)	0.26mm (0.010 Inch)

FLANGE FACE LATERAL RUN-OUT



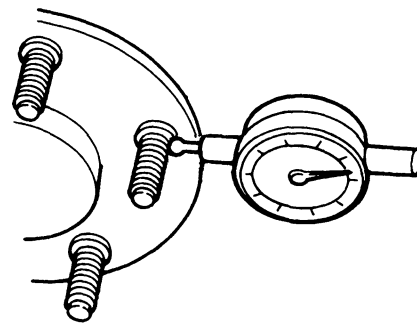
F3398-1B

DRUM/ROTOR PILOT RADIAL RUN-OUT



F3399-1C

WHEEL BOLT RUN-OUT



F3400-1D

8. Re-install driving wheels and tires in original positions. Check all wheel and tire assemblies for total radial and lateral tire runout, using Rotunda Gauge 007-0056A or equivalent as illustrated. If either is over 1.0mm (.040 inch), check the wheel rim runout, radial and lateral. If either exceeds 1.14mm (.045 inch), replace the wheel and re-check runout. If the rim is within limits, locate and mark the low point of rim radial runout. Refer to Match Mounting Tires under Adjustments and Service in this section.

DIAGNOSIS AND TESTING (Continued)

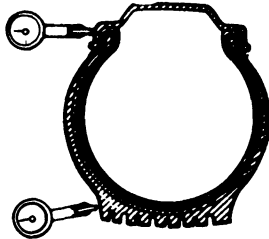
9. If rim runouts are within limits and total lateral (tire) runout is over 1mm (.040 inch), replace the tire. If total tire **radial** runout is more than 1mm (.040 inch), mark the highest point of the tread, dismount, re-index and remount the tire with the high point aligned with the low point of the wheel. Re-check radial tread runout, and if still more than 1mm (.040 inch), replace the tire and re-check runouts, re-indexing as necessary to bring radial runout within limits.

CHECK WHEEL RADIAL
RUNOUT HERE



CHECK TOTAL RADIAL
RUNOUT HERE

CHECK WHEEL LATERAL
RUNOUT HERE



CHECK TOTAL
LATERAL RUNOUT
HERE

F3401-B

NOTE: To make sure of accurate bead seat centering when remounting tires, use a mild lubricant to assist mounting on rim and tire bead, inflate to 40 psi maximum to seat the bead, then adjust the pressure to the recommended pressure noted on the safety compliance certification label affixed to the driver's side door or door latch pillar.

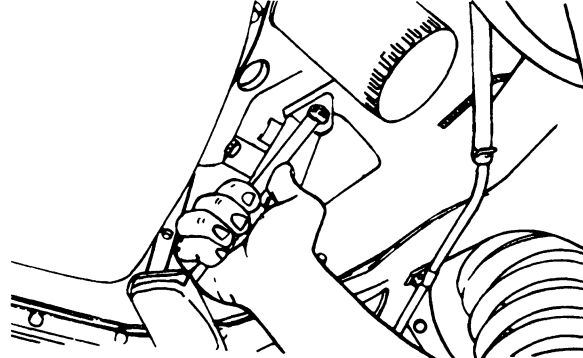
10. Balance all wheels not previously balanced, using on-vehicle balancing equipment if available. Road test the vehicle. If the condition has not been eliminated, proceed to Step 11.
11. Substitute a known-good set of wheels and tires, and road test. If shake is gone, the condition was probably caused by tire force variation, resulting from non-uniform tire construction. Re-install the original tire / wheel assemblies one-by-one, road testing at each step, until the worn or damaged tire(s) is identified. Replace tire(s) as necessary and retest. If shake persists with substitute wheels, refer to Driveline Vibration in this section under Testing.

Tip-In Moan

A moaning noise, possibly accompanied by a felt vibration, under light to medium acceleration between 40-104 km/h (25-65 mph), usually indicates a grounding or bound-up condition of power train component or exhaust system mounts. (The flexible coupling used in some vehicles is intended to eliminate this condition and the following procedure may not apply to this vehicle unless the exhaust system is damaged.) Another possible cause is a resonance condition at the natural vibration frequency of the engine. This type of vibration will usually peak at a specific engine speed (rpm) and a specific degree of acceleration (throttle setting) at that speed.

1. Check air cleaner for proper installation of base gasket, lid, element and air inlet duct assembly. If damaged gaskets, or improper duct alignment or tightening of attaching nuts and bolts are evident, correct the condition and road test. If moan persists, proceed to Step 2.
2. To check for powertrain resonance, loosen all converter or clutch housing to engine attaching bolts 3/4 turn and road test. Re-tighten bolts after test. If moan persists, proceed to Step 3.
3. Normalize engine mounts by loosening them and, with engine running, shifting transmission from neutral to drive and back to neutral. With manual transmission, load engine by slipping clutch in gear. Re-tighten mounts and road test. If moan persists, proceed to Step 4.

NEUTRALIZING ENGINE MOUNTS



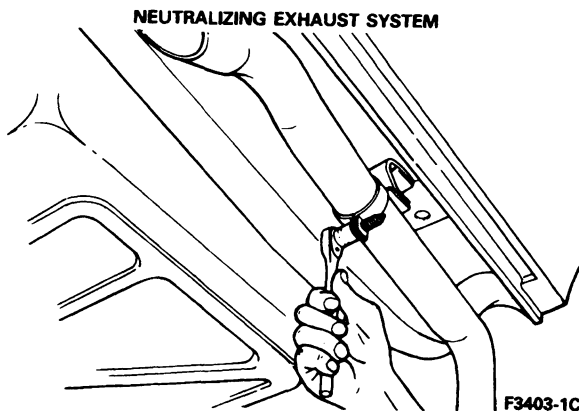
F3402-1C

4. Identify air conditioning system noise by turning air conditioning system off and on. If noise occurs only with air conditioner on, check drive belts for proper tension. Check mounting brackets for proper torque. Inspect lines for grounding-out against the body.

DIAGNOSIS AND TESTING (Continued)

5. Normalize the exhaust system to relieve strain on mounts which may be sufficiently bound-up to transmit vibration as if grounded. First, be sure the system is warmed up to normal operating temperature, as thermal expansion could be the cause of a strain problem. Loosen all hanger attachments and re-position hangers until they hang free and straight. This should include the steady rest rod from the exhaust system to the area of the rear engine (engine mount on some applications). Then loosen all flange joints and, with engine running, shift transmission from neutral to drive and back to neutral (or load engine with clutch), and re-tighten all hanger clamps and flanges (tighten the manifold to exhaust flange joint last). Refer to Section 09-00, for correct installation and torque specifications. Verify adequate clearance to prevent grounding at any point in the system. Road test the vehicle and if moan persists, refer to Engine Accessory Vibration in this section under Testing.

NOTE: After normalization, the rubber in the exhaust hangers should show some flexibility when movement is applied to the exhaust system.



Idle Boom

A low-frequency booming noise which may be heard or sensed as a pressure in the ear drums at or above idle, possibly indicates a bound-up exhaust system or engine mounts. Refer to Steps 3 through 5 of Tip-In Moan for corrective action.

Driveline Vibration

This is a higher-frequency, lower-amplitude vibration rather than a high-speed shake, directly related to road speed, and usually more noticeable at higher road speeds, 72 km/h (45 mph) and up. It is felt in the floor pan or heard as a rumble, hum or boom. It can exist in all drive modes, but may vary somewhat in acceleration, deceleration, float or coast modes. If the vibration is particularly responsive to heavy acceleration or deceleration, especially at lower speeds, driveline angles should be checked. A driveline vibration can sometimes be duplicated with the axle supported on a hoist or jack stands. While accelerating and decelerating, lightly apply brake to simulate road load resistance, noting any such vibrations.

For driveline vibration diagnosis and testing procedures, refer to Section 05-00.

Driveline Angle Check

A shuddering vibration or audible rumble at speeds up to 72 km/h (45 mph), most pronounced under heavy acceleration or deceleration and reduced or eliminated in float or neutral-coast modes, usually indicates incorrect driveline angle between driveshaft and rear axle pinion. Another possible cause is poor seating, tight or bound up U-joint trunnion or off-center mounting of U-joints. Driveline angle is controlled by ride (spring) height, suspension control arm geometry or axle spring seat angular orientation in leaf spring applications, and center bearing alignment in two-piece shafts (truck). Whether incorrect angle effects are more pronounced under acceleration or deceleration depends on whether ride height or pinion angle deviations from specification are plus or minus. The condition usually cannot be duplicated on the hoist because considerable road load torque resistance is required for it to appear.

For driveline angle checking procedures, refer to Section 05-00.

Engine Accessory Vibration

A noise or vibration that occurs at different road speeds in different gears, but always at the same engine rpm probably originates in an engine-driven or accessory belt driven accessory. This type of vibration will disappear in neutral-coast drive mode, and can be duplicated in an engine run-up to the problem speed with the vehicle standing still. It may be caused by a loose, worn or damaged drive belt, a damaged, worn or untrue drive pulley, improperly aligned or tightened accessory mounting brackets or hardware, or worn, damaged, or out-of-true conditions in an accessory itself.

DIAGNOSIS AND TESTING (Continued)

1. Run up engine to the determined problem rpm observed in the road test, with vehicle stationary. If vibration is not evident, perform stall test in drive with brakes locked (or load engine by slipping clutch in gear with manual transmission). If condition appears under load, see Tip-In Moan procedure. If condition appears during no-load test, proceed to Step 2.

CAUTION: Load tests must be of short duration to minimize torque converter or clutch overheating. If vibration does not appear under load, a more careful road test may suggest driveline vibration as the real problem.

2. With engine stopped, inspect all engine accessory drive belts and pulleys for wear or damage, and check belt tension using Belt Tension Gauge T63L-8620-A or equivalent. Verify that all accessory fasteners are tightened to specification. Refer to Section 03-05 for correct belt tension and bolt tightening specifications. Replace worn or damaged drive components, correct belt tension and tighten mounting hardware to specification. Start engine and run up to the problem speed. If vibration or noise persists, proceed to Step 3.
3. With engine idling and at a safe distance, visually check accessory drive belt and pulleys for misalignment, runout or irregular motion. Replace any pulley with runout in excess of 1mm (0.039 inch). A belt that is seen to ride up and down in a pulley groove indicates a variable-width condition, either in the belt or in the pulley. If it only happens on one pulley, replace the pulley. Otherwise, replace the belt. When all accessory drives run true at idle, run engine up to the determined problem rpm and look for belt whip. If observed, adjust belt tension to specification and recheck. If whip persists, replace belt. If no fault is found in the engine accessory drive system, the accessories themselves must be checked. See Step 4.

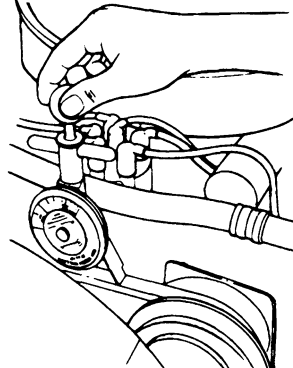
4. A noisy component can often be identified by probing with a stethoscope-type device (a length of rubber plastic or tubing will work) while the engine is running at the determined problem rpm.

A noisy component can often be identified by probing with a stethoscope-type device (a length of flexible tubing will work). If the component cannot be isolated by listening with the stethoscope-type device, remove the fan blade and listen again without the background fan noise. If the objectionable noise went away when the fan blade was removed, check the fan mounting surface to see if it is not flat or look for bent fan blade. If the noise persists with the fan blade off, try to pinpoint the component by listening with the probe. Vary the load on the accessories to see if the noise changes. Change the load on the power steering pump by turning the steering wheel to its limits. Change the load on the air conditioning compressor by turning it on and off. Change the load on the alternator by turning the lights and fan blower on and off. Change the load on the air pump by pinching the rubber outlet hose to build up back pressure in the pump. If a component can be isolated, then replace it. Replace the fan blade.

If the source of the condition is not found in the engine accessory system, or corrected by the Tip-In Moan procedures, an imbalance condition in basic components is possible, though unlikely. These include crankshaft, vibration damper, flywheel or flexplate and clutch or torque converter.

NOTE: Be sure the vibration condition observed in no-load testing occurs at the same engine speed registered on the tachometer during the road test. All engines have natural vibration frequencies which are evident at no-load, but are not a problem on the road.

CHECKING DRIVE BELT TENSION



F3410-1B

Drive Axle Noise

1. **Gear noise** is the typical "howling" or "whining" of the ring gear and pinion due to an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

DIAGNOSIS AND TESTING (Continued)

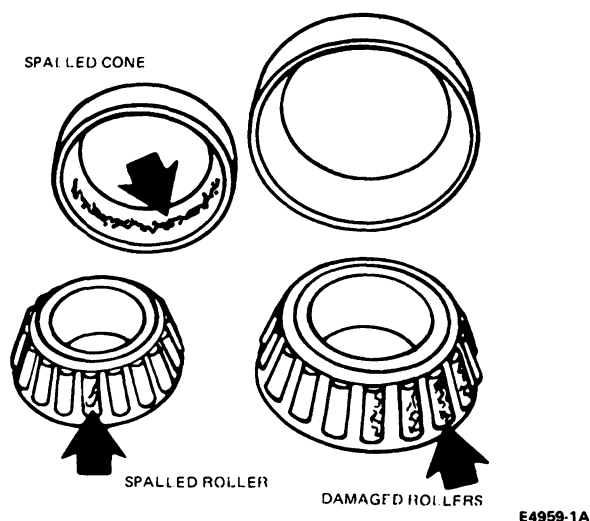
2. **Chuckle** is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from approximately 64 km/h (40 mph) and usually can be heard all the way to a stop. The frequency varies with the speed of the vehicle.
3. **Knock** is very similar to chuckle; though it may be louder and occurs on acceleration or deceleration. The teardown will disclose what has to be corrected.
4. **Clunk** may be a metallic noise heard when the automatic transmission is engaged in reverse or drive, or it may occur when throttle is applied or released. It is caused by backlash somewhere in the driveline; it is "felt" or heard in the axle.
5. **Bearing whine** is a high pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings, which are operating at driveshaft speed. Roller wheel bearings may whine the same way if they run completely dry. Bearing noise occurs at **all driving speeds**; this distinguishes it from gear whine, which usually comes and goes as speed changes.
6. **Bearing rumble** sounds like marbles being tumbled. This condition is usually caused by a malfunctioning wheel bearing. The lower pitch is produced because the wheel bearing turns at only about 1/3 of driveshaft speed.
7. **Chatter on corners** is a condition where the whole rear end vibrates only when the vehicle is moving. The vibration is plainly felt as well as heard. In conventional axles, extra differential thrust washers cause a condition of partial lockup that creates this chatter. Chatter noise on Limited-Slip or Traction-Lok axles can usually be traced to erratic movement between adjacent clutch components and can sometimes be corrected with a lubricant change and the addition of a friction modifier.
8. **Click at engagement** is a condition on axles of a slight noise, distinct from a "clunk," that happens in reverse or drive engagement. Check for the presence of a slinger.
9. **Axle shaft noise** is similar to gear noise and pinion bearing whine. However, axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (drive, cruise, coast and float), and will persist with transmission in neutral while vehicle is moving at the determined problem speed. If upon ride evaluation vehicle displays above noise condition, remove suspect axle shafts, replace wheel seals, and install a new set of axle shafts. Re-evaluate vehicle for noise before removing any internal components.

10. Bearing Noise

Bearing malfunctions normally will be obvious at disassembly. As noted earlier, pinion bearings make a high-pitched, whistling noise, usually at all speeds. However, if there is only one pinion bearing that is malfunctioning, the noise may vary in different driving phases.

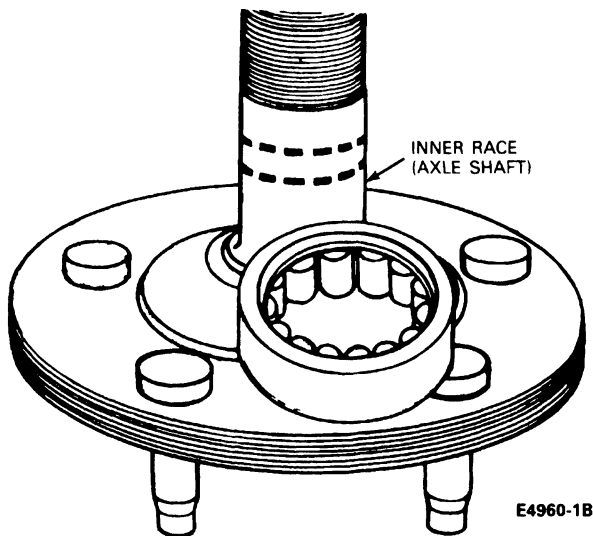
Pinion bearings are frequently replaced unnecessarily when correcting gear noise.

They should not be replaced unless they are actually scored or damaged, or there is a specific pinion bearing noise. Examine the large end of the rollers for wear. If the original bend radius has worn to a sharp edge, the bearing assembly should be replaced. Remember that the low-pitched rumble of a malfunctioning wheel bearing can be duplicated by wind noise from exterior mounted accessories or by tires.



Wheel bearing concerns might be mistaken for faulty pinion bearings, so be sure to look at the wheel bearings carefully before tearing down the axle.

Some axle bearings are pressed into the housing, making it more difficult to check them. However, the axle shaft is the inner race for the bearing on semi-float type axles used on vehicles under 8600 lbs. GVW. So if the bearing is damaged, the roller surface on the shaft will be damaged as well. The rollers can run on about the center of the polished surface. Refer to the following illustration.

DIAGNOSIS AND TESTING (Continued)**Semi-Float Axle Wheel Bearing Inner Race****Non-Axle Noise**

There are a few other conditions that can sound just like axle noise and have to be considered in pre-test diagnosis. The five most common are exhaust, tires, transmission overdrive gear noise, roof racks and trim mouldings.

1. In certain conditions, the pitch of the exhaust may sound very much like gear whines. At other times, it can be mistaken for a wheel bearing rumble.
2. Road test vehicle in both overdrive and direct drive to distinguish overdrive gear noise from axle gear noise.

3. Tires, especially snow tires, can have a high-pitched tread whine or roar, similar to gear noise. Radial tires, to some degree, have this characteristic. Also, any non-standard tire with an unusual tread construction may emit a roar or whine-type noise.
4. Trim and mouldings or antennas also can cause whistling or whining noise.
5. A roof rack can produce a whining noise and the cross bows should be removed when testing to diagnose any noise.
6. Transmission whine usually occurs at the same engine rpm while axle whine occurs at the same vehicle speed.

Therefore, be sure that none of these is the cause of the noise before proceeding with an axle teardown and diagnosis.

Analysis of Gear Noise

The noises described in the Road Test Diagnosis Guide usually have specific causes that can be diagnosed by observation as the unit is disassembled. The initial clues are, of course, the type of noise heard on the road test and the driving conditions.

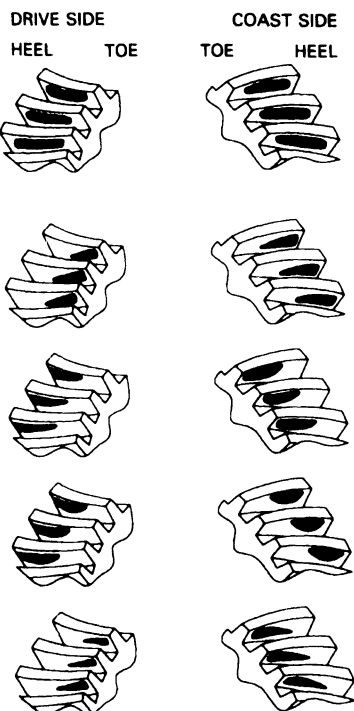
Gear Howl and Whine

When disassembling the axle to diagnose and correct gear noise, it is assumed that the tires, exhaust, and trim items have first been checked as possible causes.

DIAGNOSIS AND TESTING (Continued)

Examination of the gear tooth contact pattern will aid diagnosis of gear whine / howl. Refer to the following illustration.

**PATTERN INTERPRETATION
(RING GEAR)**



NORMAL OR DESIRABLE PATTERN. THE DRIVE PATTERN SHOULD BE CENTERED ON THE TOOTH. THE COAST PATTERN SHOULD BE CENTERED ON THE TOOTH, BUT MAY BE SLIGHTLY TOWARD THE TOE. THERE SHOULD BE SOME CLEARANCE BETWEEN THE PATTERN AND THE TOP OF THE TOOTH.

BACKLASH CORRECT. THINNER PINION POSITION SHIM REQUIRED.

BACKLASH CORRECT. THICKER PINION POSITION SHIM REQUIRED.

PINION POSITION SHIM CORRECT. DECREASE BACKLASH.

PINION POSITION SHIM CORRECT. INCREASE BACKLASH.

E8232-B

Chuckle

Chuckle that occurs on the coast driving phase is usually caused by excessive clearance due to differential gear wear; or by a damaged tooth on the coast side of the pinion or ring gear.

Any damage to a gear tooth on the coast side can cause a noise identical to chuckle. Even a very small tooth nick or ridge on the edge of a tooth is enough to cause the noise.

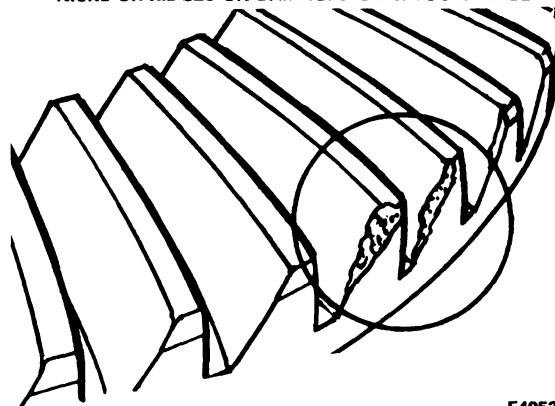
You can often correct this condition and remove the noise simply by cleaning up the gear tooth nick or ridge with a small grinding wheel.

If either gear is damaged or scored badly, the gear set must be replaced. Also, if there is metal broken loose, the carrier and housing must be cleaned to remove particles that could cause damage later. Any other damaged parts in the axle must be replaced.

To check the gear set, remove as much lubricant as possible from the gears with clean solvent. Wipe the gears dry or blow them dry with compressed air. Look for scored or damaged teeth. Refer to the illustrations below. Also look for cracks or other damage.

If the cleaned up or damaged area is larger than 3.2mm (1 / 8 inch), it is advisable to replace the gear set.

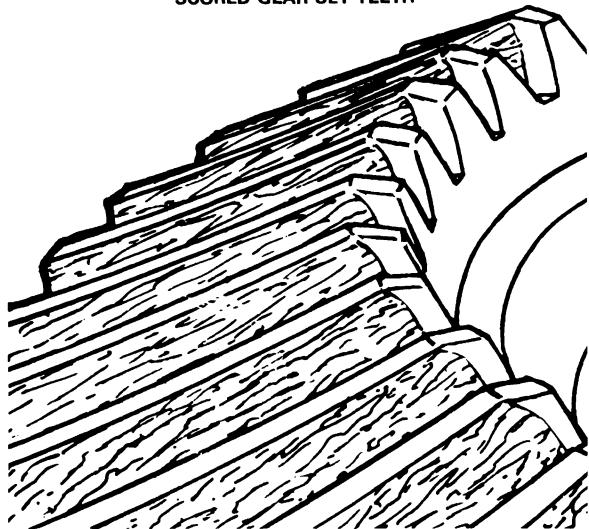
NICKS OR RIDGES ON DAMAGED GEAR TOOTH EDGE



E4953-C

DIAGNOSIS AND TESTING (Continued)

SCORED GEAR SET TEETH



Knock

Knock, which can occur in all driving phases, has several causes. In most cases, you will discover one of the following conditions:

1. A gear tooth damaged on the drive side is a common cause of the knock. This can usually be corrected by grinding the damaged area.
2. Knock is also characteristic of excessive end play in the axle shafts. Up to .762mm (.030 inch) is allowed in most axles. The frequency of knock will be less because the axle shaft speed is slower than the driveshaft.

NOTE: Be sure to measure the end play with a dial indicator, not by feel. A "guesstimate" usually feels like far more end play than there actually is.

On the 8.8 and 10.25 inch semi-float axle, end play is allowable up to 0.762mm (0.030 inch), but can be reduced to 0.127mm (0.005 inch). It is controlled by the C-washer that holds the shaft in the pocket of the side gear. To reduce the clearance, replace differential side gears, Traction-Lok clutch plates, thrust washers or axle shafts as required.

Clunk

Clunk is due to backlash in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, make a check of the total axle backlash as follows:

1. Raise the vehicle on a frame or twin hoist so that the rear wheels are free.
2. Clamp a bar between the axle companion flange and a part of the frame or body so that the flange cannot move.
3. Lock the left rear wheel to keep it from turning.
4. Turn the right wheel slowly until you "feel" it in a drive condition. Hold a chalk marker on the side of the tire 12 inches from the center of the wheel.

5. Turn the wheel the other way until you again feel the drive condition.
6. Measure the length of the chalk mark, which is the total axle backlash. **It should be one inch or less.** If the backlash is within this limit, the clunk will not be eliminated by going into the axle.

Check for these conditions if the backlash is excessive:

1. Excessive ring gear and pinion backlash.
2. Elongation of the differential pinion shaft holes in the differential case.
3. Missing side gear, or pinion gear thrust washer.
4. Galling or excessive wear of the differential pinion shaft and bore.

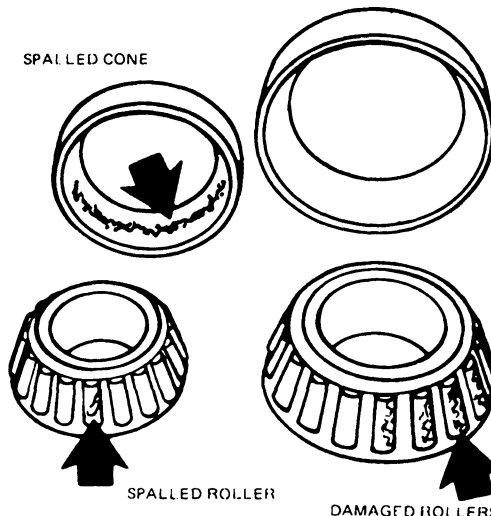
If none of the above conditions shows up, there may be a loose fit of the axle shafts to the side gear splines. You should continue as follows **until the correction is made.**

5. Install new side gears and recheck the backlash.
6. Install two new axle shafts.

Bearing Noise

Bearing malfunctions normally will be obvious at disassembly. As noted earlier, pinion bearings make a high-pitched, whistling noise, usually at all speeds. However, if there is only one pinion bearing that is malfunctioning, the noise may vary in different driving phases.

SPALLED CONE



Pinion bearings are frequently replaced unnecessarily when correcting gear noise. They should not be replaced unless they are actually scored or damaged, or there is a specific pinion bearing noise. Examine the large end of the rollers for wear. If the original blend radius has worn to a sharp edge, the bearing assembly should be replaced.

Remember that the low-pitched rumble of a malfunctioning wheel bearing can be duplicated by a wind noise from externally mounted accessories, or by tires.

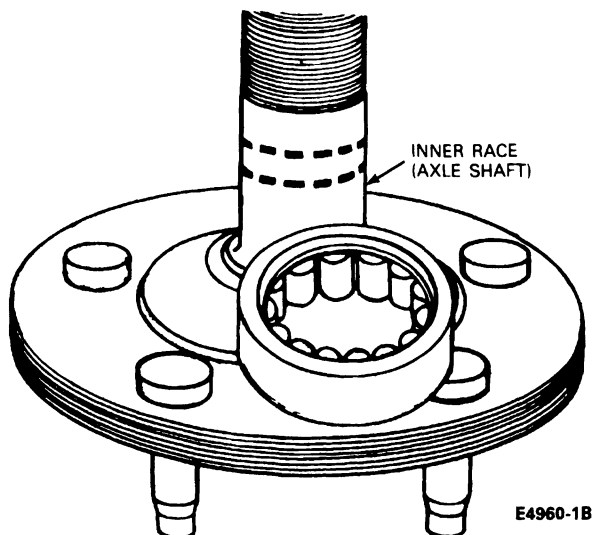
DIAGNOSIS AND TESTING (Continued)

Wheel bearing noise might be mistaken for pinion bearing noise, so be sure to look at the wheel bearings carefully before disassembly of the axle.

On 7.5- and 8.8-inch axles, wheel bearings are pressed into the housing, making it more difficult to check them. However, the axle shaft is the inner race for the bearing. So if the bearing is damaged, the roller surface on the shaft will be damaged as well.

The rollers can run on about the center of the polished surface. Refer to the following illustration.

Semi-Float Axle Wheel Bearing Inner Race



Check Bearing Preload

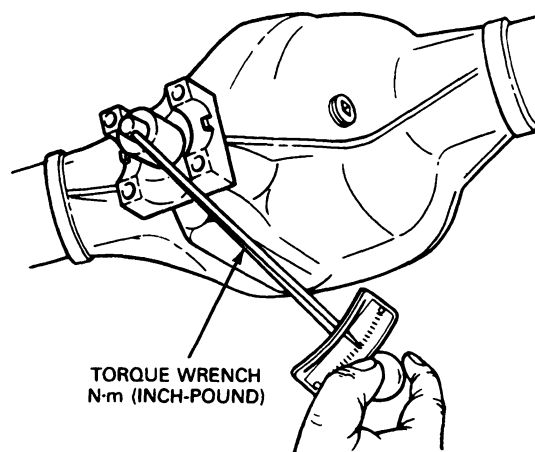
The absence of differential bearing preload causes noise as driving loads tend to move the gear pattern to the outside (heel) of the ring gear. In fact, if the preload is not set right, it can move out to the edge and score and / or fatigue the gears.

Both the pinion bearing and differential bearing preload must be checked to be sure that the pattern will stay in place under load.

Check the pinion bearing preload by putting a N·m (inch-pound) torque wrench on the pinion nut and measuring the torque effort it takes to turn the pinion without the differential assembly installed.

Rotational Torque Reading is Required to Check Pinion Bearing Preload

CHECKING PINION BEARING PRELOAD



E6104-1A

Compare the reading with the preload specification for used bearings. Refer to the appropriate rear axle section.

A tip about pinion bearing preload: The pinion seal will offer a resistance equivalent to 0.56-0.68 N·m (5-6 in-lb). If the bearings are preloaded, a reading higher than 0.56-0.68 N·m (5-6 in-lb) on the torque wrench scale must be obtained. If not, there is no preload.

Another indication of pinion preload is some threads protruding from in front of the nut. Normally about 2.29-2.54mm (0.090-0.100 inch) of threads protrude if the pinion preload is set properly. If the nut is flush with the end of the stem, chances are the preload was not set. See Pinion Bearing Preload Procedure in the appropriate rear axle section for resetting the proper preload.

NOTE: The absence of preload here may indicate that the spacer between the pinion bearings on Ford axles is crushed and should be replaced.

Brake Squeal, Vibration

Some brake pad material will cause brake squeal on occasion. If the condition persists, it may be necessary to change pads. "Glazed" pads may also squeal and require replacement. Worn brake pads may squeal as the wear sensors come in contact with the wheel rotor. Refer to Section 06-00. Determine the concern is not wheel bearing noise.

DIAGNOSIS AND TESTING (Continued)**FRONT DISC BRAKE VIBRATION / SHUDDER, E-250-350 AND F-250-350 WITH DANA AXLE — TEST A**

TEST STEP		RESULT	ACTION TO TAKE
A1	ROAD TEST		
	<ul style="list-style-type: none"> With standard wheels and tires installed, road test the vehicle and verify the condition. 	Front brake chirp. ► No shudder / vibration ► Shudder / vibration ►	Normal condition. No repair required. Brake system not responsible. REFER to Section 00-04. GO to A2.
A2	APPLY PARKING BRAKE		
	<ul style="list-style-type: none"> Lightly apply the parking brake and road test the vehicle (Release parking brake immediately after test.) 	No shudder / vibration ► Shudder / vibration ►	CHECK the front brakes. GO to A3. GO to A4.
A3	DISC BRAKES		
	<ul style="list-style-type: none"> Resurface rotors and road test vehicle. 	No shudder / vibration ► Shudder / vibration ►	Brake system repaired. GO to A5.
A4	DRUM BRAKES		
	<ul style="list-style-type: none"> Refinish brake drums and road test vehicle. 	No shudder / vibration ► Shudder / vibration ►	Brake system repaired. GO to A6.
A5	DISC BRAKE PADS		
	<ul style="list-style-type: none"> Replace disc brake pads and road test vehicle. 	No shudder / vibration ► Shudder / vibration ►	Brake system repaired. REPLACE rotors.
A6	DRUM BRAKES		
	<ul style="list-style-type: none"> Replace brake shoes and road test vehicle. 	No shudder / vibration ► Shudder / vibration ►	Brake system repaired. REPLACE drums.

ADJUSTMENTS AND SERVICE**Brake Drum Balancing**

Rear brake drum imbalance can cause a vibration condition that sometimes cannot be compensated for by wheel balancing.

If rear brake drum imbalance is suspected, raise the rear end of the vehicle, taking proper precautions. Remove the rear wheel and tire assembly.

Before testing, install all lug nuts with flatwashers on them, to retain the drums to axle flanges. If drums do not have balance weights, run the vehicle up to the speed where vibration occurred during road test.

If the drums exhibit out-of-balance symptoms, they should be removed from the vehicle and balanced as follows:

- Position the brake drum on a "bubble-type" balancer and, noting the "heavy" side of the drum, place a wheel balance weight on the drum directly opposite the heavy point. Select the appropriate number of weights until the bubble balance indicates a "balanced" condition. Mark the location of the "light" side of the drum, and note the total amount of the balance weight needed to balance the drum.

NOTE: A drum which already has a balance weight attached, or requires less than 56.6 grams (2 oz.) of weight to balance, is not the prime cause of the vibration.

- Fabricate a piece of mild steel to fit the curvature of the drum face and equal to the balance weights required to balance the brake drum (an old flywheel ring gear can be cut and used as a balance weight).

NOTE: A small postal scale may be used for determining the weight of both the balance weights used and the weight of the fabricated drum balance weight needed.

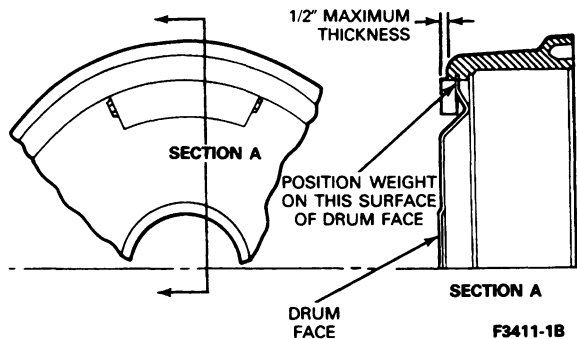
ADJUSTMENTS AND SERVICE (Continued)

3. Position the drum balance weight on the drum face in the location on the light side of the drum. Arc weld (tackweld 6.35mm [1/4 inch] long) the balance weight to the drum face.

NOTE: Under no condition should any other welding method be used other than arc welding. To prevent drum distortion, do not use a current setting of more than 100 amps.

4. Install the balanced drum on the vehicle.
5. Static balance both rear wheels and tires and install on vehicle.
6. Road test to verify condition.

Brake Drum Balance



Driveshaft Balancing

For driveshaft balancing procedures, refer to Section 05-00.

Match Mounting Tires

Match mounting is a technique to reduce radial or lateral tire runout on tire and wheel assemblies. Excessive runout is a source of ride complaints that can be minimized by match mounting the tire position on the wheel and the wheel position on the hub.

1. Measure the total indicated runout on the center of the tire tread rib and record it. Mark the tire and rim at the high spot. Mark the tire at the location the valve stem for reference.
2. Break down the tire and remount it 180 degrees on the rim so that the valve stem reference mark is opposite the valve stem on the wheel.
3. Reinflate the tire and measure the total indicated runout and again mark the high spot.
4. If the runout is reduced to acceptable guidelines the tire is ready to be put back into service. If the runout is still excessive, one of the following steps must be performed.
 - If the high spot is within 4 inches of the first high spot on the tire, and is still outside of guidelines, replace the tire.

- If the high spot is within 4 inches of the first high spot on the wheel, the wheel may be out of tolerance. Check the wheel for runout.
- If the high spot is not within 4 inches of either original high spot of the tire and rim, then draw an arrow from the second high spot to the first high spot (in the shortest direction) and rotate the tire on the rim 90 degrees in that direction. This will normally reduce the runout to an acceptable level.

In the majority of cases, the first 180 degree turn of the tire will either fix the problem or indicate which item to replace.

Distorted Wheels, 16x6 Inch Single Steel Wheel

NOTE: Wheel vibration may be caused by distorted pilot holes or lug holes on the wheel. This does not allow sufficient clamp load between the lugnut, the wheel and the rotor / hub. It may also be difficult to remove the distorted wheel from the vehicle or to place the wheel on the vehicle in a different location. To determine if a wheel has been damaged and should not be reused, refer to the following service procedure for details.

Inspect for Wheel Damage

1. Remove the wheel from the hub. If the wheel is difficult to remove, DO NOT reuse the wheel.
2. Visually inspect the wheel for distortion (turned-up) scallops in the pilot hole. If the pilot hole is distorted, DO NOT reuse the wheel.
3. Inspect the distorted lug holes by placing a lugnut in the lug hole cone seat of the wheel and inspect from the reverse side. If the lug protrudes through the lug hole, DO NOT reuse the wheel.
4. Inspect the wheel mounting surface for distortion.
 - a. Lay a straightedge across the mounting surface of the wheel (the surface of the wheel which makes contact with the rear brake drum or front rotor).
 - b. The straightedge should contact the outer edge of the mounting surface, lying between the bolt holes and across the center of the pilot hole.
 - c. The clearance between the straightedge and the pilot hole cannot exceed 0.762mm (0.030 inch). The straightedge should not contact the pilot holes. If the clearance is more than 0.762mm (0.030 inch) or the straightedge makes the contact with the pilot holes, DO NOT reuse the wheel.

Install Wheel

1. Inspect lubricant on the studs and lugnuts.
2. If lubricants are present, clean thoroughly using naphtha or equivalent.

ADJUSTMENTS AND SERVICE (Continued)

3. Tighten lugnuts to 190 N·m (140 ft-lb) using a torque wrench according to Section 04-04.

CAUTION: Excessive torque may cause distortion of the wheel. Inadequate torque may not provide adequate clamping force to assure wheel retention.

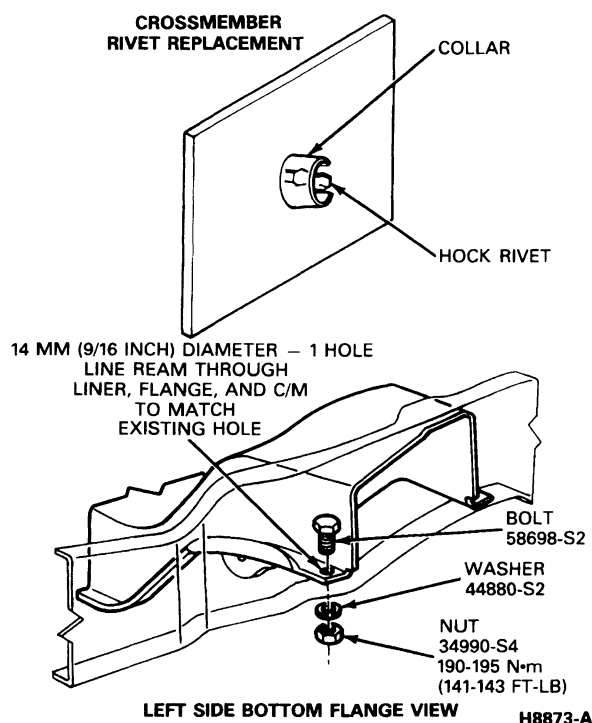
Crossmember Noise

Popping or snapping sound coming from the area of the #1 crossmember attachment to the left frame rail may be eliminated on some vehicles by replacing the huck rivet with a nut, bolt, and washer assembly. The rivet is located in the lower flange of the frame near the steering gear and has the appearance of a large "pop rivet".

1. Use a flat chisel and hammer (or air chisel) to split the exposed collar of the huck rivet.
2. Knock the rivet pin out the blind side with a 1/4 inch drift punch and hammer.

CAUTION: Removal of the huck rivet with a cutting torch is not recommended because of probable damage to the frame structure.

3. Line ream the existing hole through the liner, frame flange, and crossmember to 14mm (9/16 inch) diameter.
4. Install bolt, washer and nut. Tighten to 190-195 N·m (141-143 ft-lb).



GLOSSARY OF TERMS

Acceleration

1. **Light** — Increase in speed at less than half throttle.
2. **Heavy** — half to full throttle increase in speed.
3. **WOT** — Wide open throttle.

Ambient Temperature

Surrounding or prevailing temperature. Normally, the temperature in the service area or outdoors, depending on where testing is taking place.

Articulation

Vertical movement of the front driving or rear axle relative to the frame of the vehicle to which they are attached.

Belt Chirp

An intermittent noise usually at idle caused by belt mis-alignment.

Belt Squeal

A continuous high-frequency noise caused by a frozen accessory or insufficient tension.

Boom

A very low-frequency (sometimes cycling) noise often accompanied by sensation of pressure on the ear drums.

Bound Up

Refers to a stressed, rubber-mounted component that transmits any NVH which would normally be absorbed by the mount. (See Neutralize.)

Brakes Applied

When vehicle is stationary, service brakes applied with enough force to hold vehicle against acceleration with transmission in gear or drive.

Camber

Angle formed between front wheel spindle axis and horizontal as viewed from in front of the vehicle. Camber is positive when the wheel tops are farther apart than the wheel bottoms.

Caster

Angle formed between the kingpin axis and a vertical axis as viewed from the side of the vehicle. Caster is considered positive when the top of the kingpin axis is behind the vertical axis.

Coast

Engine / transmission engaged, foot off accelerator pedal.

Coast / Neutral

Engine / transmission taken out of gear with driveshaft / driveline by placing transmission selector in neutral or by depressing clutch (manual transmission).

Coupling Shaft

The front shaft in a two-piece driveline.

GLOSSARY OF TERMS (Continued)**CPS**

Cycle Per Second.

Cruise

Steady highway speed, neither accelerating nor decelerating; even pressure on accelerator pedal on level ground.

Controlled Rear Suspension Height

The height at which the components of a particular vehicle should be set when driveline angle measurements are made.

Deceleration / Coast

Slowing of vehicle by releasing foot from accelerator at cruise and allowing engine to slow vehicle without application of brakes.

Driveshaft (Propeller Shaft / Propshaft)

Shaft which powers the rear axle input shaft (pinion shaft). Also, the rearmost shaft in a two-piece shaft.

Drivetrain

Includes all power transmitting components from the engine to the wheels, including clutch / torque converter, transmission, transfer case, driveline and front or rear drive axles.

Engine Imbalance

Some component in the engine which is normally smoothly balanced now causing a perceptible vibration in the vehicle.

Engine Misfire

One or more cylinders in the engine fails to fire at the proper time.

Engine Run-Up Test

Operation of engine through normal rpm range with vehicle sitting still, transmission in neutral. Used for engine and accessory vibration check.

Damper

A tuned weight attached to back of transmission, transfer case, or axle to absorb vibration.

Flat Spots (Tires)

Commonly caused by letting vehicle stand while tires cool off. Can be cured by again operating vehicle until tires are warm. Also, regular tire wear patterns in the tire tread resulting from wheel-locked skids.

Flexible Coupling

A flexible joint in the exhaust pipe located between the catalytic converter and muffler, designed to eliminate binding conditions in the exhaust system and eliminate exhaust NVH.

Float

A cruising drive mode in which throttle setting matches engine speed to road speed, between cruise and coast.

Gravelly Feel

A grinding or growl in a component, similar to the feel experienced while driving on gravel.

Harshness

A harder than usual behavior of a component, like riding a vehicle with over-inflated tires.

Hz

Hertz (Cycles Per Second).

Imbalance (or Unbalance)

Out of balance; more weight on one side of a rotating component causing shake or vibration.

Inboard

Toward the centerline of the vehicle. (See Outboard.)

Isolate

Separate from the influence of other components.

NVH

Noise, Vibration, Harshness.

Neutral Engine Run-Up Test (NERU)

Operation of engine through normal rpm range with vehicle standing still, transmission in neutral. Used for engine and accessory vibration check.

Neutralize (Normalize)

To adjust to unstressed position. Used to describe various mounts and exhaust system hangers. (See Bound Up.)

Outboard

Toward the outside of the vehicle rather than toward the centerline. (See Inboard.)

Pinion Shaft (Stem)

The input shaft to a driving axle, usually a part of the smaller driving or input gear of a "Ring and Pinion" gear set.

Pumping Feel

A very slow vibration that results in a movement of vehicle components, similar to pumping the service brakes slightly.

Radial / Lateral

Radial is in the plane of rotation, lateral is at 90 degrees to the plane of rotation.

Ring Gear

The large gear, driven by the pinion gear of a "Ring and Pinion" driving axle gear set. Not applicable to transaxle.

Road Test

Operation of vehicle under conditions designed to recreate the problem condition.

Runout

Out of round or wobble.

Shake

Low frequency vibration, usually results in visual movement of components.

GLOSSARY OF TERMS (Continued)**Slip Yoke (Slip Spline)**

Driveshaft coupling device (half of a U-joint) which compensates for changes in shaft length due to articulation of axle; used at one end of driveshaft.

Tire Force Variation

Tire vibration caused by variations in the construction of the tire, resulting in a vibration when the tire rotates against the pavement. This condition may be present on perfectly round tires because of variations in the inner construction.

Two-Plane Balance

Radial and lateral balance.

Tire Deflection

Bending of the body of the tire during rotation.

T.I.R.

Total Indicated Runout.

Tip-In Moan

A light moaning noise heard when the vehicle is lightly accelerated, usually between 40-104 km/h (25-65 mph).




Vibration

Regular movement of a component that results in a sound or feel of movement.

SPECIFICATIONS

Refer to Section 05-00 for driveline specifications.

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number / Description	Illustration
TOOL-4201-C Dial Indicator with Bracketry	 TOOL-4201-C
T68P-4602-A Pinion Angle Level Gauge	 T68P-4602-A
T63L-8620-A Belt Tension Gauge	 T63L-8620-A

ROTUNDA EQUIPMENT

Tool Number	Description
006-01399	Strobe Light Balancer
007-0056A	Radial Run-out Gauge

SECTION 00-05 Roadability Diagnosis

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	00-05-1	VEHICLE APPLICATION	00-05-1
DIAGNOSIS	00-05-2		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and Bronco Vehicles

DESCRIPTION

Roadability describes the vehicle's capability to handle the road. The feel of the road is transmitted to the driver through the suspension, steering, and wheel and tire components.

The following conditions are related to roadability concerns:

- Wander is the tendency of the vehicle to require frequent, random left and right steering wheel corrections to maintain a straight path down a level road. It feels like the vehicle is slowly steering itself away from straight ahead without any steering input from the driver.
- Shimmy as observed by the driver, are large, consistent, rotational oscillations of the steering wheel resulting from large, side to side (lateral) tire / wheel movements. Shimmy is usually experienced near 64 km / h (40 mph), which may begin or be amplified when the tire contacts pot holes or irregularities in the road surface.
- Nibble — Sometimes confused with shimmy, nibble is a condition resulting from the tire interaction with various road surfaces and observed by the driver as small rotational oscillations of the steering wheel.
- Sticky Steering (Pointing) occurs when the self-aligning forces, or moments, at the tire patch are not enough to overcome friction or resistance in the steering system. In a normal condition these forces assist the driver in returning the steering wheel to within 20 degrees of where the steering wheel was positioned when driving straight ahead. A steering system with excessive resistance may hold the vehicle in a slight turn (or tend to stay pointed in the direction of the turn) when the steering wheel is turned between 20 and 90 degrees.
- A Drift / Pull condition will cause a vehicle to deviate from a straight ahead direction in the absence of any steering input (i.e., hands off the wheel). Drift / pull may be induced by conditions external to the vehicle (i.e., wind, road camber). However, a vehicle-related drift / pull, on a flat road, will cause a consistent deviation from the straight ahead path and require constant steering input in the opposite direction to counteract the effect. A pull is accompanied by a rotation of the steering wheel; a drift has no discernable steering wheel rotation.
- Poor Groove Feel is characterized by will have little or no build-up of turning effort felt in the steering wheel as the wheel is rocked slowly left and right within very small turns around center or straight ahead (under 20 degrees of steering wheel turn). Efforts may be said to be "flat on-center". Under 20 degrees of turn most of the turning effort that builds up comes from the mesh of gear teeth in the steering gear. In this range the steering wheel is not yet turned enough to feel the effort from the self-aligning forces at the road wheel or tire patch. In the diagnosis of a roadability problem it is important to understand the difference between wander and poor groove feel.
- Clear Vision — while driving the vehicle on flat pavement, steer the vehicle to obtain a straight path. Observe the angle between the spokes of the steering wheel and a level reference line of the instrument panel. The steering wheel should be approximately level or centered.

DIAGNOSIS

ROADABILITY DIAGNOSIS CHART

CONDITION	POSSIBLE SOURCE	ACTION
Wander or poor groove feel.	<ul style="list-style-type: none"> ● Improper tire pressure. ● Improper loading. ● Improper tire / wheel size. ● Steering linkage ball studs sloppy. ● Incorrect wheel alignment. ● Excessive spindle turning effort. ● Steering gear adjustment off. ● Loose suspension attachments. ● Worn ball joints. ● Worn control arm bushings. ● Loose wheel bearings. 	<ul style="list-style-type: none"> ● Inflate to specification. ● Weigh vehicle, balance and correct loading. ● Replace as necessary. ● Inspect and service. ● Align front end. ● Inspect, replace ball joints or kingpins (F-Super Duty). ● Measure / adjust preload / mesh load. ● Tighten as required. ● Inspect and replace as required. ● Inspect and replace as required. ● Check and adjust as required.
Shimmy.	<ul style="list-style-type: none"> ● Improper tire pressure. ● Improper / Worn wheels and tires. ● Loose suspension attachments and components. ● Tire imbalance. ● Weak shock absorber or steering damper control. ● Loose wheel bearings. ● Steering linkage ball joint looseness. ● Steering adjustment. ● Suspension ball joint or kingpin looseness. ● Tire non-uniformity. ● Alignment (toe) out of specification. ● Worn control arm bushings. ● Worn ball joints. ● Worn track bar bushings (F-350 4x4 and F-Super Duty). 	<ul style="list-style-type: none"> ● Inflate to specification. ● Replace as required. ● Inspect all attachments and check bushings for wear. ● Rebalance assemblies static / dynamic. NOTE: Center hole may not provide accurate centering for off-vehicle balancing. ● Service shocks or damper. ● Check and adjust per procedure. ● Inspect and service. ● Adjust yoke clearance. Measure / adjust preload / mesh load. ● Inspect, replace ball joints or kingpins. ● Check runouts of tires and wheels. ● Check and adjust. ● Inspect and replace bushings. ● Inspect and replace. ● Inspect and replace.
Steering binding (points, small angle returnability).	<ul style="list-style-type: none"> ● High spindle turning effort. ● Incorrect front wheel toe set (poor groove feel). ● Steering gear adjustment. ● Power steering control valve centering. ● Insufficient caster. 	<ul style="list-style-type: none"> ● Inspect and replace ball joints or kingpins (F-Super Duty). ● Measure and reset toe in. ● Measure / adjust preload / mesh load. ● Inspect and service. ● Check and adjust.
Drift / pull.	<ul style="list-style-type: none"> ● Tire pressure. ● Mismatched tires / wheels. ● Improper loading creating caster split. ● Tire conicity. ● Unequal tire circumferences. ● Improper toe set. ● Excessive caster split. ● Front wheel brake drag. ● Power steering control valve centering. ● Worn radius arm bushing. 	<ul style="list-style-type: none"> ● Inflate to specification. ● Service as required. ● Measure alignment. Balance vehicle load. ● Service through tire rotation. ● Measure and service. ● Measure and reset toe in. ● Check and adjust caster. ● Check during alignment. ● Check steering gear valve centering. ● Inspect and replace as required.
Clear vision error.	<ul style="list-style-type: none"> ● Incorrect toe setting. 	<ul style="list-style-type: none"> ● Inspect and correct.

GROUP

BODY 01

SECTION TITLE	PAGE	SECTION TITLE	PAGE
BODY PANELS.....	01-02-1	RESTRAINTS, PASSIVE, SUPPLEMENTAL AIR	
BODY STRIPES (TAPE) AND VINYL FILMS.....	01-18-1	BAG SYSTEM.....	01-20B-1
BUMPERS	01-19-1	SEAT/SHOULDER BELTS	01-20A-1
DOORS	01-03-1	SEATS AND ANCHORS, REAR AND SEAT BACK	
GLASS, FRAMES AND MECHANISMS	01-11-1	LATCH.....	01-10B-1
HANDLES, LOCKS, LATCHES AND		SEATS AND TRACKS, FRONT AND SEAT BACK	
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INSTRUMENT PANEL AND CONSOLE,		SEAT TRIM.....	01-10C-1
ECONOLINE	01-12B-1	TRIM, EXTERIOR, ECONOLINE.....	01-08B-1
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		WINDSHIELD WIPERS	01-16A-1

SECTION 01-01 Underbody

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING		SPECIAL SERVICE TOOLS/EQUIPMENT	01-01-3
Dust and Water Leaks	01-01-2	VEHICLE APPLICATION	01-01-1
GENERAL INFORMATION			
Type Of Sealers and Application	01-01-1		

VEHICLE APPLICATION

F-150-250-350, E-150-250-350 and Club Wagon,
F-Super Duty Chassis Cab and Bronco Vehicles

GENERAL INFORMATION

Type Of Sealers and Application

Since many sealers are used in vehicle assembly, the following all-purpose sealers have been selected for service use. The method and points of application are shown in each applicable group. Refer to the following Sealant Chart.

GENERAL INFORMATION (Continued)

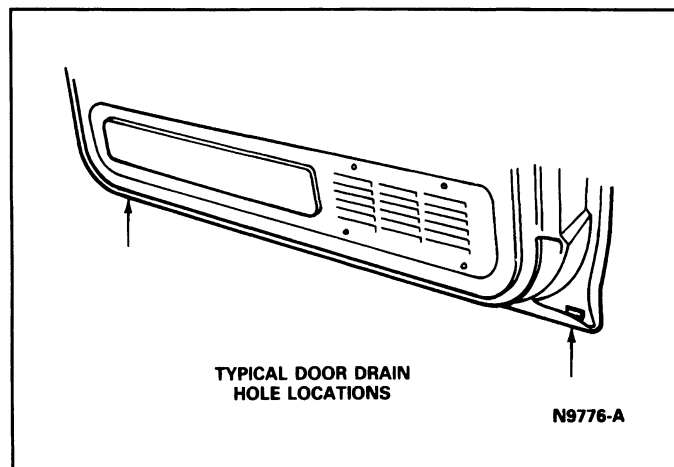
SEALANT CHART

Description	Type	Usage
Caulking Cord D6AZ-19560-A (meets Ford Specifications ESB-M4G32-A)	Plastic base with filler; is heavy bodied and commonly known as Perma-gum.	Spot weld holes around mounting clips and between two surfaces not sealed by a gasket. Apply with putty knife.
Weatherstrip Adhesive E8AZ-19552-A (meets Ford Specifications ESB-M2G14-A)	Quick-drying, strong.	Cement weatherstrip to doors, bodies, cowl ventilators and surrounding metal. Windows and windshields sealed against wind and water leaks.
Liquid Butyl Sealer C9AZ-19554-A (meets Ford Specifications ESB-M4G162-A)	Fast drying, does not run, remains semi-elastic.	Sealing seams in areas such as floor pan, wheelhouse, dash panel, running board, door openings and drip rails, outside moulding clip holes, windshield and back window installation.

DIAGNOSIS AND TESTING

Dust and Water Leaks

CONDITION	POSSIBLE SOURCE	ACTION
Dust leak	<ul style="list-style-type: none"> ● Cowl trim panel, kick pads, and floor mats. 	<ul style="list-style-type: none"> ● Remove trim. Check for leaks and seal with appropriate sealer. Road test for leaks. Recheck trim for leaks. Or use light under vehicle with trim removed. Check interior of body at joints and weld lines.
Dust / water leaks at floor pan and grommets	<ul style="list-style-type: none"> ● Missing or damaged plugs and / or grommets. 	<ul style="list-style-type: none"> ● Check plugs for proper installation.
Drain holes collecting water	<ul style="list-style-type: none"> ● Holes clogged with mud or road tar. 	<ul style="list-style-type: none"> ● Check drain holes regularly. Clean drain holes of dirt and foreign material with a punch or screwdriver. Refer to the illustration for location.
Wind noise, air entering vehicle through small holes in body	<ul style="list-style-type: none"> ● Leaks at door and window seals or sheet metal joints in doors or door openings. 	<ul style="list-style-type: none"> ● Seal leaks with RTV sealant and foam tape. Road test. Or use a Rotunda Vacuum / Air / Water Leak Detector 055-0013 or equivalent to obtain a water leak reading. Recheck for leaks using detector. Road test.
Rattles	<ul style="list-style-type: none"> ● Loose screws, nuts, bolts, small pieces of body deadener in door wells, pillars, and quarter panels. ● If tightening bolts and screws does not eliminate rattle, cause could be misalignment. ● Weatherstripping and anti-squeak material has slipped out of position. 	<ul style="list-style-type: none"> ● Check doors by carefully striking underside of door with a mallet; listen for loose objects in door. Repair. Tighten body bolts and screws. ● Refer to Section 01-04 for adjustment and alignment procedures. ● Apply additional cement or other adhesive; install in proper location to eliminate rattle.

DIAGNOSIS AND TESTING (Continued)**SPECIAL SERVICE TOOLS/EQUIPMENT****ROTUNDA EQUIPMENT**

Tool Number	Description
055-00103	Vacuum / Air / Water Leak Detector

SECTION 01-02 Body Panels

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Hood Adjustment, E-150-250-350	01-02-7	E-150-250-350	01-02-1
Hood Adjustment, F-150-250-350, F-Super Duty Chassis Cab and Bronco	01-02-6	F-150-250-350, F-Super Duty Chassis Cab and Bronco	01-02-1
Hood Latch Adjustment, F-150-250-350, F-Super Duty Chassis Cab, E-150-250-350 and Bronco	01-02-7	Hood Hinge	01-02-1
Hood Latch, Remote Control Cable, E-150-250-350, F-150-250-350, F-Super-Duty Chassis Cab and Bronco	01-02-8	E-150-250-350	01-02-2
REMOVAL AND INSTALLATION		F-150-250-350, F-Super Duty Chassis Cab and Bronco	01-02-1
Front Fender	01-02-2	Hood Latch	01-02-2
E-150-250-350 and Club Wagon	01-02-5	REPAIR OPERATION	
F-150-250-350, F-Super Duty Chassis Cab and Bronco	01-02-2	Fiberglass Repair, Econoline Safety Precautions	01-02-10
Hood	01-02-1	Painting	01-02-10
		Repair Procedure, General	01-02-10
		SPECIFICATIONS	01-02-10
		VEHICLE APPLICATION	01-02-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab and Bronco Vehicles

REMOVAL AND INSTALLATION

Hood

F-150-250-350, F-Super Duty Chassis Cab and Bronco

Removal and Installation

1. Remove the two link assembly bolts.
2. Remove the hood hinge bolts. With an assistant, lift the hood off the hinges.
3. If replacing hood, transfer the hood latch components and ornaments to the new hood.
4. With the aid of an assistant, position hood on the hinges and install the hinge bolts snug.
5. Install link assembly to hood with two bolts.
6. Adjust the hood for a proper fit by shifting the hood on the hinges. Tighten the hinge bolts.
7. Adjust the hood latch for proper alignment. Refer to hood latch adjustment procedure in this section.

E-150-250-350

Removal

1. Open the hood. Retain in the open position.
2. Cover the cowl area to prevent paint damage.
3. Remove hinge-to-hood attaching screws or nuts.
4. Remove the hood from the vehicle.
5. Remove the hood lock striker from the hood.

Installation

1. Position hood to hood hinges. Install the attaching screws or nuts.
2. Adjust the hood as outlined in this section. Tighten the hood-to-hinge attaching screws or nuts to 17-27 N·m (13-19 ft·lb).
3. Install the hood lock striker on the hood and adjust the hood latch if required.

Hood Hinge

F-150-250-350, F-Super Duty Chassis Cab and Bronco

Refer to the illustrations under Adjustments.

Removal

1. Open the hood. Retain hood in open position with a suitable prop.
2. Mark the hinge(s) locations.

3. Remove four hinge-to-hood attaching screws.

NOTE: Do not allow the hood to slide down as damage to the cowl top may result.

4. Remove the hinge attaching bolts and remove the hinge from the vehicle.

Installation

1. Position the new hinges to the vehicle. Install the attaching bolts snug.

REMOVAL AND INSTALLATION (Continued)

2. Position the hood to the hinges. Install the four attaching screws snug.
3. Adjust the hood as outlined in this section. Tighten the hinge attaching screws to 17-27 N-m (13-19 ft-lb).
4. Remove the protective cover and close the hood.

E-150-250-350**Removal and Installation**

1. Open the hood. Retain hood in the open position.
2. Cover the cowl area to prevent paint damage.
3. Remove hinge-to-body attachments. Remove hood.
4. Remove hinge-to-hood attachments. Remove the hinge.

For installation, perform removal procedures in reverse order. Adjust hood, refer to hood adjustment in this section.

Hood Latch**Removal and Installation**

Mark location of hood latch prior to removal to aid in positioning of new latch when installed.

1. If equipped, remove the hood latch cable plate screw, the cable plate, cable clip and cable from the hood latch.
2. Remove the hood latch attaching screws. Remove the latch assembly.
3. Position the latch assembly. Install the attaching screws snug, but do not tighten.
4. Install the hood release cable, cable clip, hood latch cable plate and cable plate screw.
5. Adjust the latch assembly for positive engagement with the hood latch striker. Tighten the latch attaching screws. Refer to Specifications in this section.
6. Lubricate the latch handle pivot, catch pawls and spring with Multi-Purpose Grease Spray D7AZ-19584-AA (ESR-M1C159-A and ESB-M1C106-A) or equivalent.
7. Check the latch mechanism alignment by opening and closing hood several times.
8. Make sure lubricant has effectively worked into the pivot points and bearing surfaces.

NOTE: Latch should be lubricated every six months, to ensure smooth operation.

Front Fender**F-150-250-350, F-Super Duty Chassis Cab and Bronco****Removal**

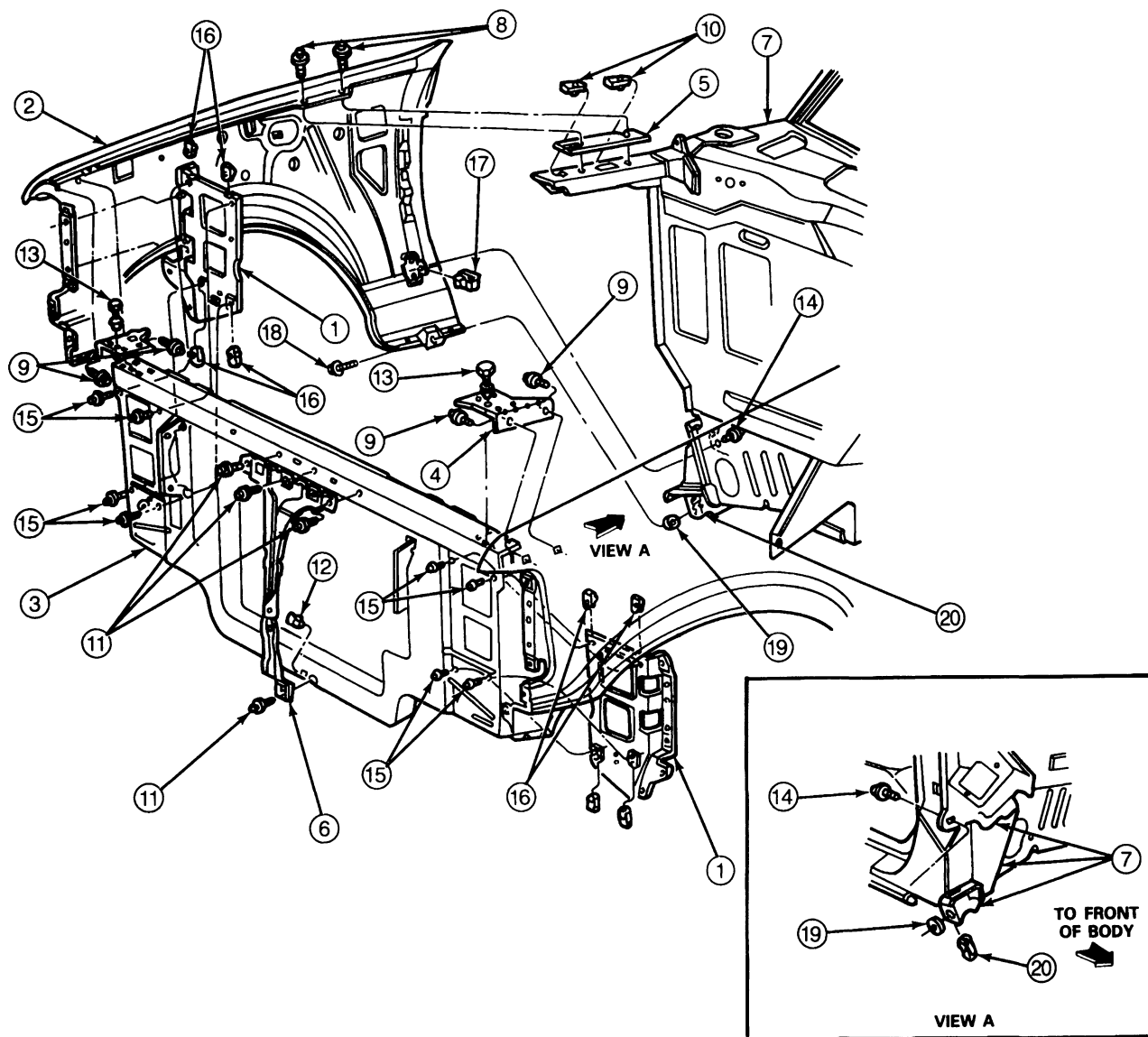
1. Clean all dirt from the fender attaching screws, bolts and nuts.
2. Remove headlamp assemblies from the vehicle. Refer to Section 17-01.
3. Remove the screws attaching the front of the fender to the radiator support at upper and lower locations.
4. Remove one screw attaching the rear lower end of the fender to the lower corner of the cab.
5. Remove one screw from inside the cab attaching the rear lower end of the fender to the cowl.
6. Remove the top edge fender screws to the cowl extension.
7. Remove screws around wheel opening attaching the fender apron.
8. Remove apron bolts to fender.
9. Remove bolts attaching battery tray to fender (right side only) and bolts attaching auxiliary battery tray or tool box (left side only) (both R.P.O.).
10. Remove hood latch cable from left fender and main wiring harness from right fender.
11. Remove hood prop spring screws to the fender. Remove fender.

Installation

1. Position the fender nuts and retainers.
2. Apply sealer to the apron upper edge.
3. Position the fender to apron and loosely install the screws.
4. From inside the cab, loosely install rear lower end fender attaching screw to cowl.
5. Loosely install a fender rear lower end screw to cab cowl.
6. Loosely install front fender screws to radiator support.
7. Loosely install rear top edge of fender screw to cowl extension.
8. Loosely install the bolts, attaching the battery tray to fender (right side only) and bolts attaching auxiliary battery tray or tool box (left side only) (both R.P.O.).
9. Adjust the fender position and tighten all mounting screws and bolts to specifications listed at the rear of this section.
10. Install the hood prop spring to the fender.
11. Install headlamp assemblies. Refer to Section 17-01.

REMOVAL AND INSTALLATION (Continued)

Front Fender Installation, F-150-250-350, F-Super Duty Chassis Cab and Bronco



N9807-A

Item	Part Number	Description
1	16C198	Bracket Assembly
2	16005	Fender Assembly
3	8A927	Radiator Support
4	16B072	Fender to Radiator Support Reinforcement
5	16D162	Front Fender Shim
6	16864	Hood Latch Support Brace
7	Ref.	Dash Panel and Cowl Side
8	N802984-S55	Bolt 23.4-31.6 N·m (17.2-23.3 Ft-Lb)
9	N606689-S55	Screw and Washer 23.4-31.6 N·m (17.2-23.3 Ft-Lb)
10	N801107-S100	Nut

(Continued)

Item	Part Number	Description
11	N606689-S36M	Screw and Washer 25.5-34.5 N·m (18.8-25.4 Ft-Lb)
12	N623332-S100	Nut
13	N806891-S	Nut
14	N803506-S36	Bolt 12-18 N·m (106-160 In-Lb)
15	N805230-S55	Screw and Washer 9.0-14.0 N·m (79.6-123.9 In-Lb)
16	N800854-S100	Nut
17	N800296-S101	U-Nut
18	N803506-S36	Bolt 23.4-31.6 N·m (17.2-23.3 Ft-Lb)

(Continued)

REMOVAL AND INSTALLATION (Continued)

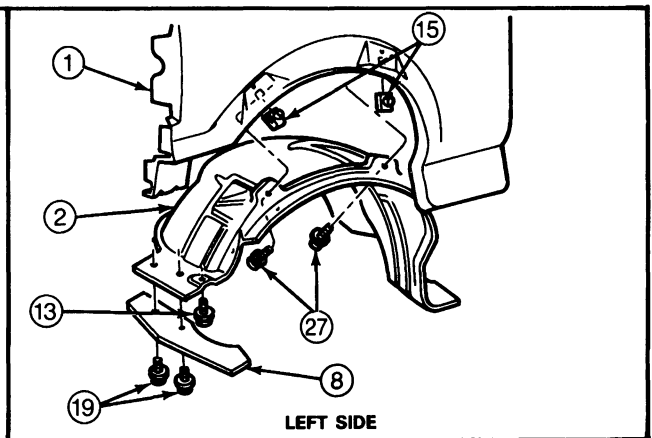
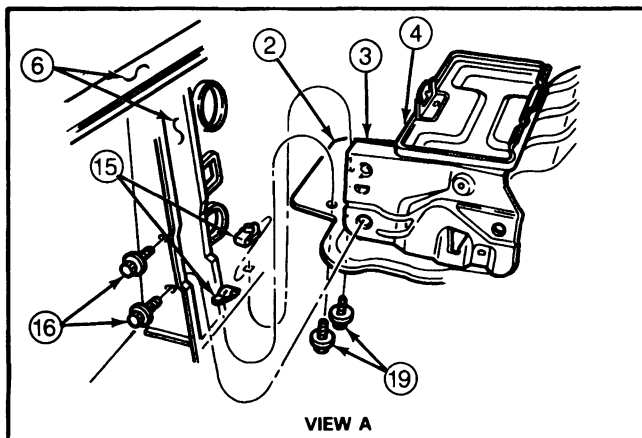
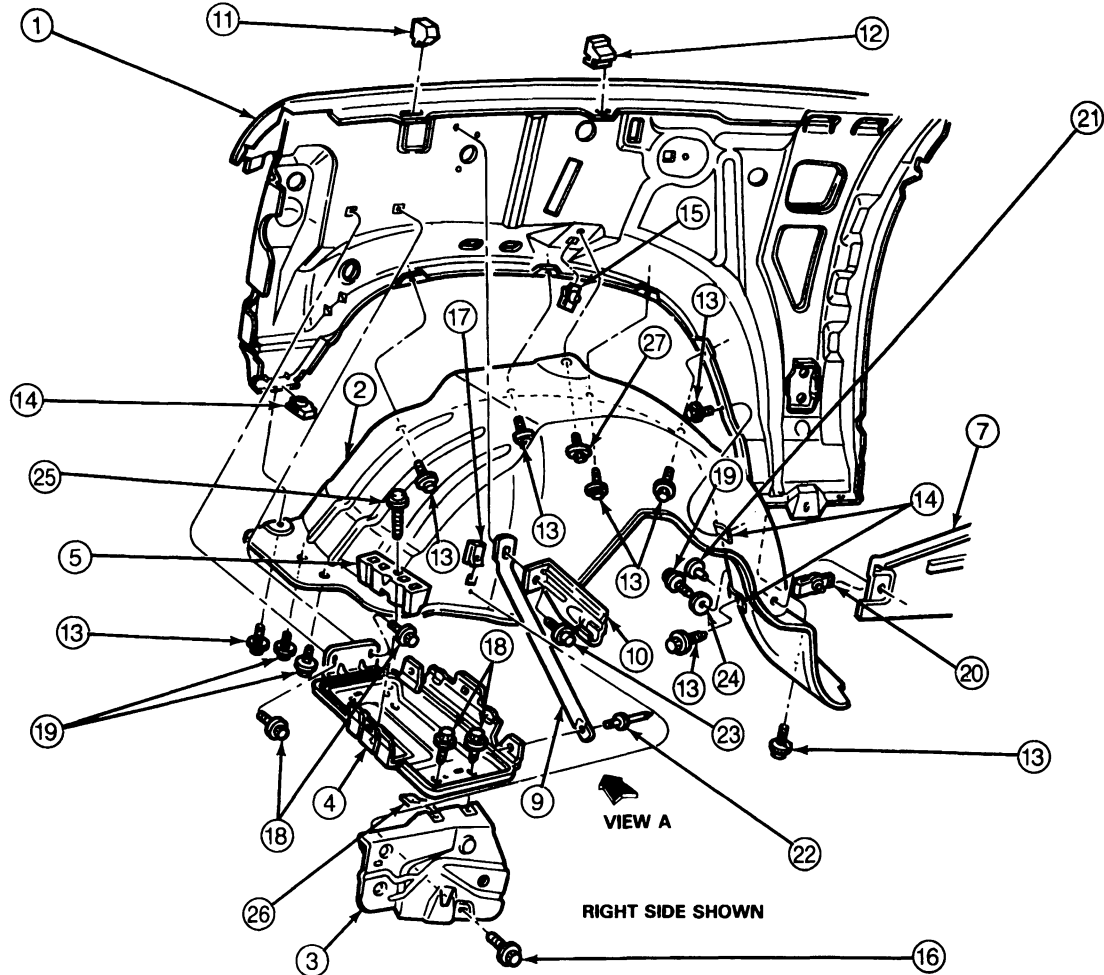
Item	Part Number	Description
19	N801256-S36 or 44725-S2	Washer

Item	Part Number	Description
20	N800538-S100	Nut

TN9807A

(Continued)

Front Fender Apron Installation, F-150-250-350, F-Super Duty Chassis Cab and Bronco



N9809-A

REMOVAL AND INSTALLATION (Continued)**FRONT FENDER APRON INSTALLATION, F-150-250-350, F-SUPER DUTY CHASSIS CAB AND BRONCO (LEGEND)**

Item No.	Part Number	Description
1	Ref.	Fender
2	16044	Fender Apron
3	10A812	Battery Tray Support Reinforcement
4	10723	Battery Tray
5	10747	Battery Hold Down
6	Ref.	Radiator Support
7	Ref.	Front Floor Side Member
8	9F721	Air Cleaner Deflector
9	10N697	Battery Tray Brace
10	17A140	Jack Handle Retainer Bracket
11	N806649-S	Hood Bumper
12	N806650-S	Hood Bumper
13	N800322-S55	Screw 1.0-2.2 N•m (8.8-19.4 In-Lb)
14	45260-S100	U-Nut
15	N623332-S100	Nut

Item No.	Part Number	Description
16	N606688-S55	Bolt 22-34 N•m (17-25 Ft-Lb)
17	N623333-S100	Nut
18	N803506-S55	Bolt 22-34 N•m (17-25 Ft-Lb)
19	N800576-S55	Bolt 9.0-14.0 N•m (79.6-123.9 In-Lb)
20	N800925-S100	U-Nut
21	388930-S	Pushpin
22	382707-S	Rivet
23	N606675-S55	Screw and Washer 9.0-14.0 N•m (79.6-123.9 In-Lb)
24	358870-S36B	Washer
25	N803471-S55	Screw and Washer 8.0-12.0 N•m (70.8-106.2 In-Lb)
26	N800296-S100	Nut
27	N800322-S55	Screw 9.0-14.0 N•m (79.6-123.9 In-Lb)

CN9810-A

E-150-250-350 and Club Wagon**Removal**

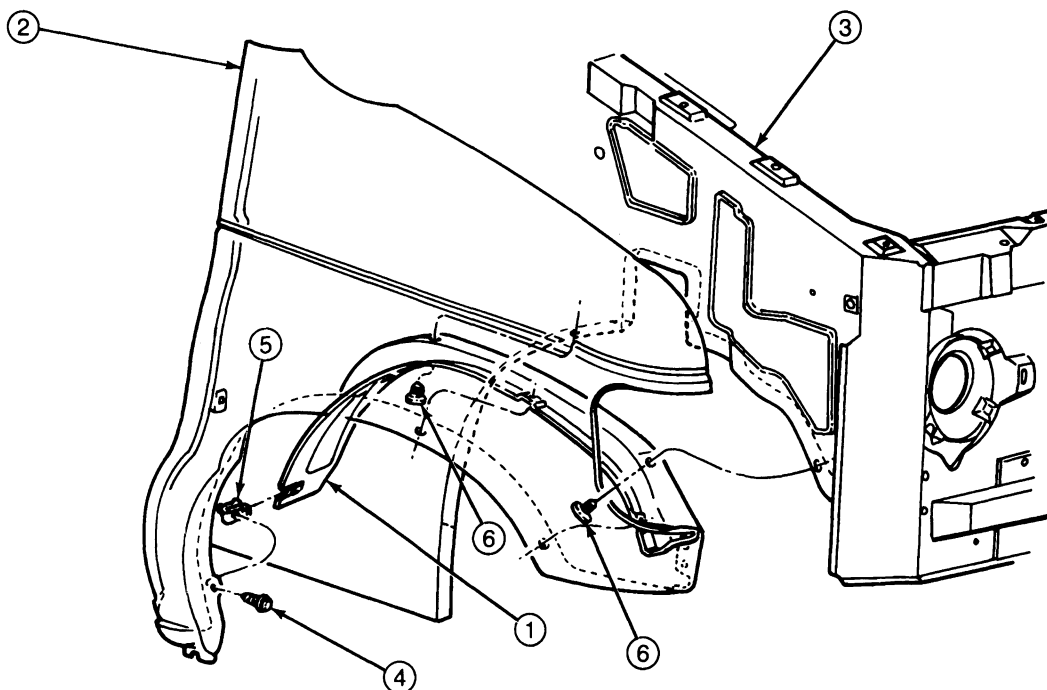
1. Remove the radiator grille as outlined in Section 01-08.
2. Remove the two side bolts attaching the end of the radiator grille opening lower panel to the fender.
3. Remove the three screws at fender lower edge to the wheel housing.
4. Remove the lower fender rear attaching screw and shim(s).
5. Open the door and remove the upper fender rear attaching screw and shim(s).

6. Remove the two screws at fender front edge to the radiator support.
7. Remove the three screws and shim(s) attaching the top edge of the fender, and remove fender.

Installation

To install the front fender, reverse Steps 1 through 7.

Loosely install all attaching screws until the fender is adjusted for proper fit and appearance. Do not exceed two shims at any location except at the lower fender rear attaching screw. When all shims are installed, tighten all attaching screws to specifications listed at the rear of this section. Then install the radiator grille as outlined in Section 01-08.

REMOVAL AND INSTALLATION (Continued)**Front Fender Apron Installation, E-150-250-350**

N9811-A

Item	Part Number	Description
1	16B560	Front Fender Apron Splash Shield
2	Ref.	Front Fender
3	Ref.	Body Side

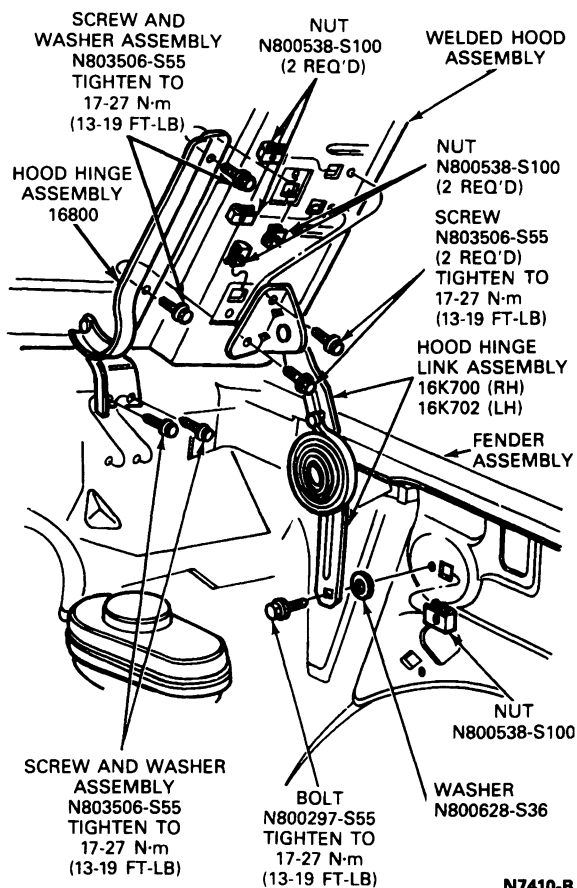
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Item	Part Number	Description
4	56912-S55	Screw and Washer 1.0-2.0 N-m (8.8-17.7 In-Lb)
5	384816-S100	Spring Nut
6	388577-S	Push Pin

TN9811A

ADJUSTMENTS**Hood Adjustment, F-150-250-350, F-Super Duty Chassis Cab and Bronco**

1. Open hood and mark hinge and latch assembly locations.
2. Loosen hinge-to-fender inner attaching screws.

ADJUSTMENTS (Continued)**Hood, Hinge Installation, F-150-250-350, F-Super Duty Chassis Cab and Bronco**

3. Adjust the hinge up or down or rotate as required to obtain a flush fit between the hood and top of cowl panel. Tighten hinge-to-fender inner attaching bolts.
4. Loosen two hood latch assembly attaching screws.
5. Loosen the hinge-to-hood attaching screws.
6. Move the hood forward or rearward and from side to side as required for a proper hood fit. Then, tighten the hinge-to-hood attaching screws.
7. Move the latch from side to side as required to center the latch with the hood striker. Tighten the hood latch attaching screws.
8. Lubricate each hood hinge at all pivot points with Multi-Purpose Grease Spray D7AZ-19584-AA (ESR-M1C159-A and ESB-M1C106-B) or equivalent.
9. Check hood and hinge alignment, by opening and closing hood several times.
10. Make sure lubricant has worked into pivot points.

Hood Adjustment, E-150-250-350

The hood can be adjusted fore and aft and up and down to obtain the proper clearance.

1. To adjust the hood, loosen the hood-to-hinge fore-or-aft adjustment or the hinge-to-cowl up-or-down adjustment until they are snug.
2. Position the hood as required, and tighten the attaching screws.
3. After the hood has been adjusted, check the hood latch adjustment.
4. Adjust the hood latch if required. Refer to the proper procedures within this section for hood latch adjustment.

Hood Latch Adjustment, F-150-250-350, F-Super Duty Chassis Cab, E-150-250-350 and Bronco

Before adjusting the hood latch, make sure the hood is properly aligned. Refer to the proper procedures within this section for hood alignment. The hood latch can be moved from side to side and up and down to obtain a snug hood fit.

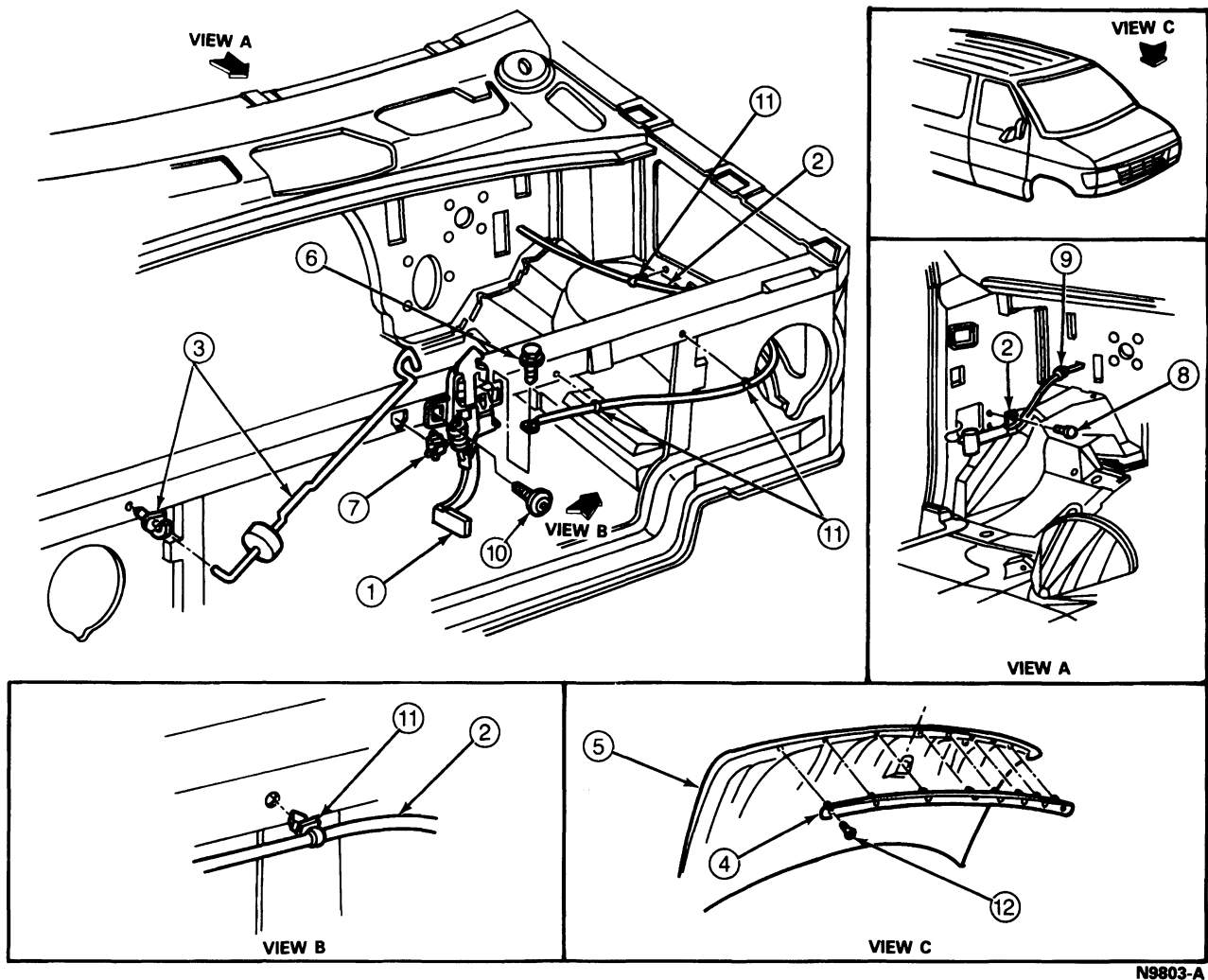
NOTE: If the hood latch is being replaced simply install the new latch using the locator pins on the backside of the latch, then tighten the latch attaching screws. If the hood, fenders or radiator support were replaced or repaired, the locator pins should be easily hammered out backside of the latch, follow the hood latch adjustment procedure below:

1. Loosen hood latch attaching screws enough to move latch.
2. Move the latch until aligned with hood latch striker. Tighten the latch attaching screws to 9-14 N-m (79.6-123.9 in-lb).
3. Check the hood latch for full engagement with the hood latch striker. If the hood latch does not make full engagement with the hood latch striker, repeat Steps 1 and 2.
4. Lubricate the latch handle pivot, catch pawls and spring with Multi-Purpose Grease Spray D7AZ-19584-AA (ESR-M1C159-A and ESB-M1C106-B) or equivalent.
5. Check the functional operation of the latch mechanism by opening and closing the hood several times to ensure alignment is correct. Make sure lubricant has effectively worked into the pivot points and bearing surfaces.

NOTE: Latch should be lubricated every six months, to ensure smooth operation.

ADJUSTMENTS (Continued)

Hood Latch, Prop Rod and Cable Release, E-150-250-350



N9803-A

Item	Part Number	Description
1	16700	Latch Assembly
2	16C656	Cable Assembly
3	16A931	Hood Support Rod
4	—	Hood Seal
5	Ref.	Hood
6	387514-S55	Screw 1.8-2.6 N·m (16.0-23.0 In·Lb)

(Continued)

Item	Part Number	Description
7	16B730	Hood Support Rod Retainer
8	N802141-S58	Screw 2.7-3.7 N·m (23.8-32.7 In·Lb)
9	N806495-S	Grommet
10	N802850-S55	Screw 9-14 N·m (79.6-123.9 In·Lb)
11	386132-S	Push-In Clip
12	—	Pushpin

TN9803A

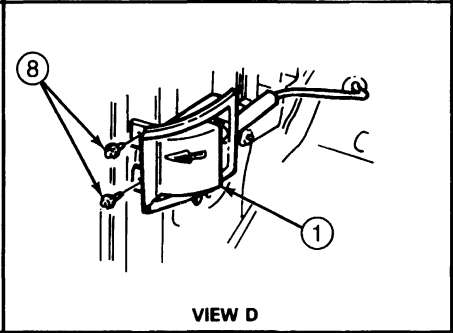
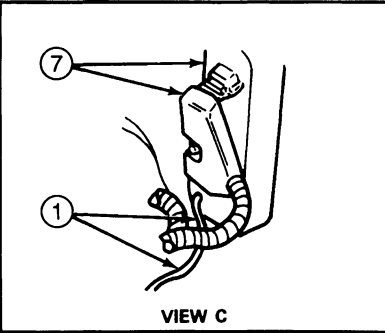
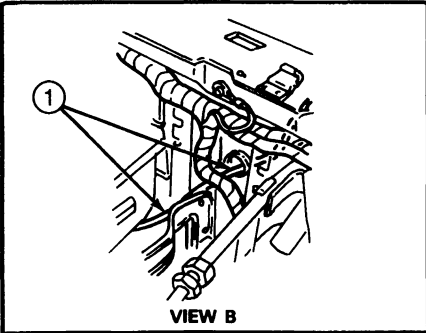
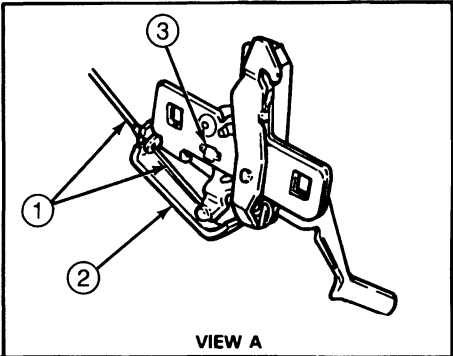
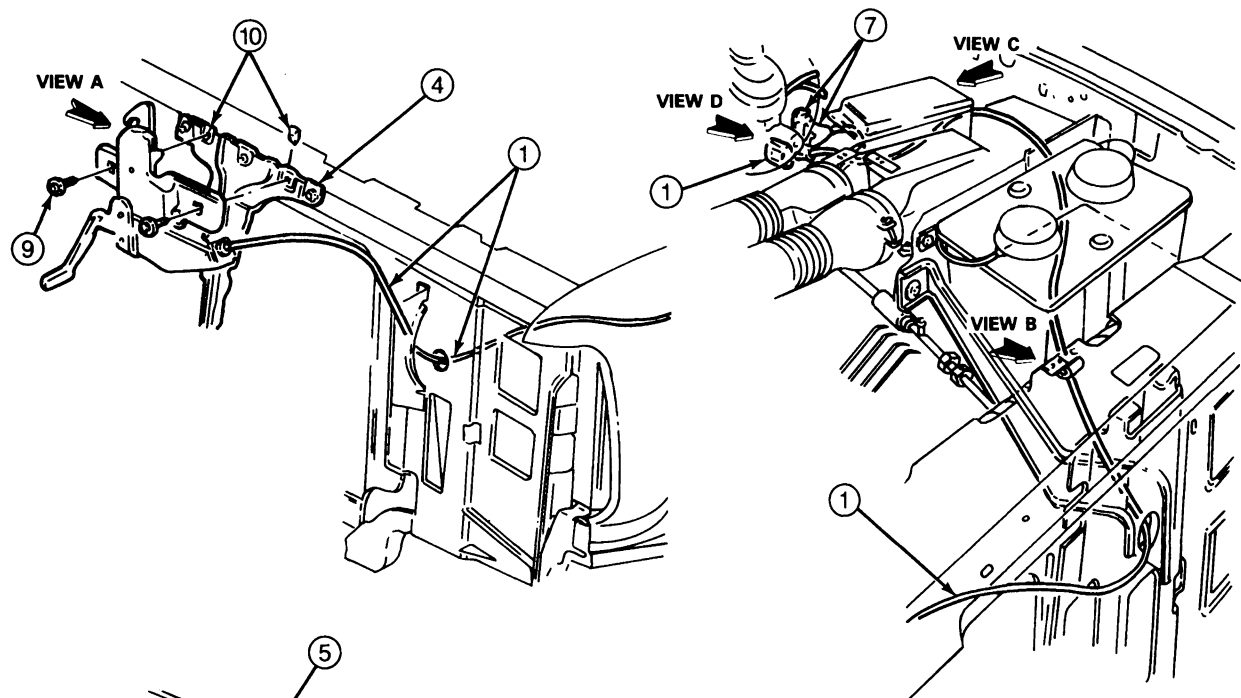
Hood Latch, Remote Control Cable, E-150-250-350, F-150-250-350, F-Super-Duty Chassis Cab and Bronco

The remote control-operated hood latch is adjusted the same as the non-remote latch.

The release cable and handle is routed as shown in the following illustrations.

ADJUSTMENTS (Continued)

Hood Latch and Cable Assembly, F-150-250-350 and Bronco



N9805-A

Item	Part Number	Description
1	16C656	Cable Assembly
2	16700	Latch Assembly
3	16917	Cable Clip

(Continued)

Item	Part Number	Description
4	Ref.	Hood Latch Support Brace
5	Ref.	Hood
6	16C644	Hood Assist Spring
7	Ref.	Powertrain Control Module

(Continued)

ADJUSTMENTS (Continued)

Item	Part Number	Description
8	N802141-S58	Screw and Washer 2.7-3.7 N-m (23.8-32.7 In-Lb)
9	N803878-S55M	Screw and Washer 22-34 N-m (17-25 Ft-Lb)

(Continued)

Item	Part Number	Description
10	N804222-S100	U-Nut
11	N606688-S43B	Screw and Washer 22-34 N-m (17-25 Ft-Lb)
12	N623333-S100	U-Nut

TN9805A

REPAIR OPERATION**Fiberglass Repair, Econoline
Safety Precautions**

1. Always use rubber gloves or the special hand cream supplied with epoxy resin repair kits. **REMOVE ANY RESIN FROM HANDS AS SOON AS POSSIBLE AND PARTICULARLY BEFORE THE MIXTURE STARTS TO GEL.** Any resin that adheres to the hands may be removed with lacquer thinner followed by a thorough washing with soap and water.
2. Use a respirator when grinding the fiberglass surface and use a vacuum attachment when operating a belt sander.
3. Always work in a well-ventilated area to avoid possible toxic fumes that may result from using resin mixtures. Do not get resin on clothing.
4. Keep all materials, utensils and the work area clean and dry as resin repairs involve chemical reactions. Any dirt, foreign material or moisture may upset the chemical reaction and result in an unsatisfactory repair.

- If low spots exist, fill with resin mixture to which short fibers cut from the fiberglass cloth have been added. Add enough on the cloth to form a putty-like resin mixture.

Painting

After the desired repaired surface has been obtained, prime and paint the surface in the normal manner.

SPECIFICATIONS**TORQUE SPECIFICATIONS: F-150-250-350, F-SUPER
DUTY CHASSIS CAB AND BRONCO**

Description	N-m	Lb-Ft
Hood Hinge Assembly Screw(s) and Washer(s)	17-27	13-19
Hood Hinge Link Assembly to Fender Bolt	17-27	13-19
Link Assembly to Hood Screw(s)	17-27	13-19
Hood Latch to Cowl Panel	17-27	13-19
Cable Screw(s) (F-150, 250, 350 and Bronco)	2.7-3.7	23.8-32.7 In-Lb
Hood Assist Spring Screw (F-150-250-350 and Bronco)	22-34	17-25
Latch Assembly	22-34	17-25
Fender to Radiator Support Screw(s) and Washer(s)	23.4-31.6	17.2-23.3
Fender to Cowl Extension Bolt(s)	23.4-31.6	17.2-23.3
Hood Latch Support Brace Screw	25.5-34.5	18.8-25.4
Dash Panel and Cowl Side Bolt	12-18	106-160 In-Lb
Radiator Support to Bracket Assembly Screw(s) and Washer(s)	9.0-14.0	79.6-123.9 In-Lb
Apron Bolt(s)	23.4-31.6	17.2-23.3
Fender Apron to Fender Screw(s)	1.0-2.2	8.8-19.4
Radiator Support Bolt(s)	22-34	17-25
Battery Tray to Fender Bolt(s)	22-34	17-25
Lower Apron to Fender Bolt(s)	9.0-14.0	79.6-123.9 In-Lb
Jack Handle Retainer Bracket Screw(s) and Washer(s)	9.0-14.0	79.6-123.9 In-Lb

(Continued)

Repair Procedure, General

Grind or sand away all loose or broken material at the damaged area. Scuff sand the surface approximately 25.4mm (1 inch) around the area to provide a good bonding surface. Make sure the surface to be repaired is clean, dry, oil and paint free.

Cracks

- Form a shallow V-shape along the crack with a file or grinder.
- Fill the area with a good quality polyester or epoxy body repair compound. Follow the manufacturer's directions with regard to mixing procedures.
- Allow the compound to harden and then sand smooth.
- If the surface is not level or smooth, use an additional filling and sand to a final smooth finish.

Larger Broken Areas

- Use fiberglass cloth (five layers) impregnated with the resin, to cover the area. Overlap the damaged portion by 25.4-50.8mm (1-2 inches).
- When the material has hardened, file or grind and sand smooth.

SPECIFICATIONS (Continued)**TORQUE SPECIFICATIONS: F-150-250-350, F-SUPER
DUTY CHASSIS CAB AND BRONCO (Cont'd)**

Description	N-m	Lb-Ft
Battery Hold-Down Screw(s) and Washer(s)	8.0-12.0	70.8-106.2 In-Lb
Center Apron to Fender Screw(s)	9.01-14.0	79.6-123.9 In-Lb
Hood Latch to Cable Assembly	1.8-2.6	16.0-23.0 In-Lb

(Continued)

**TORQUE SPECIFICATIONS: F-150-250-350, F-SUPER
DUTY CHASSIS CAB AND BRONCO (Cont'd)**

Description	N-m	Lb-Ft
Hood Latch Screw(s)	9-14	79.6-123.9 In-Lb
Cable Assembly Screw	2.7-3.7	23.8-32.7 In-Lb
Apron to Fender Lower Screw(s) and Washer(s)	1.0-2.0	8.8-17.7 In-Lb

SECTION 01-03 Doors

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Door Alignment.....	01-03-14	Door Hinge, Bronco, F-150-250-350, F-Super	
Sliding Door.....	01-03-12	Duty and E-150-250-350.....	01-03-5
Fore and Aft Adjustment.....	01-03-13	Door Weatherstrips	01-03-7
In or Out Adjustment.....	01-03-12	E-150-250-350	01-03-7
Up or Down Adjustment	01-03-12	F-150-250-350, F-Super Duty Chassis Cab	
CLEANING AND MAINTENANCE		and Bronco	01-03-9
Door and Window Weatherstrip		Secondary Weatherstrip.....	01-03-9
Lubricant	01-03-12	Door, Sliding, E-150-250-350	01-03-2
Door, Hood and Tailgate Hinges,		Doors	01-03-4
Lubricant	01-03-12	Lower Guide Assembly E-150-250-350.....	01-03-2
Lock Cylinder Lubricant.....	01-03-12	Striker, Front and Rear Sliding Door	01-03-4
DESCRIPTION AND OPERATION		Tailgate	01-03-5
Sliding Door.....	01-03-1	F-150-250-350 Pickup.....	01-03-5
REMOVAL AND INSTALLATION		Tailgate Weatherstrip Assembly.....	01-03-11
Center Hinge, Sliding Door,		Upper Bracket and Roller Assembly, Sliding	
E-150-250-350	01-03-2	Door, E-150-250-350	01-03-1
Check Straps, Cargo Side and Back Doors,		SPECIFICATIONS	01-03-17
E-150-250-350	01-03-4	VEHICLE APPLICATION	01-03-1

VEHICLE APPLICATION

E-150-250 F-150-250, F-Super Duty Chassis Cab and Bronco

DESCRIPTION AND OPERATION

Sliding Door

The door is operated by rotating the inside or outside handle rearward to release the latch and by sliding the door rearward to the full open position. When the door has been pushed fully rearward, the hold-open check will activate and prevent the door from inadvertently closing. There are no intermediate hold-open positions. To close the door, the inside or outside handle must be activated forward to release the door from the check position.

For a thorough description of sliding door, latch, and lock operation, refer to Section 01-14A.

REMOVAL AND INSTALLATION

Upper Bracket and Roller Assembly, Sliding Door, E-150-250-350

Removal and Installation

1. Remove the upper garnish molding. Open and support the door.
2. Remove upper bracket trim cover.
3. Mark the location of the upper bracket assembly to the door.
4. Remove the screws retaining the bracket.
5. Remove upper stop assembly.
6. Remove the assembly from the door, through opening at the back of the upper track.
7. Position the new bracket to the door. Install the three retaining screws.
8. Install upper stop assembly.
9. Adjust door to obtain proper fit, as described in this section.

REMOVAL AND INSTALLATION (Continued)**Lower Guide Assembly E-150-250-350****Removal and Installation**

1. Open and support the door.
2. Remove step well cover and latch guide cover and lower guide check nuts and remove check.
3. Slide door forward on support to access lower guide attaching screws.
4. Mark the location of the lower guide bracket to the door.
5. Remove the guide attaching screws.
6. Disconnect the stop actuating cable from the lower latch assembly.
7. Remove the guide assembly.
8. Remove lower latch assembly from lower guide assembly.

For installation, follow removal procedures in reverse order.

6. Operate door. Check for proper operation and alignment.
7. Install door trim. Refer to Section 01-05B.

Door, Sliding, E-150-250-350**Removal and Installation**

1. Open door.
2. Remove following trim items: upper garnish moldings, rear quarter panels, lower stepwell panel, and lower guide latch cover.
3. Remove lower latch assembly from lower guide assembly. Refer to Section 01-14A.
4. Remove upper stop assembly and lower check assembly from tracks.
5. Remove center track shield.
6. Slide the door fully rearward and remove by tilting front upper corner inward until upper roller is out of track.
7. Lift lower roller assembly upward out of track.
8. Remove rear center roller from track.
9. Remove door from vehicle.

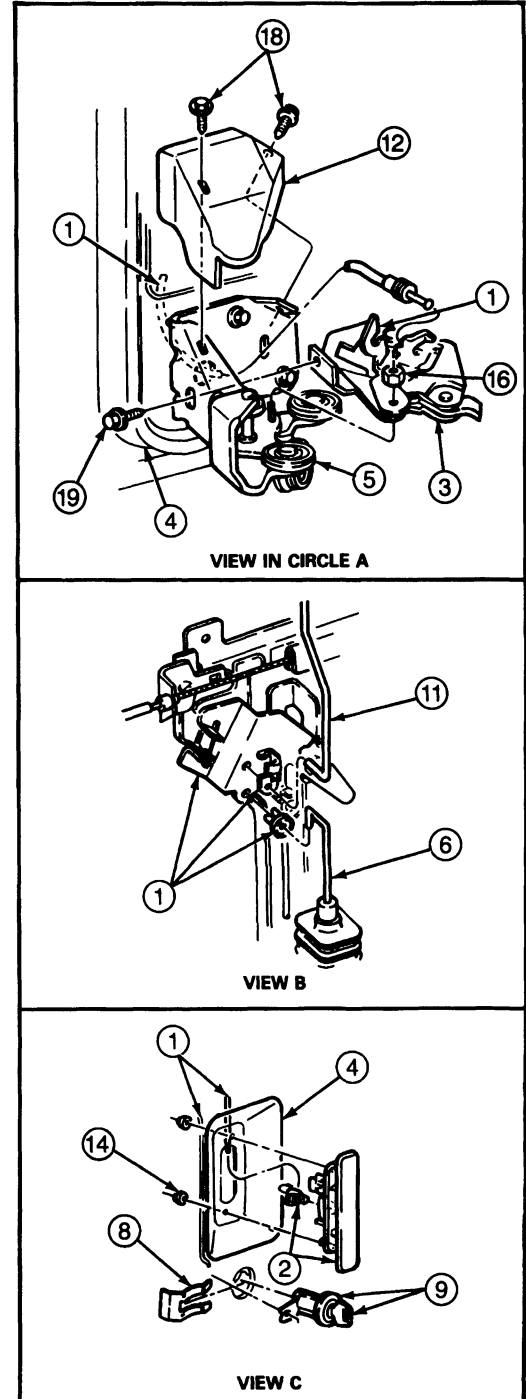
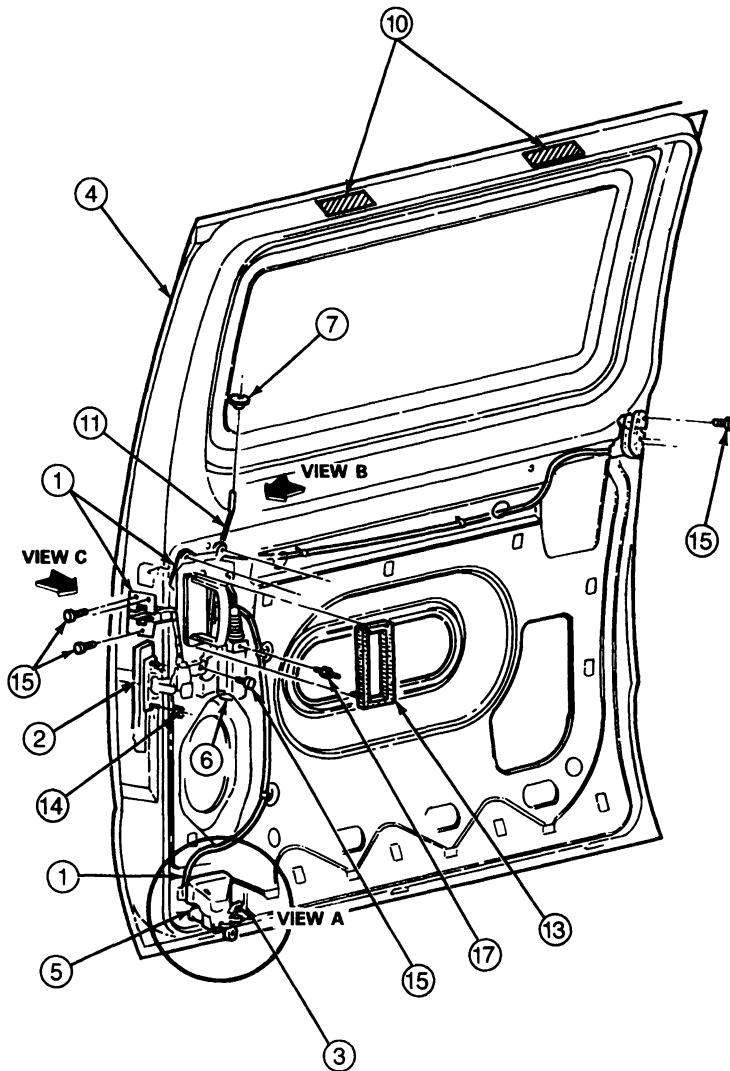
For installation, follow removal procedures in reverse order.

Center Hinge, Sliding Door, E-150-250-350**Removal and Installation**

1. Remove sliding door interior trim panel to access center hinge. Refer to Section 01-05B.
2. Partially open door and support at bottom.
3. Remove four center hinge-bolts to-door.
4. Slide hinge rearward and out of center track.
5. Install new center hinge to door and follow adjustment procedures in this section.

REMOVAL AND INSTALLATION (Continued)

Sliding Door Installation, E-150-250-350



N9879-B

REMOVAL AND INSTALLATION (Continued)**SLIDING DOOR INSTALLATION, E-150-250-350 (LEGEND)**

Item No.	Part Number	Description
1	264A00	Remote Control and Latch Assembly
2	26600	Body Side Front Door Outside Handle
3	264B46	Body Side Door Lower Guide Latch
4	Ref.	Sliding Door
5	Ref.	Body Side Door Lower Guide
6	218A42	Front Door Latch Actuator Assembly
7	21999	Door Latch Knob Grommet
8	43629	Door Lock Cylinder Retainer
9	Ref.	Lock Set
10	11396	Shield
11	264A80	Push Button Rod Assembly

Item No.	Part Number	Description
12	264B48	Lower Guide Latch Shield
13	24694	Inside Seal
14	N621905-S55	Nut 9.0-14.0 N·m (79.6-123.9 In-Lb)
15	N806679-S101	Screw 8.9-12.1 N·m (78.7-107.0 In-Lb)
16	N621906-S55M	Nut and Washer 10.2-13.8 N·m (90.2-122.1 In-Lb)
17	N802034-S	Rivet
18	W621124-S55	Screw 10.0-14.0 N·m (88.5-123.9 In-Lb)
19	N800510-S55	Screw 10.2-13.8 N·m (90.2-122.1 In-Lb)

CN9680-A

Striker, Front and Rear Sliding Door**Removal and Installation**

1. Remove nine B-pillar trim panel screws.
2. Remove two striker bolts and transfer the shim(s) to the new striker.
3. Position the striker and install the two attaching bolts (snug). Adjust as necessary. Refer to adjustment procedure in this section.
4. Install nine B-pillar trim panel screws.

6. If replacing hinge, remove hinge-to-pillar bolts, and remove the hinge.

For installation, follow removal procedures in reverse order. Adjust doors, as described in this section, if required. Cement the door weatherstrip in proper position on the door using Weatherstrip Adhesive COAZ-19552-AA (ESB-M2G14-A) or equivalent. Include the belt seals.

Doors

Refer to illustrations in Adjustments portion of this section.

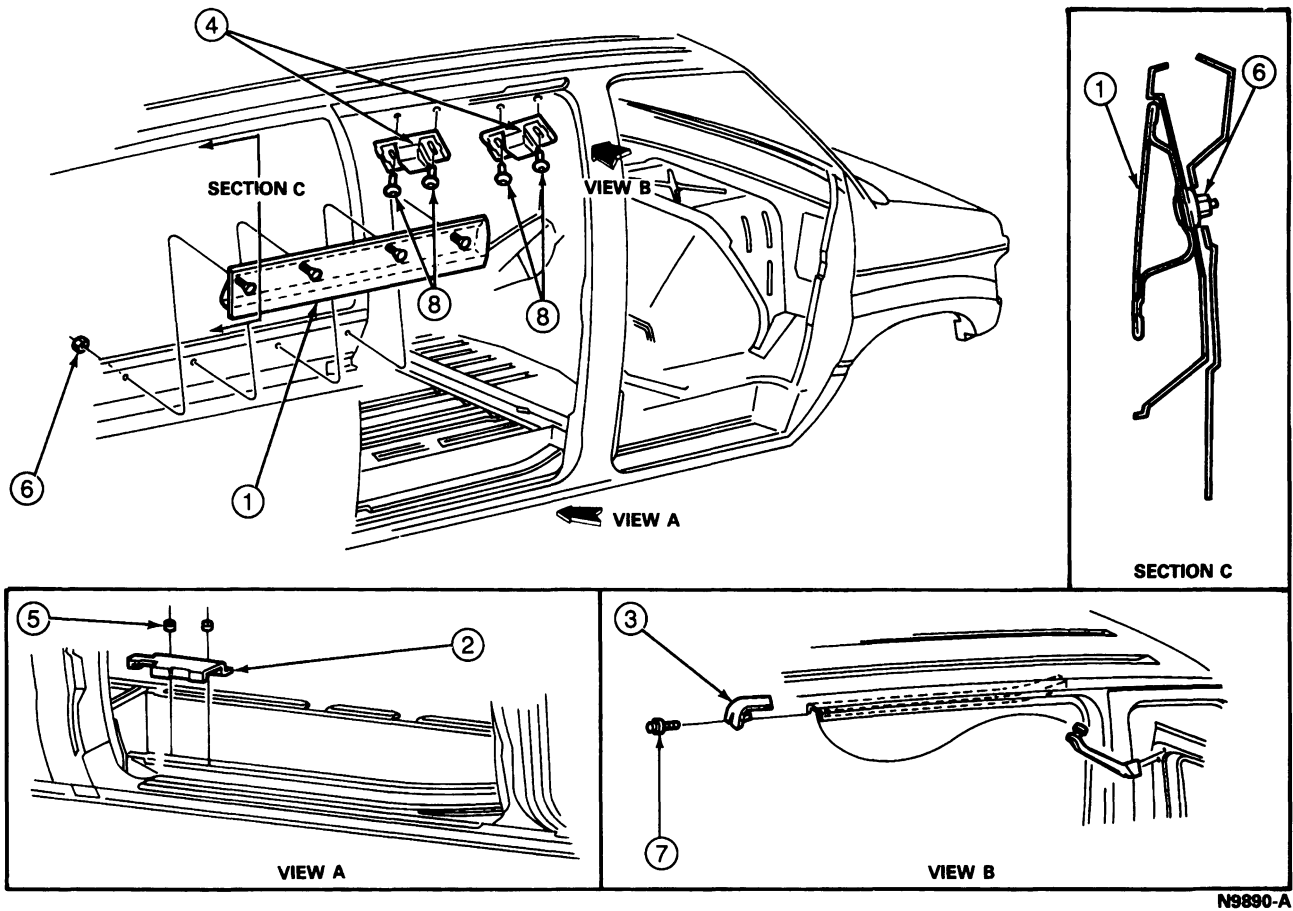
Removal and Installation

1. Remove all usable hardware, trim, and glass. Refer to Sections 01-05A or 01-05B, 01-14A and 01-11.
2. Remove watershield, if equipped.
3. Remove the upper and lower hinge access hole cover plates, if equipped. Mark hinge location on door and body.
4. Remove the door-to-lower hinge retaining bolts.
5. Support the door, and remove the door-to-upper hinge retaining bolts. Slide the door off the hinges.

Check Straps, Cargo Side and Back Doors, E-150-250-350**Removal and Installation**

1. Open the door to gain access to the check strap.
2. Remove the body side bracket screws and remove the bracket.
3. Disconnect the door check arm assembly from the body side bracket.
4. Remove the door trim panel and watershield, if equipped.
5. Remove the door check arm assembly bolts and remove the assembly from the door through the inside of the door panel.

For installation, follow removal procedures in reverse order. Tighten the bolts and screws to 9.0-14.0 N·m (79.6-123.9 in-lb).

REMOVAL AND INSTALLATION (Continued)**Sliding Door Center Track Shield and Check Bumper, E-150-250-350**

Item	Part Number	Description
1	25030	Shield Assembly
2	25068	Check Assembly
3	25076	Upper Track Stop Assembly
4	25300	Wedge Assembly

(Continued)

Item	Part Number	Description
5	N620480-S36	Nut 9-14 N-m (80-123 In-Lb)
6	N621926-S36	Nut and Washer 8-14 N-m (10-123 In-Lb)
7	N670480-S2	Screw 10-14 N-m (88-123 In-Lb)
8	N802897-S1	Rivet

Door Hinge, Bronco, F-150-250-350, F-Super Duty and E-150-250-350**Removal and Installation**

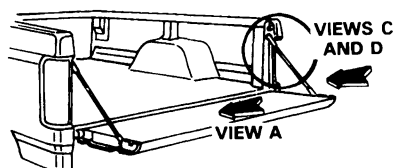
1. Support the door.
2. Mark the location of the hinge on the door and body.
3. Remove the hinge-to-body attaching bolts.
4. Remove the hinge-to-door attaching bolts and remove the hinge.
5. Position the new hinge to the door and body, and install the attaching bolts.
6. Adjust the door and hinges. Remove the support.

Tailgate**F-150-250-350 Pickup****Removal and Installation**

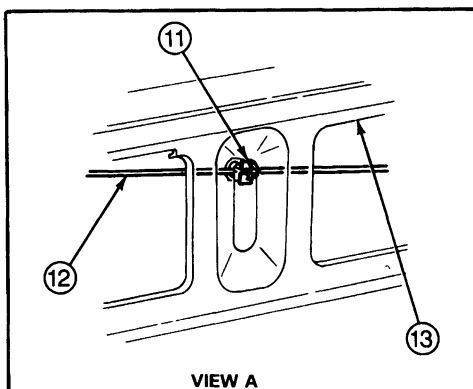
1. Remove the tailgate support strap at the pillar T-head pivot.
2. Lift off the tailgate at right hinge; pull off left hinge.
3. If a new tailgate is being installed, transfer all mouldings, latches, hinges, brackets, links, clips and washers to the new tailgate.

REMOVAL AND INSTALLATION (Continued)

Tailgate Installation, Styleside Pick-Up

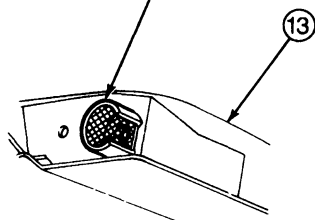


TYPICAL

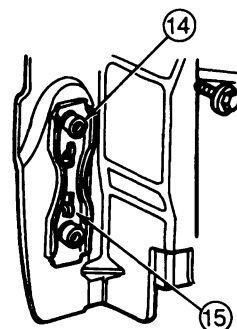
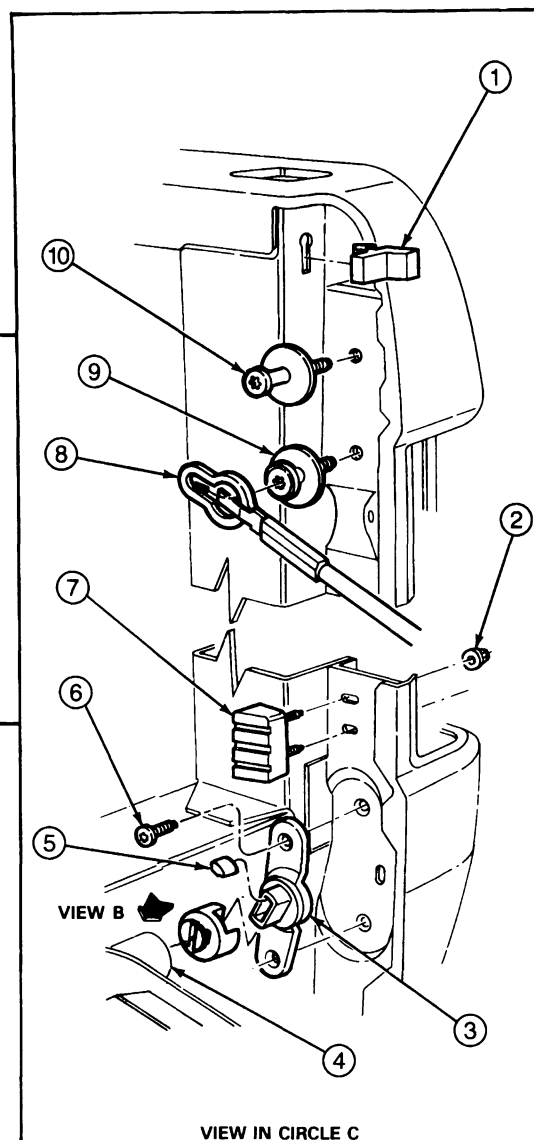


VIEW A

APPLY LUBRICANT, TYPE
ESB-M1C185-A OR EQUIVALENT,
TO INSIDE PORTION OF TAILGATE
RETAINER HINGE CUP.



VIEW B

F150 FLARESIDE ONLY
VIEW IN CIRCLE D

VIEW IN CIRCLE C

N7396-D

Item	Part Number	Description
1	40224	Bumper Assembly
2	N621906-S43M	Nut and Washer Assembly
3	430B38	Roller Assembly
4	40702	Tailgate Assembly
5	430B44	Insert
6	N804563-S100	Screw 35-55 N·m (26-40 Ft·Lb)
7	402A12	Bumper Assembly
8	43150	Latch Assembly

(Continued)

Item	Part Number	Description
9	N805156-S39	Screw and Washer
10	432A06	Striker Assembly 33-45 N·m (24-33 Ft·Lb)
11	40224	Bumper
12	43868	Link
13	Ref	Panel Assembly
14	9943488-A	Hinge Plate, Lower Anchor (Flareside Only)
15	—	Tabs (Flareside Only) (1 each side req'd)

REMOVAL AND INSTALLATION (Continued)

Bronco

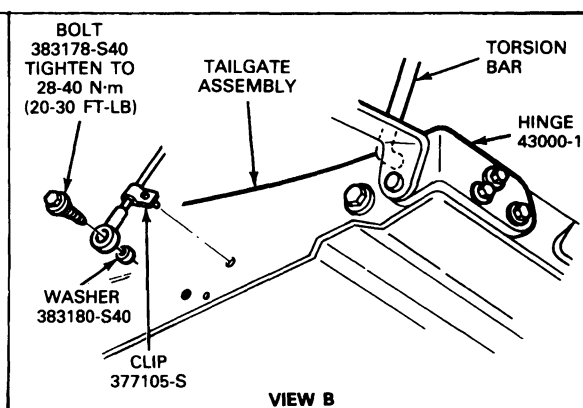
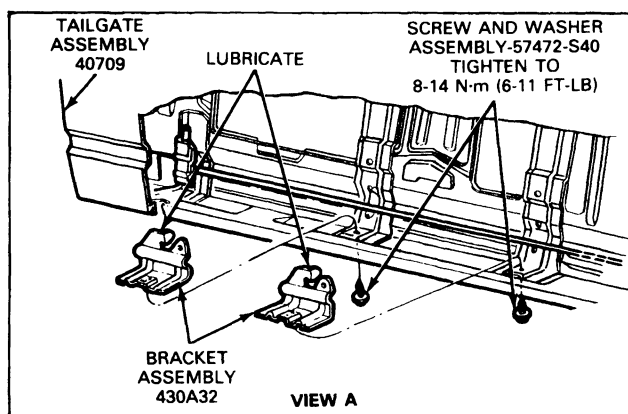
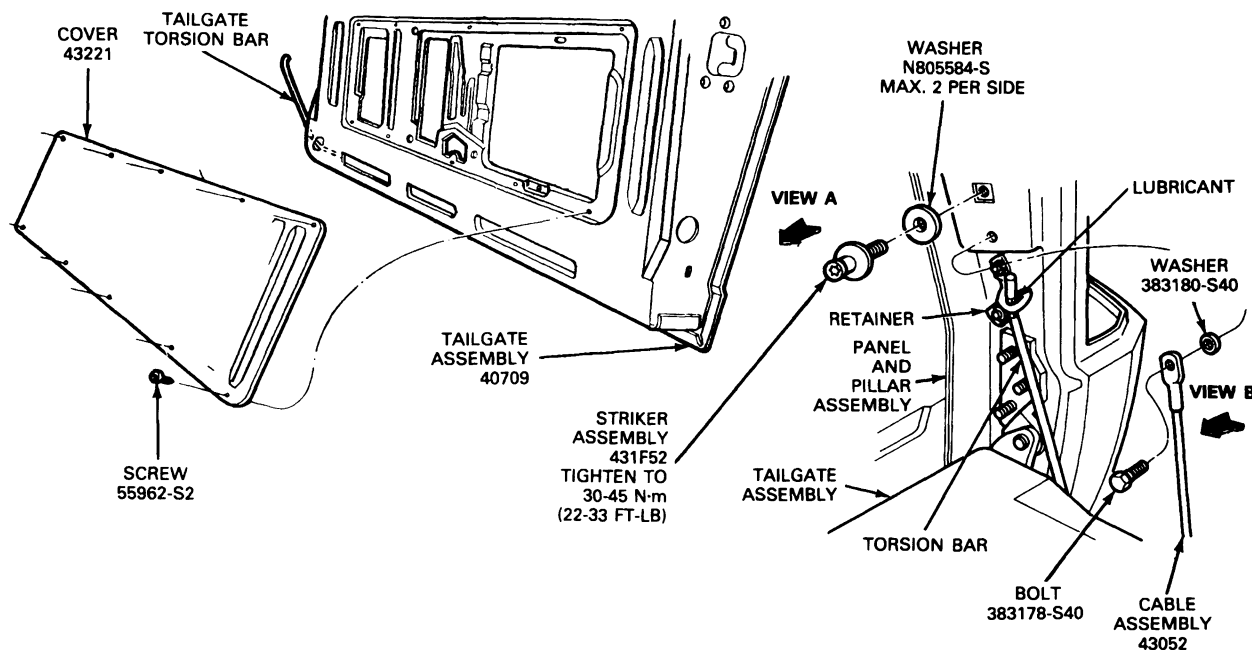
Removal and Installation

1. Unlatch the tailgate handle and lower the tailgate. Disconnect the left and right cable assemblies at the tailgate.
2. Disconnect the tailgate window motor wire at the connector. Pull the lead wire from the tailgate body rail.

3. Support the tailgate while slightly open, and remove the torsion bar retainer from the body.
4. Remove the three screw and washer assemblies that secure the left and right hinge assemblies to the body.
5. Remove the tailgate from the vehicle.

For installation, follow removal procedures in reverse order.

Tailgate Installation, Bronco



N4235-G

Door Weatherstrips

E-150-250-350

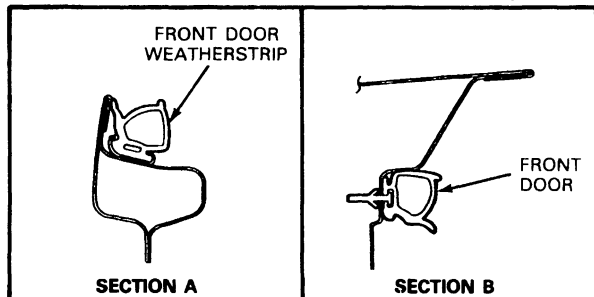
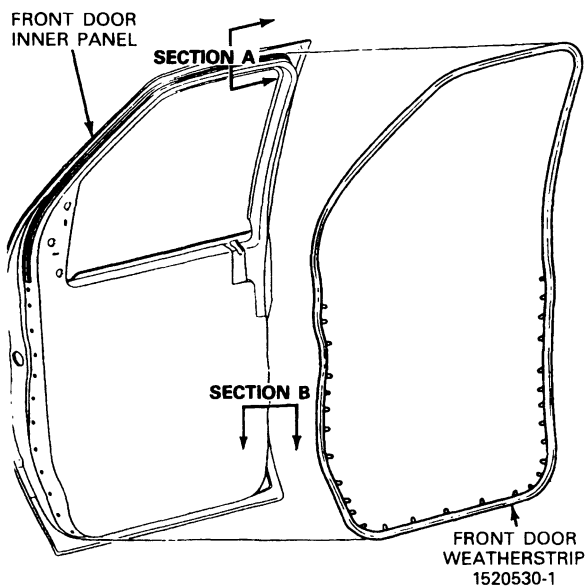
Removal

1. Remove weatherstrip from door.
2. On Hi-series locate adhesive tape which secures the lower end of A-pillar weatherstrip to the door. Remove any excess adhesive.

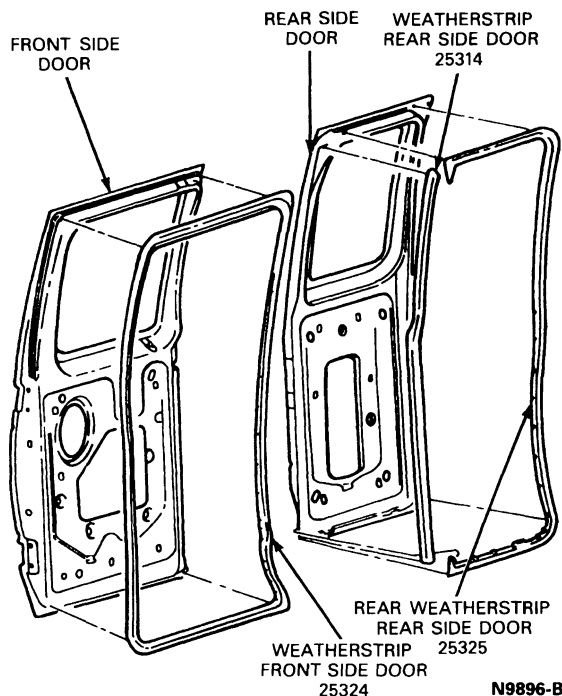
3. Remove pushpins from weatherstrip mounting holes.
4. If equipped, remove any excess butyl tape near lower hinge.

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Install new weatherstrip by inserting upper pushpins into upper mounting holes. Continue around bottom of door.
2. Install upper portion of weatherstrip by tucking inboard portion of weatherstrip the entire length of the retainer inboard surface.
3. Press on outboard profile to snap weatherstrip into retainer.
4. Inspect outboard weatherstrip by moving the lip portion away from door.
5. Seat any remaining weatherstrip areas.
NOTE: Pay special attention to moulded details on door corners.
6. On Hi-series, locate adhesive tape attaching surface at bottom of A-pillar. Alcohol wipe adjacent door. Remove adhesive protective liner and press into place.
7. Locate butyl material, near lower hinge, remove protective liner from tape and press firmly into position.

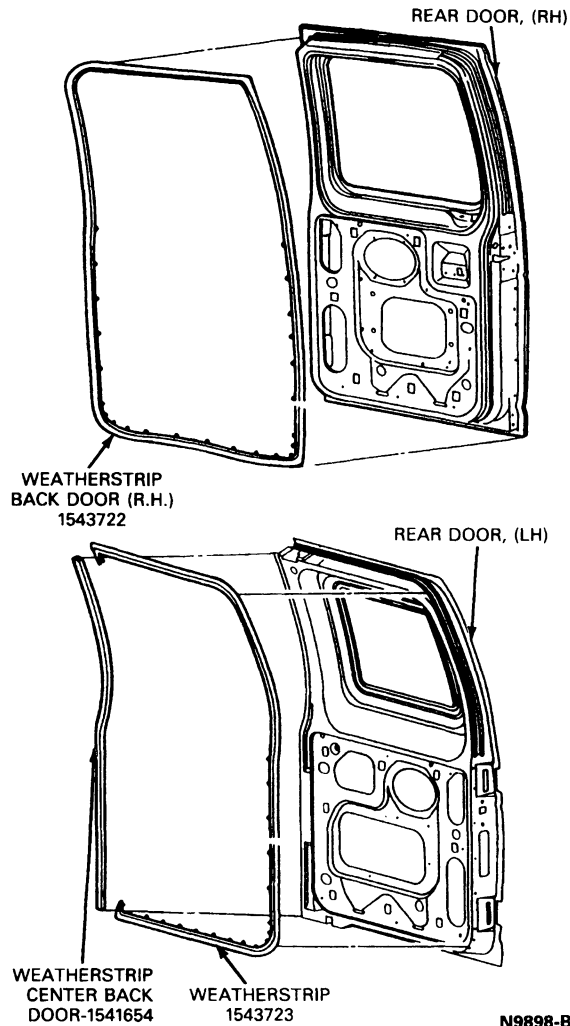
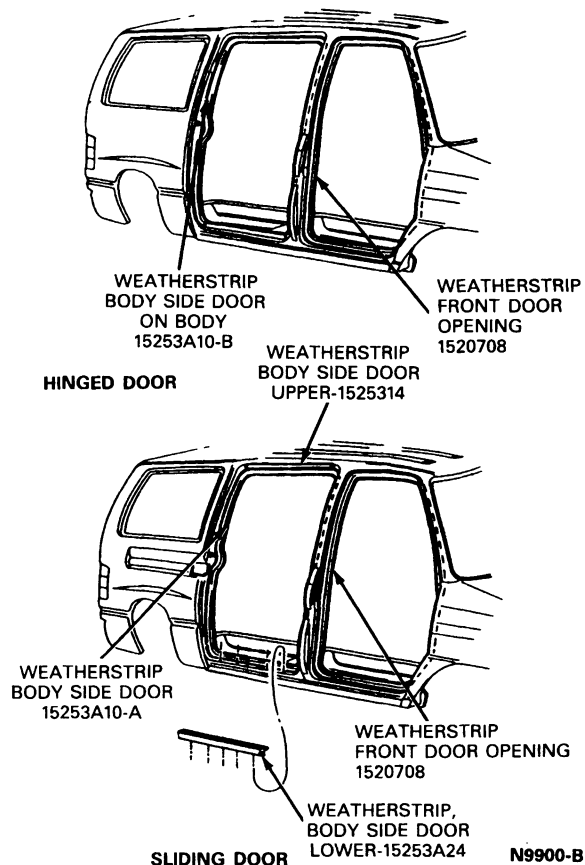
Front Door Weatherstrip, E-150-250-350

N9894-B

Side Cargo Doors, Weatherstrip, E-150-250-350

REMOVAL AND INSTALLATION (Continued)

Back Door Weatherstrips, E-150-250-350

Bodyside Door Opening Weatherstrips,
E-150-250-350F-150-250-350, F-Super Duty Chassis Cab and
Bronco

Removal and Installation

1. Remove the weatherstrip and clean all old weatherstrip and adhesive from the body.
2. Clean weatherstrip mounting surface with alcohol.
3. Remove protective liner from replacement weatherstrip, and press into place.
4. Use roller to complete attachment by firmly pressing and thoroughly "wetting out" the adhesive.

Secondary Weatherstrip

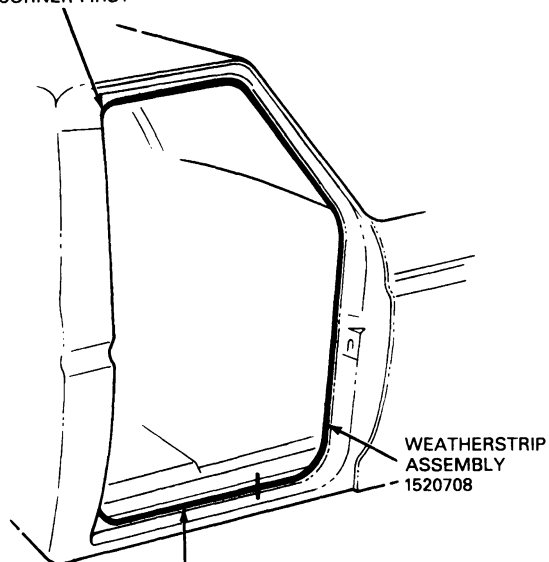
NOTE: Secondary weatherstrip is also used on XLT and Lariat models.

Removal and Installation

1. Remove weatherstrip and clean all old weatherstrip from door.
NOTE: Replacement weatherstrip has paper backed adhesive on attachment surface.
2. Peel off paper backing and apply seal to door inner panel.

REMOVAL AND INSTALLATION (Continued)**Door Opening and Upper Door Weatherstrips,
F-150-250-350, F-Super Duty and Bronco**

INSTALL THIS
CORNER FIRST

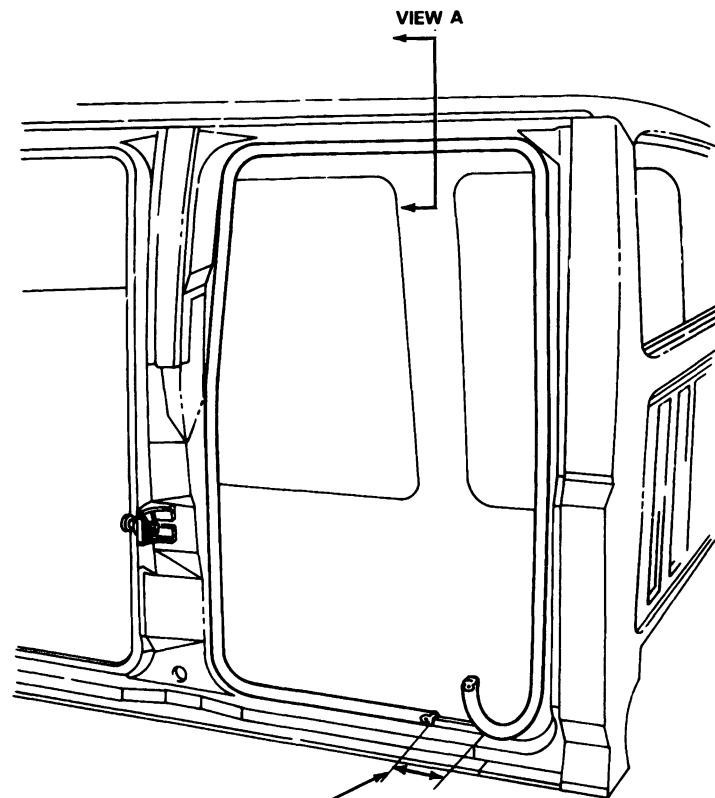


**NOTE: WEATHERSTRIP TO BE
CUT APPROX. 6.0 TO 12.0 MM
(0.24-0.47 INCHES) LONGER THAN
REQUIRED AND BUTT TOGETHER,
AVOID OVERLAPPING.**

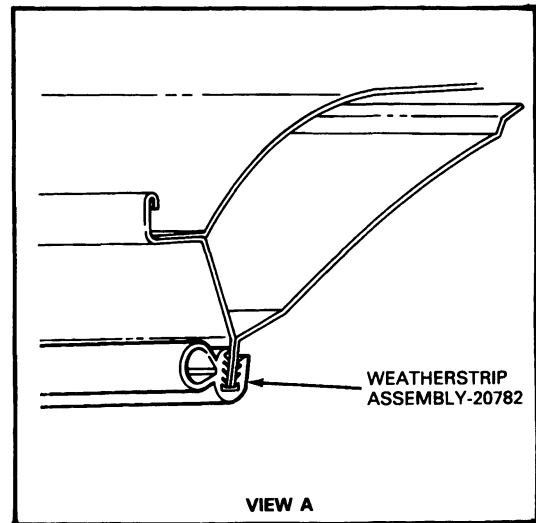
N4808-E

REMOVAL AND INSTALLATION (Continued)

Rear Door Weatherstrip, F-350 Crew Cab



BUTT JOINT LOCATION
TO BE 105.0 MM \pm 20 MM
4.1 INCH \pm 0.8 INCH



N5907-B

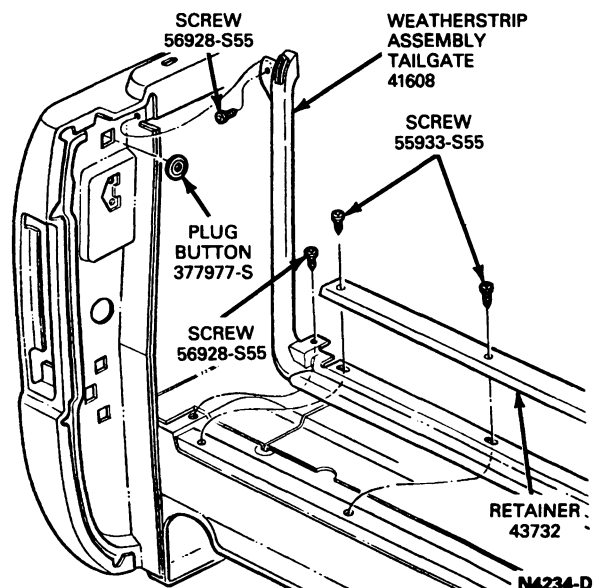
Tailgate Weatherstrip Assembly

Removal and installation

1. Lower tailgate.
2. Remove tailgate weatherstrip and weatherstrip retainer-to-body screws.
3. Remove weatherstrip and retainer from the body.

For installation, follow removal procedures in reverse order.

Tailgate Opening Weatherstrips, Bronco



N4234-D

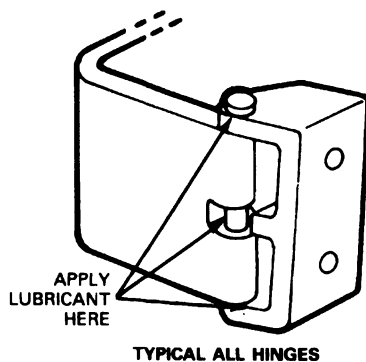
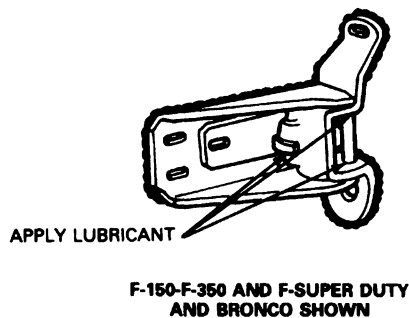
CLEANING AND MAINTENANCE

Door and Window Weatherstrip Lubricant

Use Silicone Lubricant C0AZ-19553-AA (Jelly) and D7AZ-19553-AA (Spray) on the door and window weatherstrips whenever necessary. Silicone lubricant helps avoid weatherstrip squeaks and retards excess weatherstrip wear from chafing between the door glass upper frame and the weatherstrip. It also helps to retain door window alignment by reducing friction between the glass frame and the rubber weatherstrip.

Door, Hood and Tailgate Hinges, Lubricant

Use Multi-Purpose Grease Spray D7AZ-19584-AA (ESR-M1C159-A and ESB-M1C106-B) or equivalent to lubricate door hinges. Apply an even coat to all movable hinge surfaces as outlined in the maintenance schedules or when a binding or squeaking condition occurs.



Lock Cylinder Lubricant

Apply Lock Lubricant D8AZ-19587-AA (ESB-M2C20-A) or equivalent to prevent sticking or binding of all key lock cylinders.

ADJUSTMENTS

Sliding Door

In or Out Adjustment

Front Upper

To adjust the upper edge of the door, loosen the two attaching screws and move the arm in or out to obtain a flush fit with the adjacent door panel at the top edge of the sliding door.

Front Lower

Support the door assembly so **no up or down** movement can be made to the door when performing the in or out adjustment.

To adjust the lower front edge of the door, loosen the retaining screws on the guide assembly and move the guide assembly **forward** to obtain a snug fit to the body, and **rearward** to move it away from the body, at the B-pillar post.

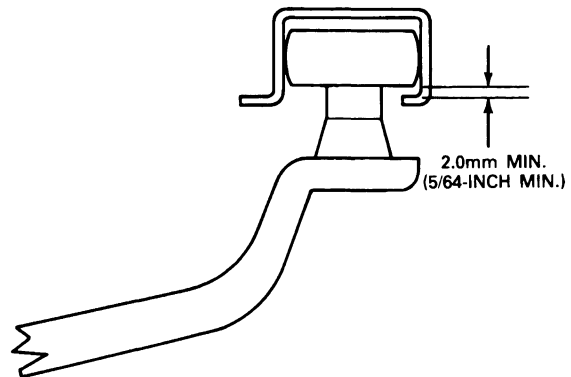
Rear, Upper and Lower Edge of Door

To move rear edge of door in or out, open door and loosen and adjust rear latch striker as required. Tighten striker as outlined in Section 01-14A.

Up or Down Adjustment

1. Support door assembly to prevent slippage when loosening guide.
2. Remove lower guide latch shield to access lower guide attaching screws.
3. Loosen three lower guide attaching screws.
4. Adjust guide with plastic hammer to obtain door up or down position.
5. Tighten adjusting screws. Remove support.

CAUTION: Lower guide roller must be horizontal to assure hold-open latch function. Also, the upper roller assembly must not be less than 2.0 mm (5/64 inch) from the bottom flange of the upper track. The front striker is not used for up or down adjustment of door. Raise and lower guide if vertical adjustment is required.



Center Hinge Assembly

1. Remove door trim panel.

ADJUSTMENTS (Continued)

2. Loosen four rear hinge assembly mounting bolts.
3. Move hinge assembly up or down until desired door adjustment is obtained.
4. Open door and check door and striker alignment.
5. Adjust rear door latch striker up or down as required.
6. Tighten striker.
7. Close door slowly, check rear latch striker clears latch.

Striker, Rear Latch

1. Mark location of rear striker.
2. Loosen and move striker in or out to obtain a flush fit with body sheet metal.
3. Tighten striker.

Fore and Aft Adjustment**Center Hinge Assembly**

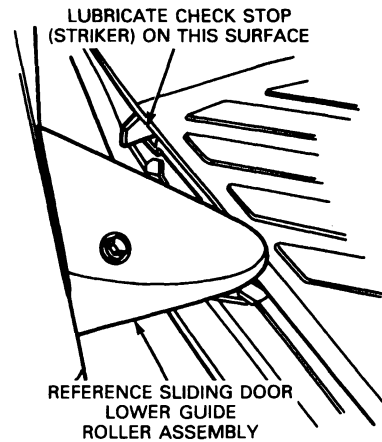
1. To access center hinge, remove door trim panel. Refer to Section 01-05A or 01-05B.
2. Loosen four hinge attaching bolts.
3. Support door, move door fore or aft to adjust hinge.
4. When required adjustment is reached, tighten bolts and check alignment.

NOTE: Alignment must be performed with correct bumper on front face door. Bumper is required to maintain door margin.

Lower Check

NOTE: Lower check should engage lower guide assembly to hold sliding door assembly in full open position.

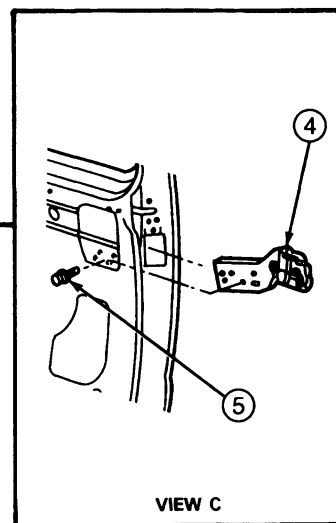
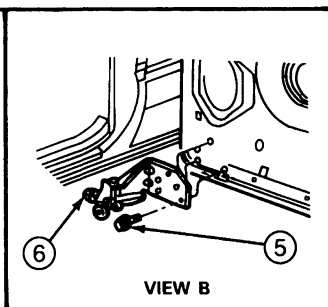
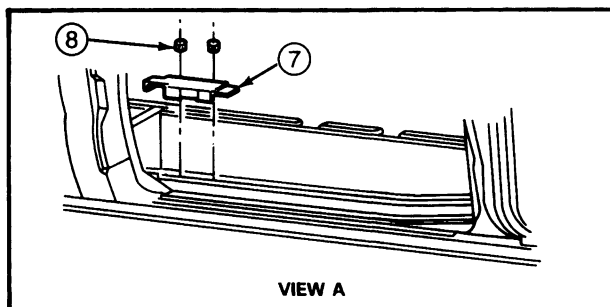
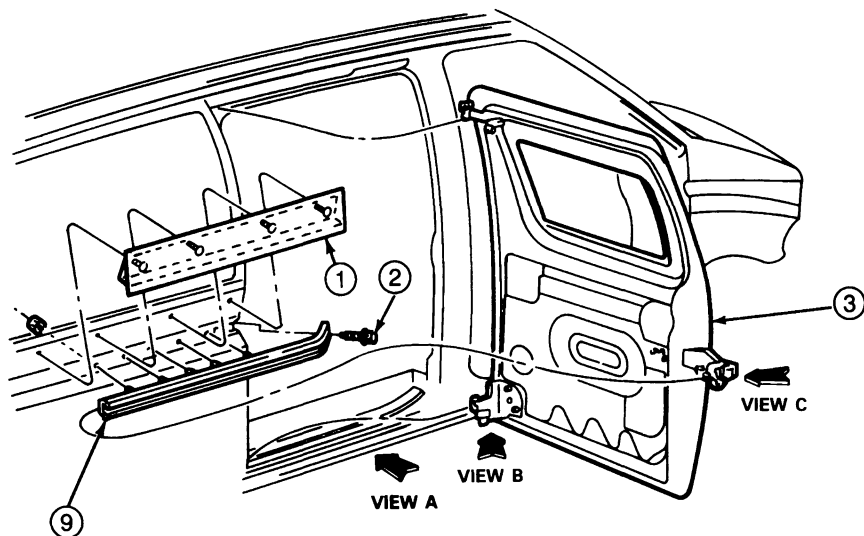
1. Inspect lower end of check for body sealer and remove any excess.
2. Install check in horizontal position.
3. Lubricate lower check striker at least once a year.
4. If striker binds, use multi-purpose grease spray D7AZ-19584-AA or equivalent.



N10816-A

ADJUSTMENTS (Continued)

Sliding Door Adjustments, E-150-250-350



N9884-B

Item	Part Number	Description
1	25030	Center Track Shield
2	N605888-S36	Bolt 8-14 N·m (70-123 In-Lb)
3	Ref	Sliding Door
4	26800	Center Hinge Assembly

(Continued)

Item	Part Number	Description
5	N606690-S2	Bolt 19-26 N·m (14-19 Ft-Lb)
6	268A26	Lower Guide Assembly
7	25068	Lower Guide Check Assembly
8	N620480-S36	Nut 9-14 N·m (80-123 In-Lb)
9	26028	Center Track Assembly

Door Alignment

CAUTION: Do not cover up a poor alignment with a latch striker adjustment.

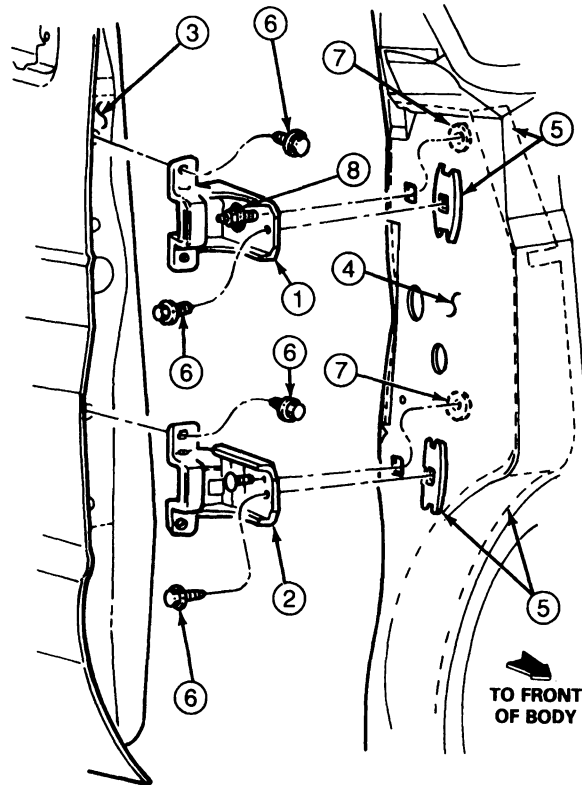
The door hinges provide sufficient adjustment to correct most door misalignment conditions. The holes of the hinge and/or hinge attaching points are enlarged or elongated to provide for hinge and door alignment.

1. Determine which hinge bolts must be loosened to move the door in the desired direction.

2. Loosen the hinge bolts enough to permit movement of the door with a padded pry bar.
3. Move the door the distance estimated to obtain the desired fit.
4. Tighten the hinge bolts and check the door fit for binding or interference with the adjacent panel.
5. Repeat the operation until the desired fit is obtained. Check the striker plate alignment for proper door closing. Refer to Section 01-14A.

ADJUSTMENTS (Continued)

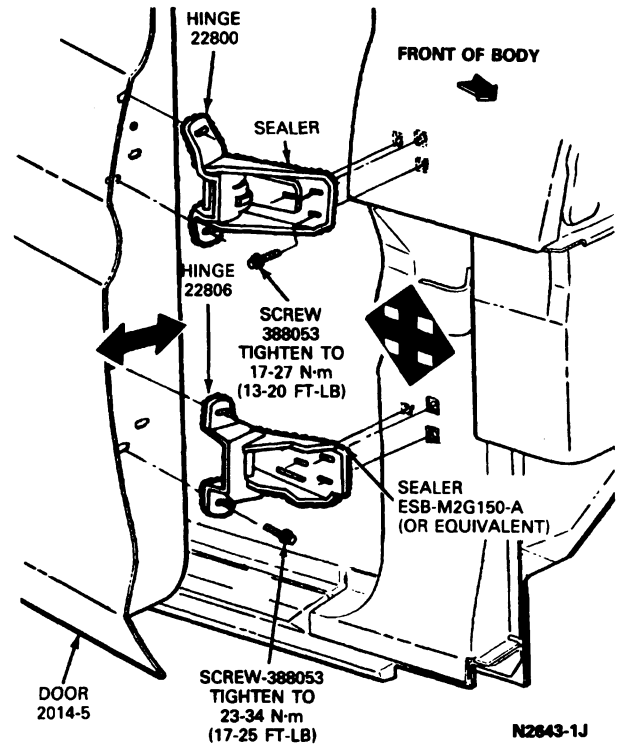
Front Door Hinge Adjustment, E-150-250-350



N9886-B

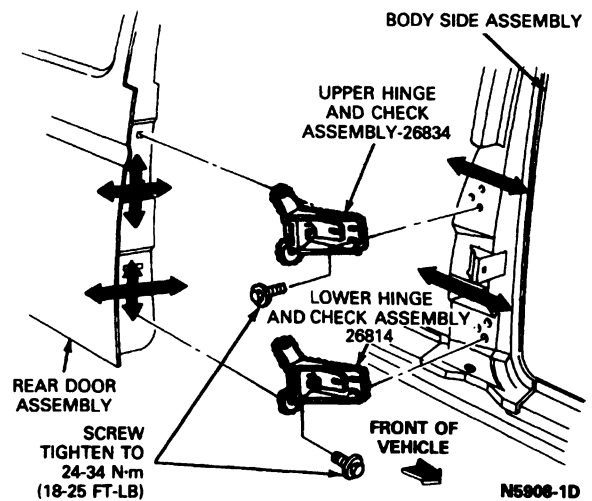
Item	Part Number	Description
1	22800	Front Door Upper Hinge
2	22806	Front Door Lower Hinge and Check Assembly
3	20124	Front Door Assembly
4	211A10	Door Opening Panel Frame
5	22842	Hinge Reinforcement Assembly
6	N803417-S2	Bolt 25-35 N·m (18-25 Ft-Lb)
7	N801193-S2	Nut and Washer 25-35 N·m (18-25 Ft-Lb)
8	N800251-S53	Nut and Washer (M8 x 1.25) 24.5-35 N·m (18-26 Ft-Lb)

Front Door Hinge Adjustment, Bronco and F-150-250-350 and F-Super Duty Chassis Cab



N2643-1J

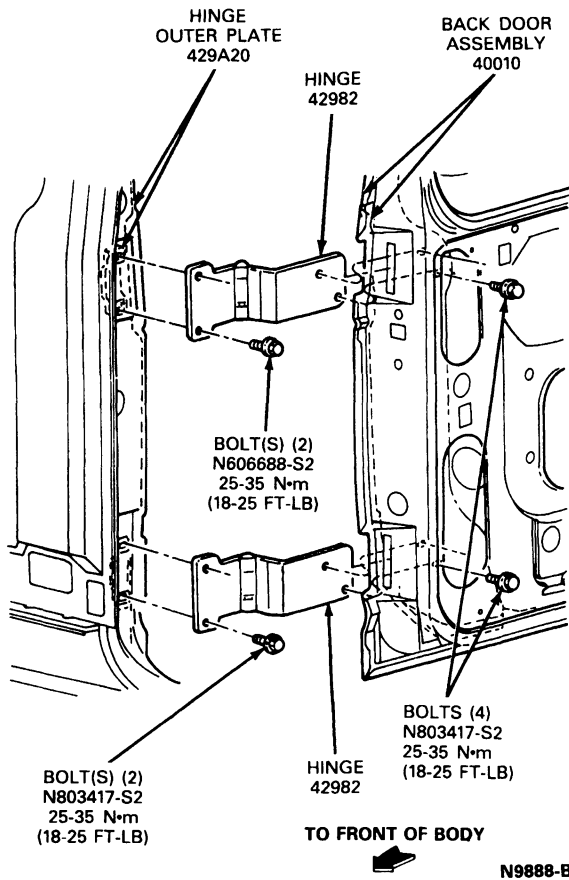
Rear Door Hinge Adjustment, F-350 Crew Cab



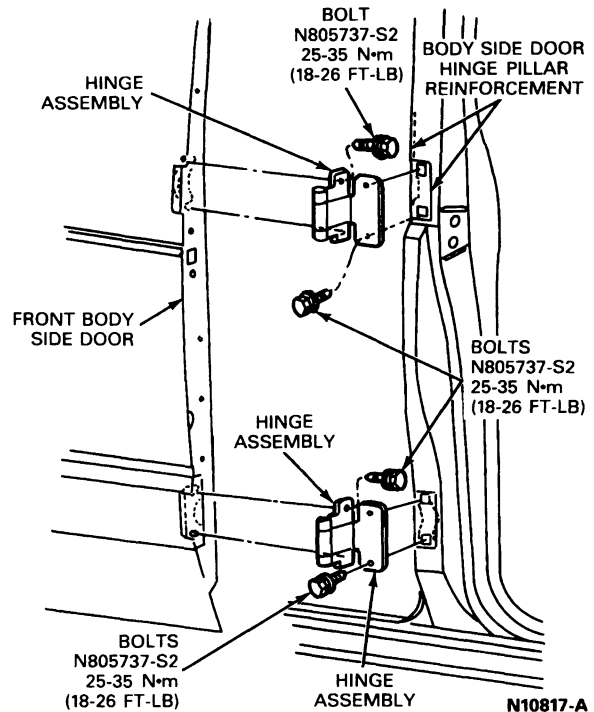
N5906-1D

ADJUSTMENTS (Continued)

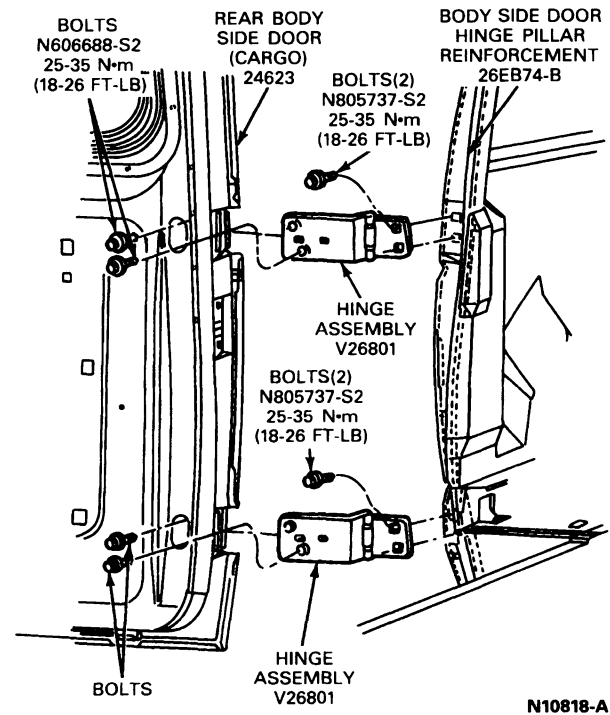
Hinged Assembly, Back Door, E-150-250-350



Body Side Cargo Door, E-150-250-350



Rear Cargo Door, E-150-250-350



SPECIFICATIONS**TORQUE SPECIFICATIONS, E-SERIES**

Description	N-m	Lb-Ft
Door Handle Nut	9.0-14.0	79.6-123.9 In-Lb
Lower Guide Latch Nut / Washer	10.2-13.8	90.2-122.1 In-Lb
Lower Guide Latch Shield Screw	10.0-14.0	88.5-123.9 In-Lb
Lower Guide Screw	10.0-13.8	90.2-122.1 In-Lb
Center Track Assembly Nut and Bolt	8.0-14.0	70.8-123.9 In-Lb
Inside Lower Guide Assembly Bolt	19.1-25.9	14.0-19.1
Center Track Nut	9-14	80-123 In-Lb
Center Track Assembly Bolt(s)	8-14	70-123 In-Lb
Center Track Shield Nut / Washer	8-14	70-123 In-Lb
Front door Hinge and Check Bolt(s)	25-35	18-25
Front Door Hinge and Check Nut	25-35	18-25
Hinge Reinforcement Assembly Nut / Washer	24.5-35	18-26
Rear Door Hinge(s) Bolt(s)	25-35	18-25

(Continued)

TORQUE SPECIFICATIONS, E-SERIES (Cont'd)

Description	N-m	Lb-Ft
Body Side Bracket to door Bolt(s)	9.0-14.0	79.6-129.9 In-Lb
Body Side Bracket Screw	9.0-14.0	79.6-129.9 In-Lb

TORQUE SPECIFICATIONS, F-SERIES AND BRONCO

Description	N-m	Lb-Ft
Front Door Hinge Screw(s)	23-34	17-25
Tailgate Roller Screw(s)	35-55	26-40
Striker Assembly	33-45	24-33.2
Handle to Control Assembly Nut and Washer	9-14	6.6-10.3
Tailgate Latch Screw and Washer Assembly	22-34	16.2-25
Tailgate Latch Screw and Washer Assembly (Bronco)	3-8	2-6
Handle to Control Screw and Washer Assembly (Bronco)	8-14	6-11
Striker Assembly (Bronco)	30-45	22-33
Bracket Assembly to Tailgate Screw and Washer Assembly (Bronco)	8-14	6-11
Clip to Tailgate Bolt	28-40	20-30

SECTION 01-04 Pickup Box

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Axle Shimming.....	01-04-12	Pickup Box Tie-Down Hooks, F-150	
Cab and Styleside Pickup Box Alignment, All		Flareside.....	01-04-7
F-Series Vehicles.....	01-04-10	Pickup Box, Styleside and Flareside	01-04-7
Pickup Box Lean.....	01-04-11	Rear Bumper Valance Panel, F-150	
Pickup Box Shimming	01-04-12	Flareside.....	01-04-6
DESCRIPTION.....	01-04-1	Rear Fender, F-350 with Dual Rear Wheels	01-04-8
REMOVAL AND INSTALLATION		SPECIFICATIONS	01-04-15
Bodyside Outer Panel, F-150 Flareside	01-04-1	VEHICLE APPLICATION	01-04-1

VEHICLE APPLICATION

F-150 Regular and SuperCab 4x2 and 4x4

DESCRIPTION

The styleside pickup box is standard on F-150-250-350 vehicles equipped with single rear wheels. On F-350 vehicles equipped with dual rear wheels, a flareside fender that attaches to the pickup box is standard.	A flareside box is available as an option on the 117-inch wheelbase F-150 Regular Cab (4x2 and 4x4) and the 139-inch wheelbase F-150 SuperCab (4x2 and 4x4).
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REMOVAL AND INSTALLATION

Bodyside Outer Panel, F-150 Flareside

Removal and Installation

1.

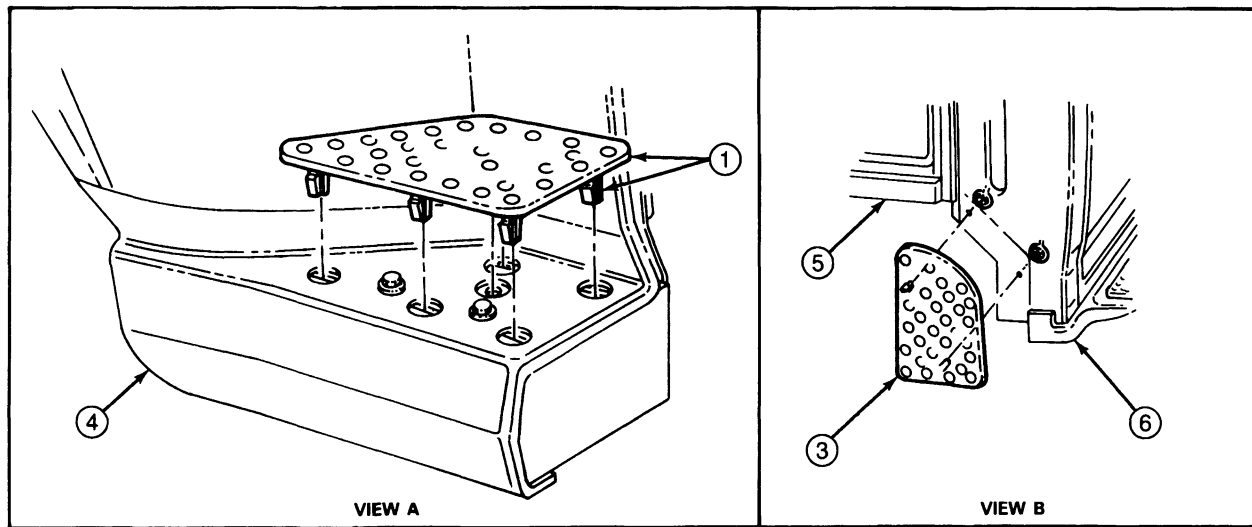
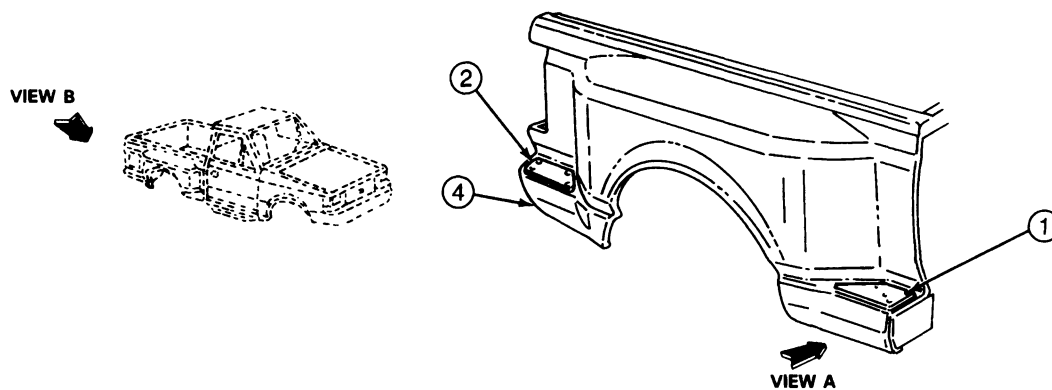
Remove tailgate from vehicle and remove tail lamp assembly. Refer to Section 17-01 for tail lamp removal and installation procedures.

2.

Remove the bodyside panel step mats.

REMOVAL AND INSTALLATION (Continued)

Bodyside Step Mat Installation



N9450-A

Item	Part Number	Description
1	83200	Front Step Mat, Right Side
2	8327	Rear Step Mat, Right Side
3	15277	Body Corner Panel Filler

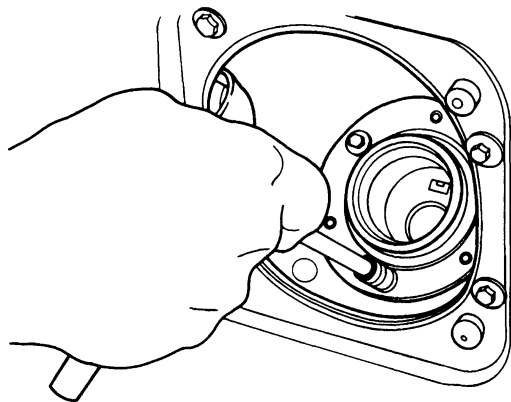
(Continued)

Item	Part Number	Description
4	Ref.	Body Side Outer Panel
5	Ref.	Cab Assembly
6	Ref.	Cab Step

TN9450A

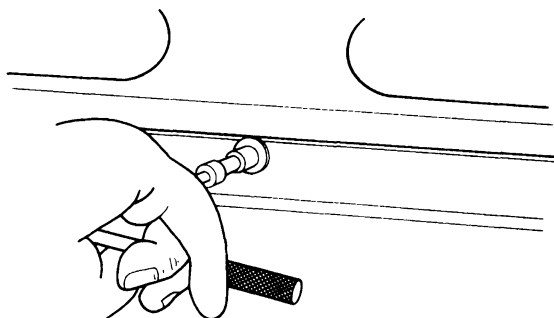
REMOVAL AND INSTALLATION (Continued)

3. Open the fuel filler door(s) and remove the four screws holding the filler pipe(s) to the bodyside.



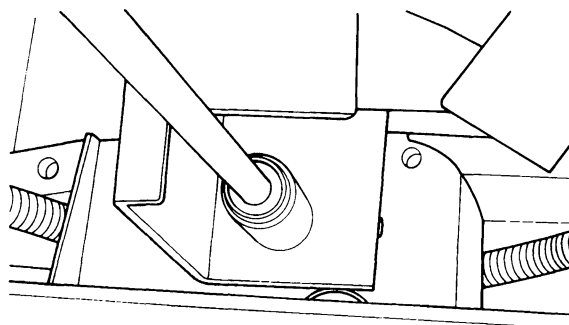
N9702-A

4. From inside the bodyside panel remove bodyside panel bolts.



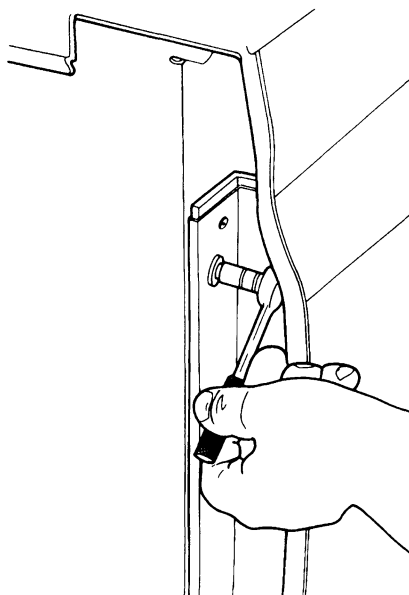
N9703-A

5. Remove valance panel-to-bodyside panel bolts.
6. Remove pickup box-to-frame nuts.



N9704-A

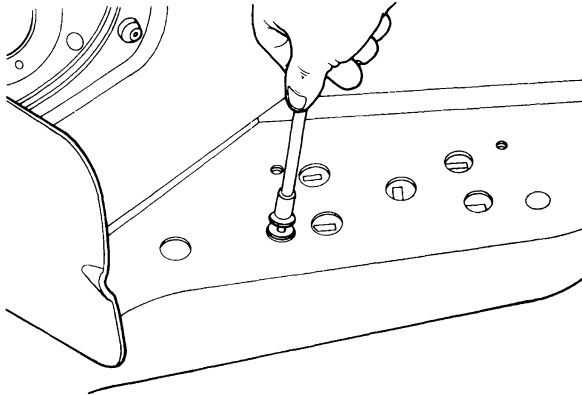
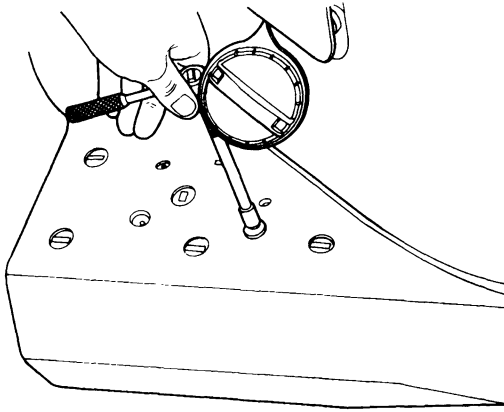
7. With the aid of an assistant, lift the pickup box from the frame and move it rearwards enough to gain access to the bodyside panel front holding bolts.
8. Remove the front panel to box bolts.



N9705-A

REMOVAL AND INSTALLATION (Continued)

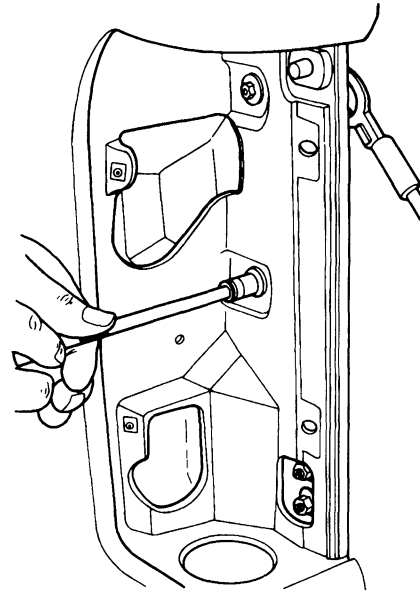
9. Remove the screw and washer assemblies from the bodyside panel at the front and rear step.



N9706-A

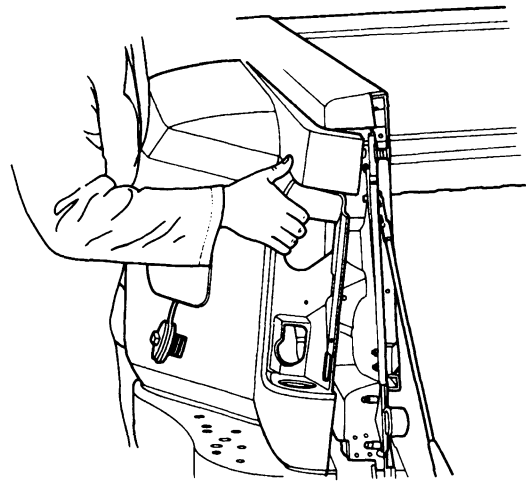
10. Remove the bolts from inside the tail lamp housing.

NOTE: There are two upper rear bolts that retain the bodyside panel to the pickup box that are hidden at the underside of the panel and are accessible through the tail lamp housing.



N9707-A

11. With the help of an assistant, remove the bodyside panel from the pickup box.



N9708-A

NOTE: If the bodyside front and rear step supports are damaged, replace by removing the screw and washer assemblies. Refer to the following illustration. Tighten the screw and washer assemblies to 7.0-8.1 N·m (62-71 in-lb).

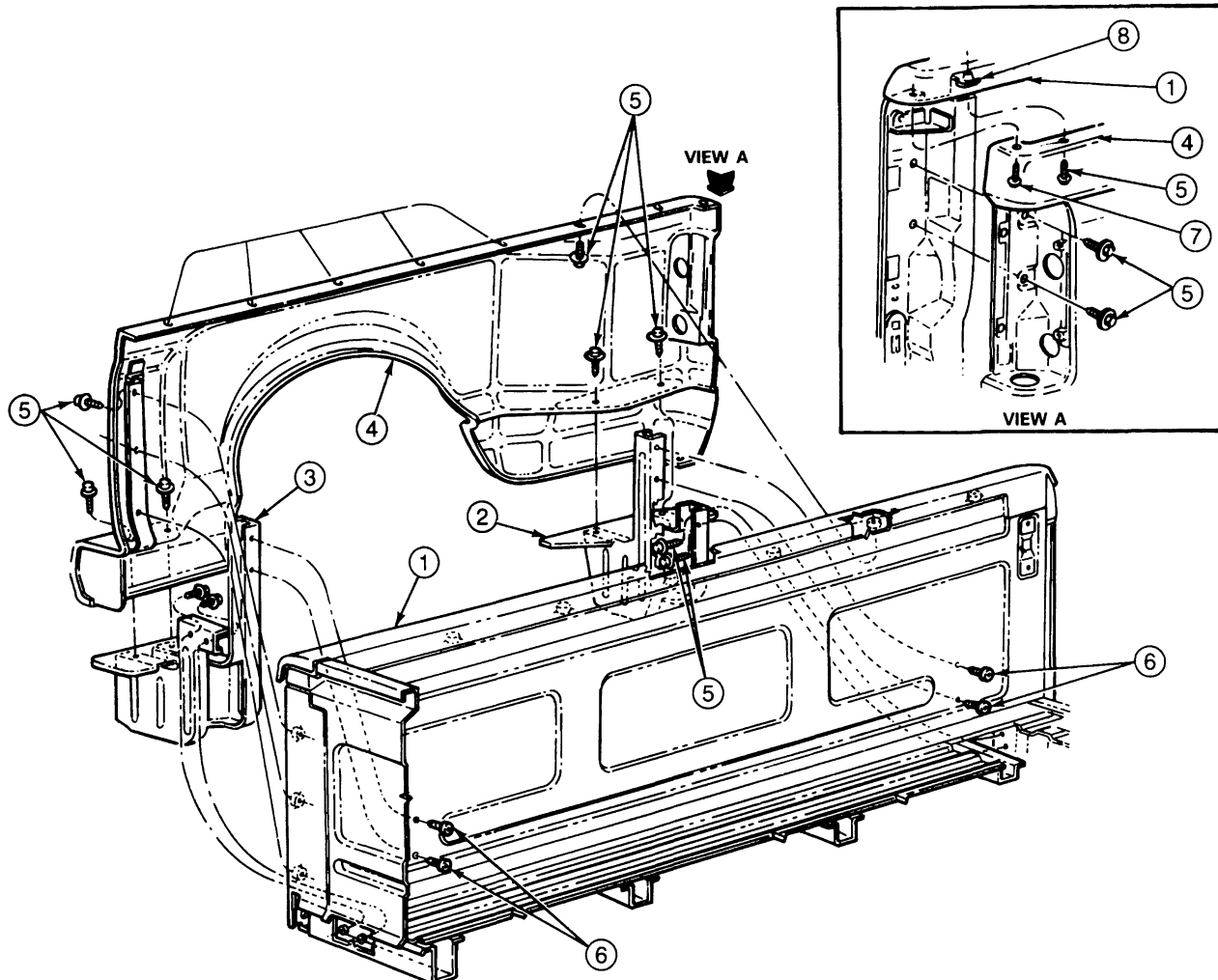
REMOVAL AND INSTALLATION (Continued)

For installation, follow removal procedures in reverse order. Tighten all bodyside panel-to-pickup box bolts to 7.0-8.1 N·m (62-71 in·lb).

NOTE: Use Ford Stud and Bearing Mount E0AZ-19554-BA (ESE-M4G167-AZ) or equivalent on box attaching bolts during installation.

Bodyside Outer Panel Installation

NOTE: Valance panel must be installed prior to installing outer panels.



N9709-A

Item	Part Number	Description
1	Ref.	Pickup Box
2	83200	Rear Step Support
3	83200	Front Step Support
4	83278	Bodyside Panel

(Continued)

Item	Part Number	Description
5	N807111-S40	Screw and Washer 7.0-8.1 N·m (62-71 in·Lb)
6	N807112-S100	Screw and Washer 7.0-8.1 N·m (62-71 in·Lb)
7	N610959-S55	Screw
8	N623332-S100	J-Nut

TN9709A

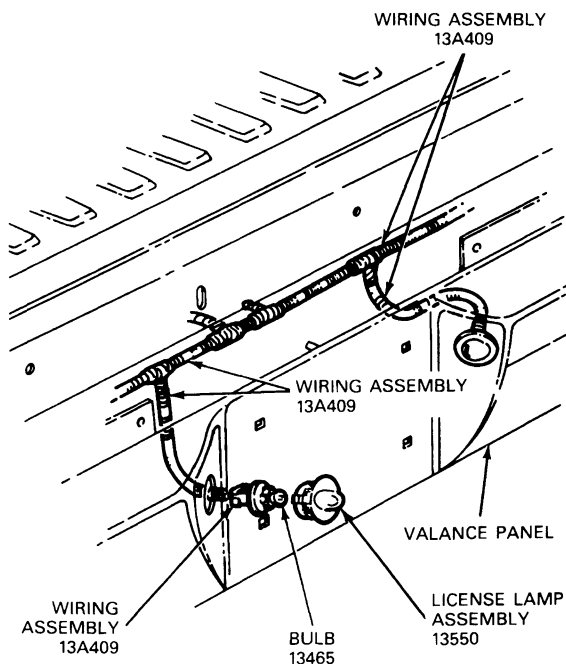
REMOVAL AND INSTALLATION (Continued)

Rear Bumper Valance Panel, F-150 Flareside

Removal and Installation

1. Remove the license plate lamp bodies from the valance panel.

License Plate Lamp Installation



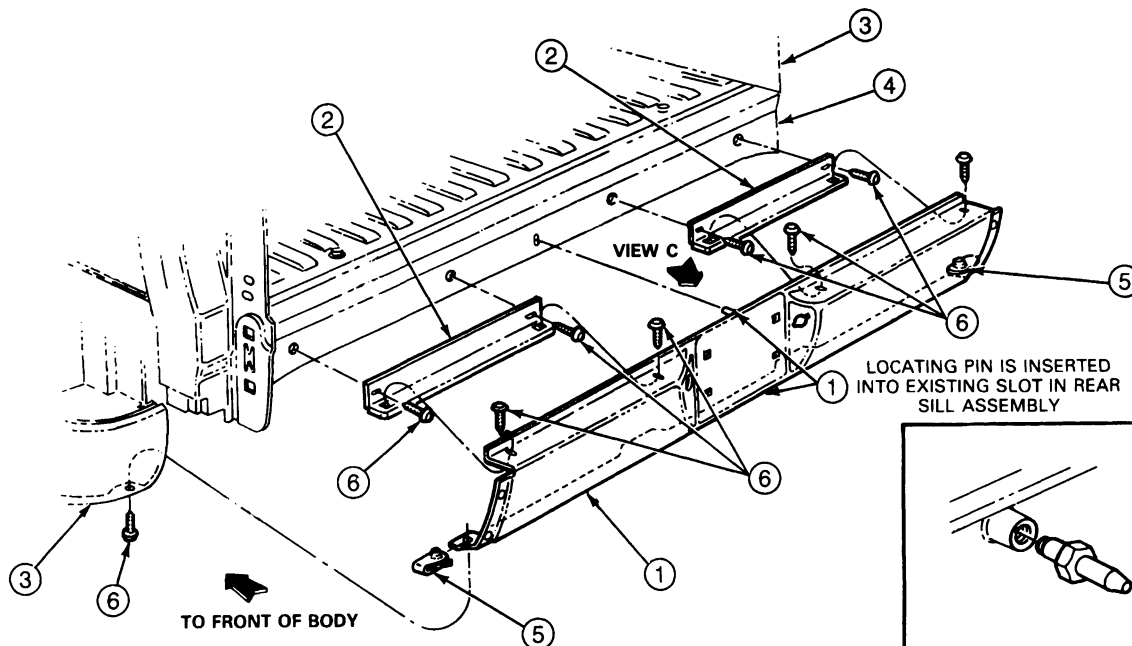
N9711-B

2. Remove the bolts from the lower side of the valance panel to the bodyside panel.
3. Open the tailgate and remove the top valance panel to pickup box bolts.
4. Remove the valance panel from the vehicle.

NOTE: If the valance panel bracket assemblies are damaged, replace by removing the screw and washer assemblies. Tighten bracket bolts to 7.0-8.1 N-m (62-71 in-lb).

For installation follow removal procedures in reverse order. Tighten all valance panel holding bolts to 7.0-8.1 N-m (62-71 in-lb).

Valance Panel Installation



N9713-A

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	83525	Valance Panel
2	63403	Lower Bracket Assembly
3	Ref.	Bodyside Panel

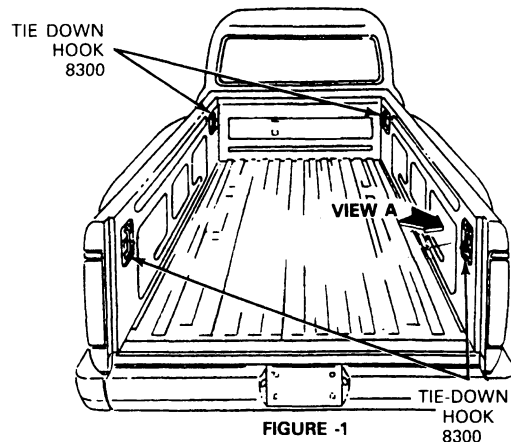
(Continued)

Item	Part Number	Description
4	Ref.	Floor Sill
5	N623342-S100	J-Nut
6	N807112-S100	Screw and Washer 7.0-8.1 N·m (62-71 in·lb)

TN9713A

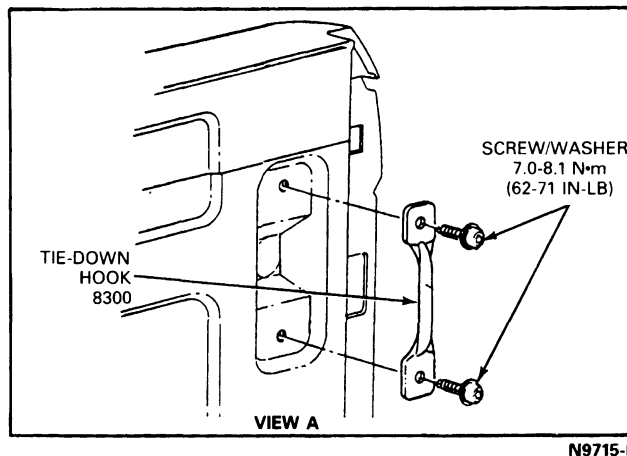
Pickup Box Tie-Down Hooks, F-150 Flareside**Removal and Installation**

1. Remove the screw and washer assemblies holding the tie-down hooks to the pickup box.

Pickup Box Tie-Down Hooks Installation

2. Remove the tie-down hooks from the pickup box.

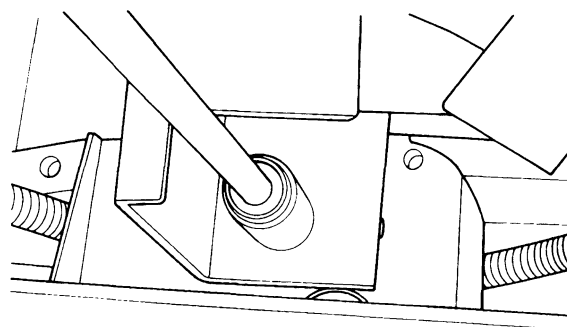
For installation, follow removal procedures in reverse order. Tighten the tie-down hook screw and washer assemblies to 7.0-8.1 N·m (62-71 in·lb).

**Pickup Box, Styleside and Flareside****Removal and Installation**

1. Remove the tailgate from the pickup box.
2. Remove the tail lamps from the box. Refer to Section 17-01.

NOTE: The wiring assembly for the taillight must be rerouted through the tail lamp housing so when removing box the wiring does not interfere with the box.

3. From underside of vehicle, remove the six nuts attaching the pickup box to the frame rails.



N9704-A

4. Remove the six bolts from the pickup box. Note the location of each bolt.

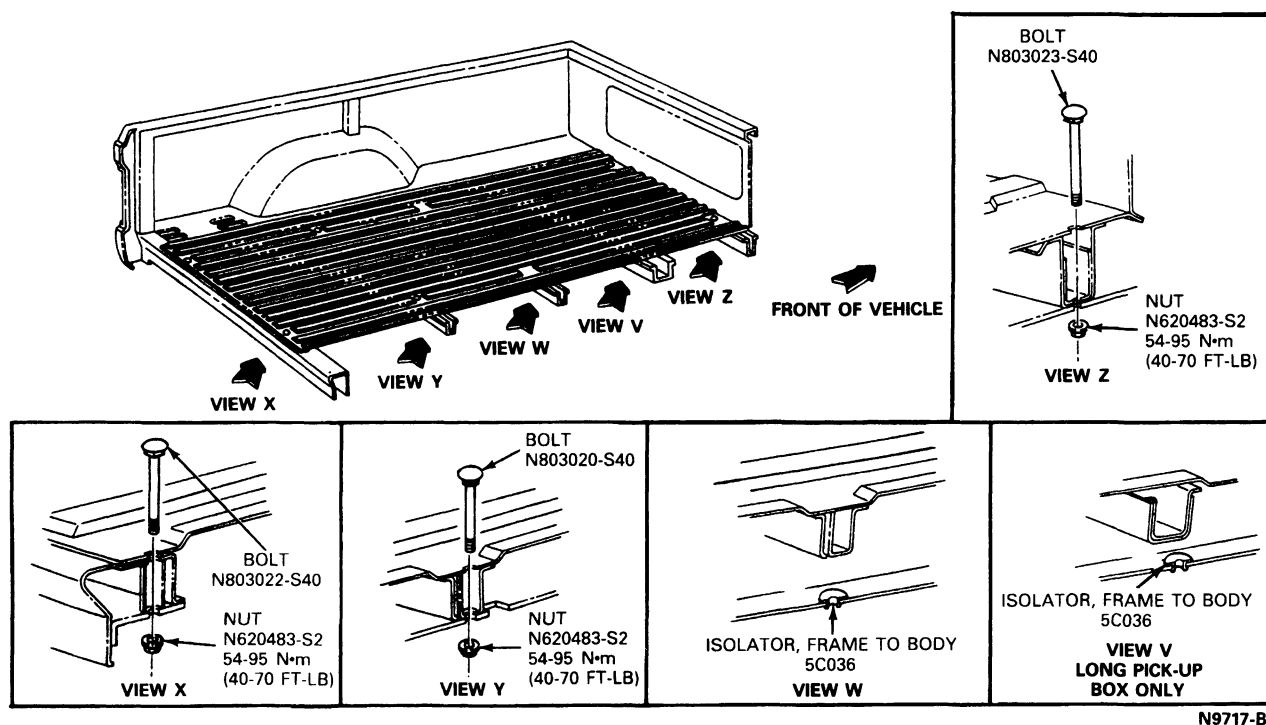
REMOVAL AND INSTALLATION (Continued)

5. Remove filler neck attaching screws from box.
6. With the aid of an assistant, lift the pickup box enough to clean the frame and remove from vehicle.

NOTE: Because of the weight of the pickup box it may be necessary to have two people on each side of the box when removing.

For installation, follow removal procedures in reverse order. Tighten the pickup box nuts to 54-95 N·m (40-70 ft·lb).

Pickup Box Installation, Styleside Box Shown, Flareside Box Similar



N9717-B

Rear Fender, F-350 with Dual Rear Wheels

Removal and Installation

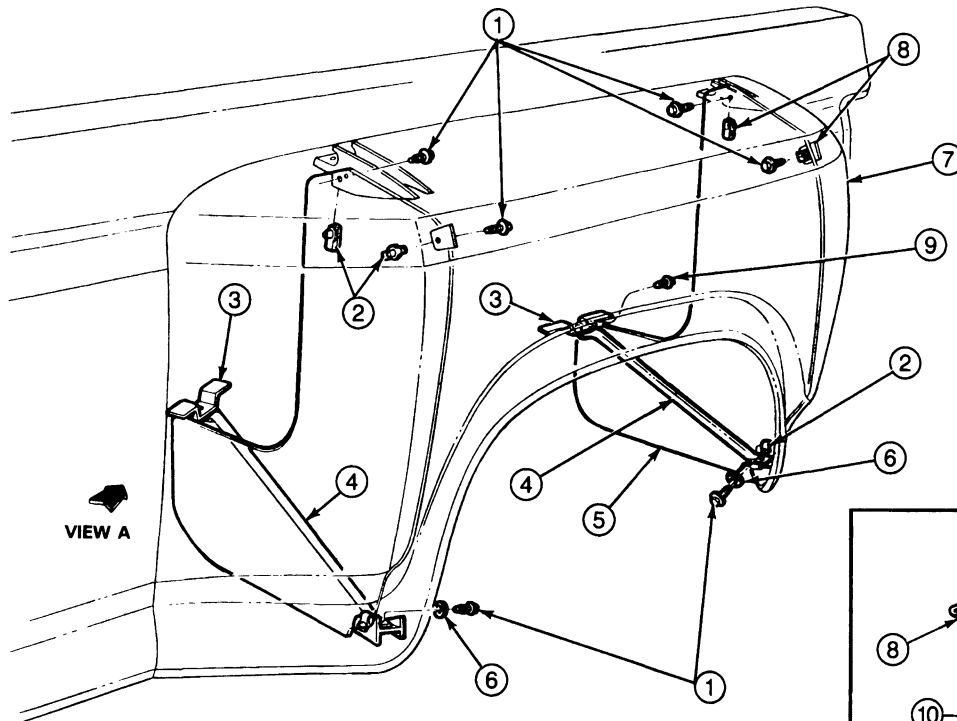
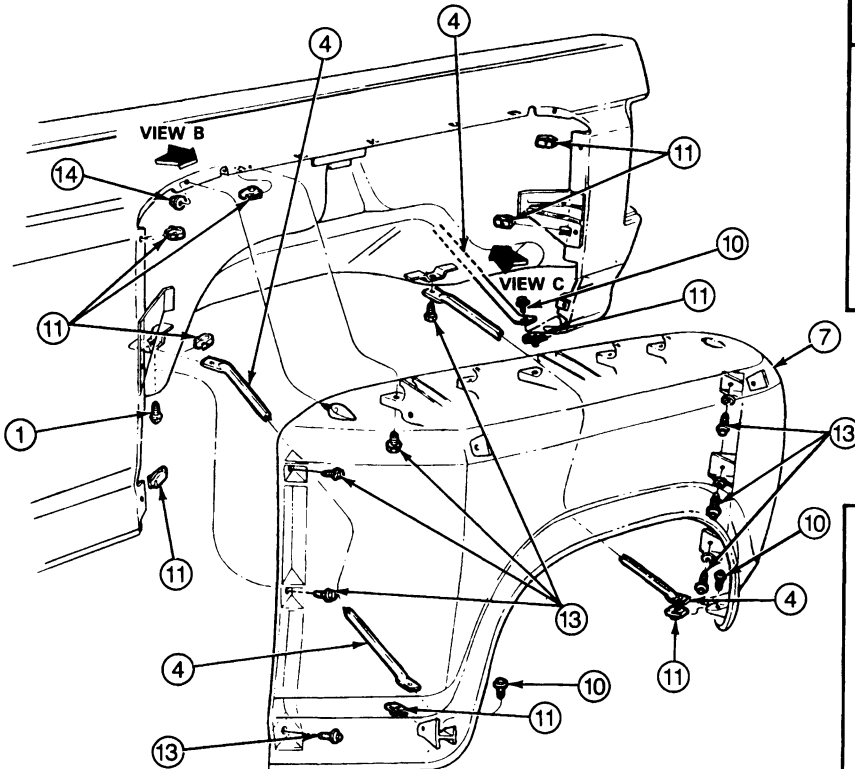
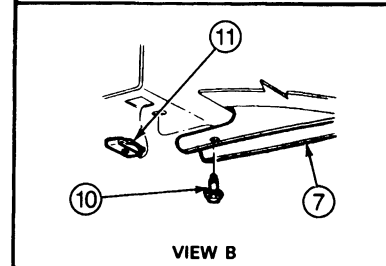
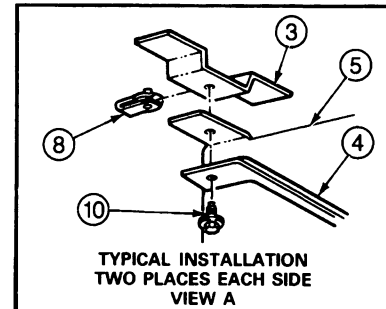
1. Disconnect rear lamp wiring.
2. Remove two upper and one lower splash shield-to-fender attaching nuts and bolts.
3. Remove front and rear fender brace attaching bolts.

4. Remove 11 fender-to-body attaching bolts.
5. Support fender and remove two (one each upper corner) fender-to-body retaining nuts. Remove fender.

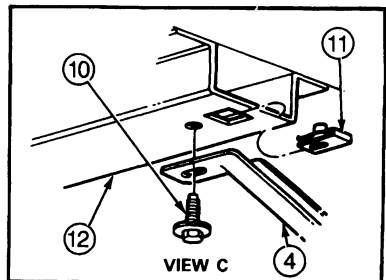
For installation, follow removal procedures in reverse order. Refer to the following illustration for tightening specifications.

REMOVAL AND INSTALLATION (Continued)

Rear Fender, F-350 with Dual Wheels

F-350 STYLESIDE-DUAL REAR WHEEL
FENDER SPLASH SHIELD (8.0 FT BOX)

F-350 DUAL REAR WHEEL FENDER



N9719-A

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	N605892-S2	Bolt 7-11 N·m (5-8 Ft-Lb)
2	N623332-S100	Nut
3	Ref.	Bracket
4	Ref.	Brace
5	28370	Shield
6	44722-S2	Washer
7	16312	Fender

(Continued)

Item	Part Number	Description
8	N800854-S2	Nut
9	381801-S36	Screw
10	N606676-S2	Bolt 7-11 N·m (5-8 Ft-Lb)
11	N800925-S2	Nut
12	Ref.	Rear Floor Pan Assembly
13	N606677-S2	Bolt 7-11 N·m (5-8 Ft-Lb)
14	N620480-S2	Nut

TN9719A

ADJUSTMENTS

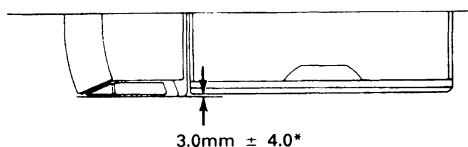
The valance and bodyside panels can be slightly adjusted by loosening their attaching bolts. However, if the panels cannot be aligned satisfactorily, the attaching brackets and underbody should be checked for damage.

The pickup box design is the same for both F-Series SuperCab and Regular Cab. The rear of the regular cab body is 3mm wider on each side than the front width of the pickup box. However on SuperCab vehicles, the front of the pickup box is 7mm wider on each side than the rear width of the cab body.

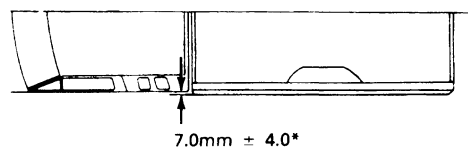
If there is a cab-to-box alignment concern, use the following instructions to correct the situation.

**REGULAR CAB VS. SUPERCAB
BOX IS COMMON — SUPERCAB CAB
IS NARROWER AT REAR**

F-REGULAR CAB



F-SUPERCAB



* — MEASURED AT UPPER CHARACTER LINE

N9945-A

Cab and Styleside Pickup Box Alignment, All F-Series Vehicles

1. Loosen the eight box attaching bolts.
2. Relocate the box so front of box is centered on the rear of the cab.
3. Make sure the cab-to-box margin at the outboard edge of the box is no less than 21.0mm.

NOTE: Less than the minimum clearance may result in cab-to-box contact during severe usage.

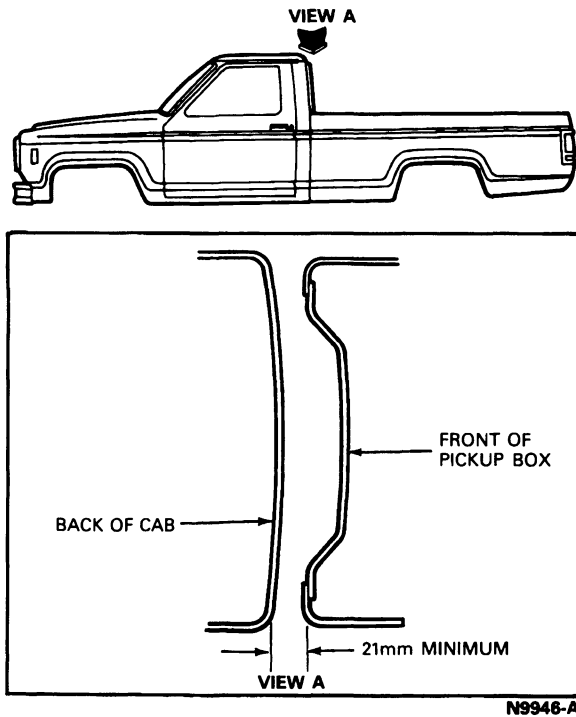
4. If satisfactory alignment is achieved, tighten the eight bolts to 54-95 N·m (40-70 ft-lb).
5. If satisfactory alignment cannot be achieved following the above instructions, it may be necessary to also adjust the position of the cab.
6. Loosen the six cab front end sheet metal mounting bolts.
7. Move the cab and the pickup box to achieve proper alignment.

CAUTION: Make sure that the cab-to-box margin is no less than 21.0mm.

8. Tighten the eight pickup box bolts to 54-95 N·m (40-70 ft-lb).
9. Tighten the four cab bolts to 68-95 N·m (50-70 ft-lb). Tighten the front end sheet metal bolts to 76-102 N·m (56-75 ft-lb).

ADJUSTMENTS (Continued)

10. Adjust the transmission shift select cable. Refer to Section 07-05.

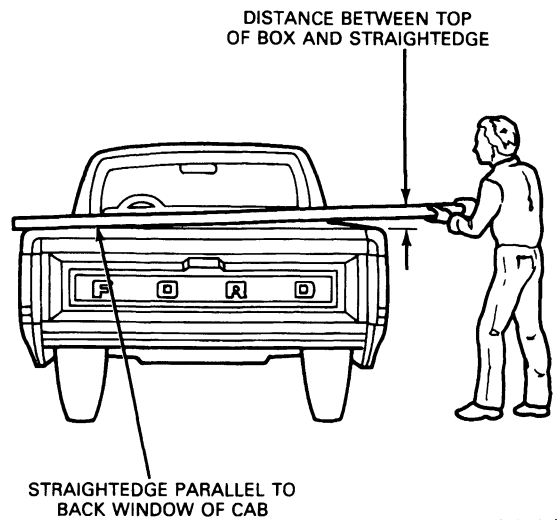


Pickup Box Lean

The following procedure may be used to eliminate pickup box lean.

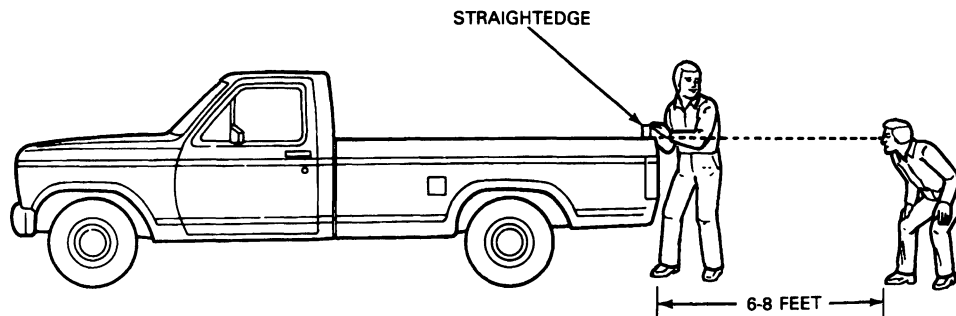
1. Place the vehicle on a flat, smooth surface.
2. Inspect vehicle for any heavy add-ons that may cause excessive weight on any corner of the vehicle.
3. Vehicle should be empty, fuel tanks should be full, no cargo in the pickup box, such as tools, equipment or debris.

4. Vehicle must be sitting on the wheels and tires and not on a hoist, jack, or jack stands.
5. Check all wheels and tires.
 - Wheels must be same size and design, right and left side on each axle.
 - Tires must be same brand, tire size, tread design, and equal tread wear side-to-side on each axle.
 - Wheel size and design, tire size, and tire design should be indicated on the Vehicle Certification Label. Usage of larger size, off-road, wide tread wheels and /or tires are not approved.
 - Check tire pressures of all tires; inflate to specifications indicated on the Vehicle Certification Label.
6. Lay a straightedge at least 6-1/2 inches long across the rear edge of the pickup box and have an assistant hold the straightedge.



ADJUSTMENTS (Continued)

7. Standing 6-8 feet behind the truck, with your eye level at the top of the pickup box, have your assistant lift whichever side of the straightedge is necessary to make it parallel to the back window of the cab.



N9948-A

8. Measure the distance between the bottom of the straightedge and the top of the pickup box outer panel and shim the low side of vehicle as follows:
- If the distance is between 0 and .25 inches do nothing.
 - If the distance is between .26 inch and .70 inch shim the axle.
 - If the distance is greater than .70 inch but less than 1.20 inch, shim the pickup box.
 - If the distance is greater than 1.20 inch, shim both the axle and pickup box.
 - If any of these conditions exist, refer to shimming procedures in this section.
9. If, after shimming, the rear bumper is not aligned with the rear of pickup box, re-align the bumper as follows:
- Remove the four bumper-to-chassis frame attaching bolts.
 - Ream the four holes to 17mm (two each side) on the bumper arms through which the chassis frame attaching bolts are installed.
 - Reinstall the bumper to chassis frame attaching bolts and align the bumper to the pickup box.
 - Torque the bumper attaching bolts to 95-140 N·m (70-103 lbs.-ft.)

Axle Shimming

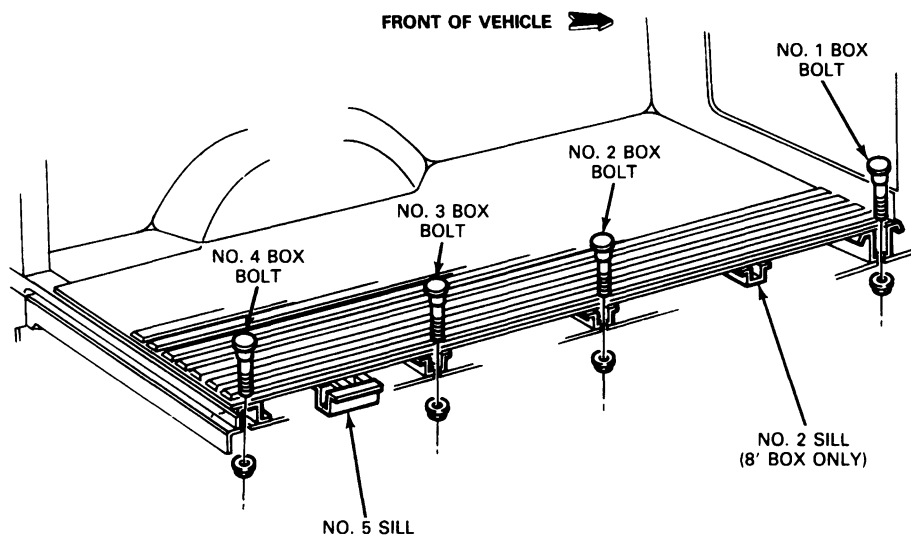
1. Raise vehicle frame until the weight is off the rear springs, with the tires still touching the floor.
2. Loosen the spring U-bolts to allow the axle to separate from the spring.
3. On the low side of the vehicle, position one shim (D7TZ-5742-A) between the spring and the spring tie bolt head through the hole in the shim. On 4x4 vehicles, position shim between the rear spring and axle spacer. Tape may be used to hold the shim in position.
4. Make sure that the spring leaves are properly aligned and the spring U-bolts contact spring assembly edges or axle seat.
5. Tighten the spring U-bolt so the spring tie bolt head that extends through the shim enters axle seat hole.
6. Torque U-bolt nuts on F-150 to 102-135 N·m (75-100 ft.-lbs.), on F-250-350 to 203-284 N·m (150-210 lbs.-ft.).

Pickup Box Shimming

1. Loosen all box attaching bolts. Remove the four bolts on the low side of the box.

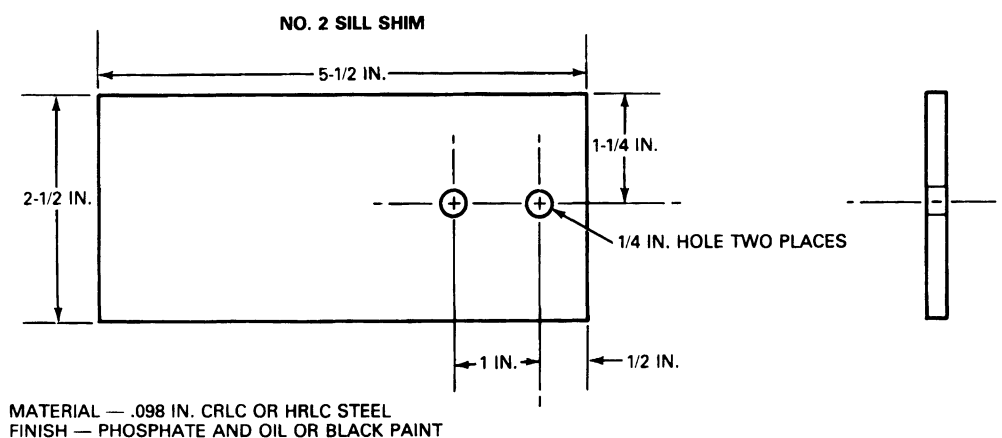
ADJUSTMENTS (Continued)

Pickup Box Bolt Locations



N9949-A

2. Raise the low side of the box and insert the shims between the top of the frame and bottom of the box cross sills according to the following chart.



N9950-A

3. Install the bolts listed below on the side of the box that was shimmed and tighten all box bolt nuts to 54-95 N-m (40-70 ft.-lbs.).

PICKUP BOX SHIMMING SPECIFICATIONS

Location	Type of Bolt	Shim
No. 4 box bolt (rear most)	Same as current No. 1 bolt — 4.25 inches, oval shoulder	8 shims (2.5 O.D. x .75 I.D. x .060)
No. 5 sill (next sill forward, it does not have a bolt)	No change	1 "L" shim (see illustration) screwed to No. 5 sill

(Continued)

ADJUSTMENTS (Continued)

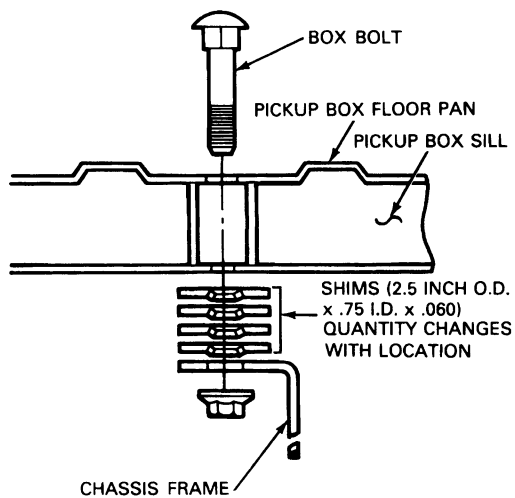
PICKUP BOX SHIMMING SPECIFICATIONS (Cont'd)

Location	Type of Bolt	Shim
No. 3 box bolt (next body bolt forward of the No. 4 bolt)	Use current No. 2 bolt — 3.50 inches long, square shoulder	5 shims (same as No. 4 shims)
No. 2 box bolt (next body bolt forward)	New bolt required — 4.00 inches long, square shoulder	4 shims (same as No. 4 shims) 8-foot box 2 shims (same as No. 4 shims) 6.5-foot box
No. 2 sill (8-foot box only)	New bolt required — 4.00 inches long, square shoulder	1 flat shim (see illustration) screwed to No. 2 sill
No. 1 box bolt (bolt at front of pickup box)	No change; use existing bolt — 4.25 inches long, oval shoulder	No shims

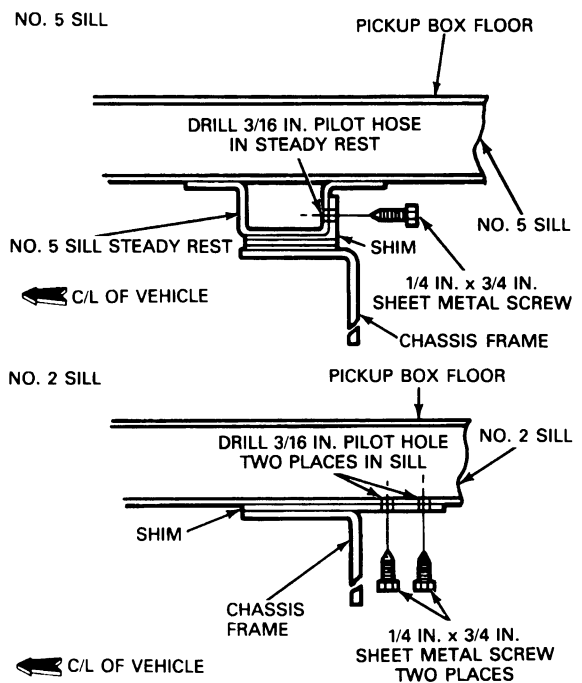
TN9951A

NOTE: Bolts should be held down from top of box to prevent the shoulder from popping out of the floor while starting the nut. Tighten all bolts to 54-95 N-m (40-70 ft.-lbs.).

NO. 2, NO. 3, AND NO. 4 PICKUP BOX BOLTS



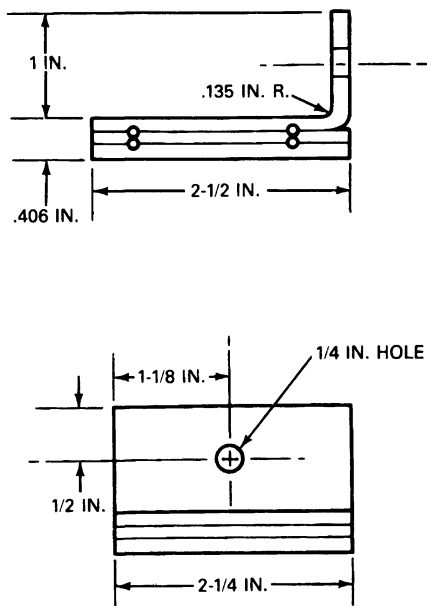
N9952-A



N9953-A

ADJUSTMENTS (Continued)

NO. 5 SILL SHIM



TACK WELD ON EDGES TO HOLD THE THREE PARTS TOGETHER

MATERIAL — .136 IN. CRLC OR HRLC STEEL 3 PIECES
FINISH — PHOSPHATE AND OIL OR BLACK PAINT

N9954-A

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
Pickup Box Bolts (8)	54-95	40-70
Cab Bolts	68-95	50-70
Front Sheet Metal Bolts	76-102	56-75
Bumper Attaching Bolts	95-104	70-103
U-Bolts:		
— F-150	102-135	75-100
— F-250-350	203-284	150-210
Bodyside Front And Rear Step Support Screw(s) And Washer(s)	7.0-8.1	62-71 In-Lb
Bodyside Panel-to-Pickup Box Bolts (F-150 Flareside)	7.0-8.1	62-71 In-Lb
Bracket Bolts (F-150 Flareside)	7.0-8.1	62-71 In-Lb
Valance Panel Bolts (F-150 Flareside)	7.0-8.1	62-71 In-Lb
Tie-Down Hook Screw And Washer Assemblies (F-150 Flareside)	7.0-8.1	62-71 In-Lb
Pickup Box Nuts	54-95	40-70
Splash Shield Bolt(s) (F-350 w/ dual rear wheels)	7-11	5-8
Fender Bolt(s) (F-350 w/ dual rear wheels)	7-11	5-8
Dual Rear Fender-To-Fender Bolt(s)	7-11	5-8

SPECIFICATIONS (Continued)**PICKUP BOX SHIMMING SPECIFICATIONS**

Location	Type of Bolt	Shim
No. 4 box bolt (rearmost)	Same as current No. 1 bolt — 4.25 inches, oval shoulder	8 shims (2.5 O.D. x .75 I.D. x .060)
No. 5 sill (next sill forward, it does not have a bolt)	No change	1 "L" shim (see illustration) screwed to No. 5 sill
No. 3 box bolt (next body bolt forward of the No. 4 bolt)	Use current No. 2 bolt — 3.50 inches long, square shoulder	5 shims (same as No. 4 shims)
No. 2 box bolt (next body bolt forward)	New bolt required — 4.00 inches long, square shoulder	4 shims (same as No. 4 shims) 8-foot box 2 shims (same as No. 4 shims) 6.5-foot box
No. 2 sill (8-foot box only)	New bolt required — 4.00 inches long, square shoulder	1 flat shim (see illustration) screwed to No. 2 sill
No. 1 box bolt (bolt at front of pickup box)	No change; use existing bolt — 4.25 inches long, oval shoulder	No shims

TN9951A

SECTION 01-05A Trim, Interior, F-Series and Bronco

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING AND INSPECTION	01-05A-17	REMOVAL AND INSTALLATION (Cont'd.)	
DESCRIPTION AND OPERATION		Headlining	01-05A-12
Color Codes	01-05A-1	Mouldings	01-05A-13
REMOVAL AND INSTALLATION		Side Trim Panels, Bronco	01-05A-3
Door Trim Panel, F-150-250-350, F-Super Duty		Sun Visors	01-05A-17
Chassis Cab and Bronco	01-05A-6	SPECIAL SERVICE TOOLS/EQUIPMENT	01-05A-17
Floor Carpet/Mat	01-05A-7	SPECIFICATIONS	01-05A-17
General Trim Panel Information	01-05A-1	VEHICLE APPLICATION	01-05A-1

VEHICLE APPLICATION

F-150-250-350 and Bronco Vehicles

DESCRIPTION AND OPERATION

Color Codes

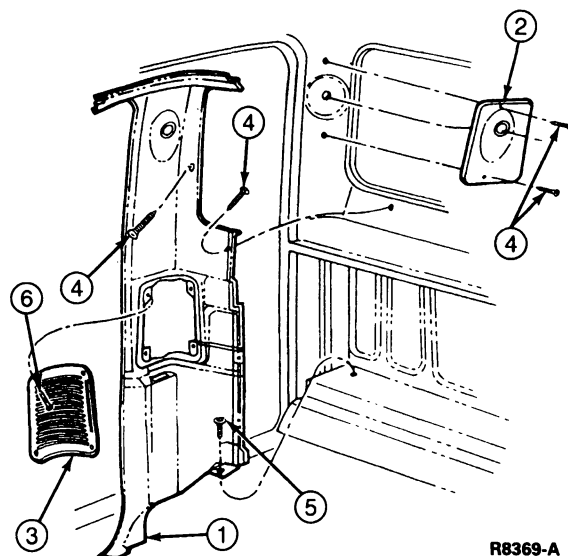
When replacing trim, always make sure the correct color of trim is ordered. See the Trim Codes on the Safety Compliance Certification Label on the passenger's side door. For coding information, refer to Section 00-01.

REMOVAL AND INSTALLATION

General Trim Panel Information

Since all interior trim panels are retained to the body panels with screws and /or metal strips, the removal and installation procedures are apparent, as shown in the assembly illustrations. Access to some of these panels, however, requires prior removal of other parts. Applicable removal procedures follow.

Body Interior Trim Panels, F-Series



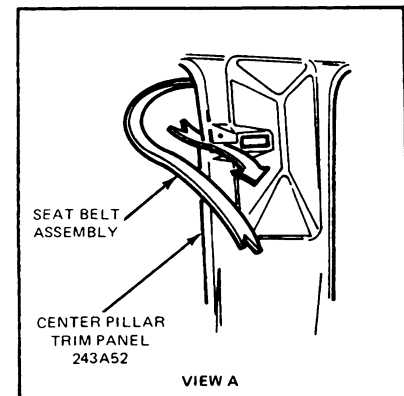
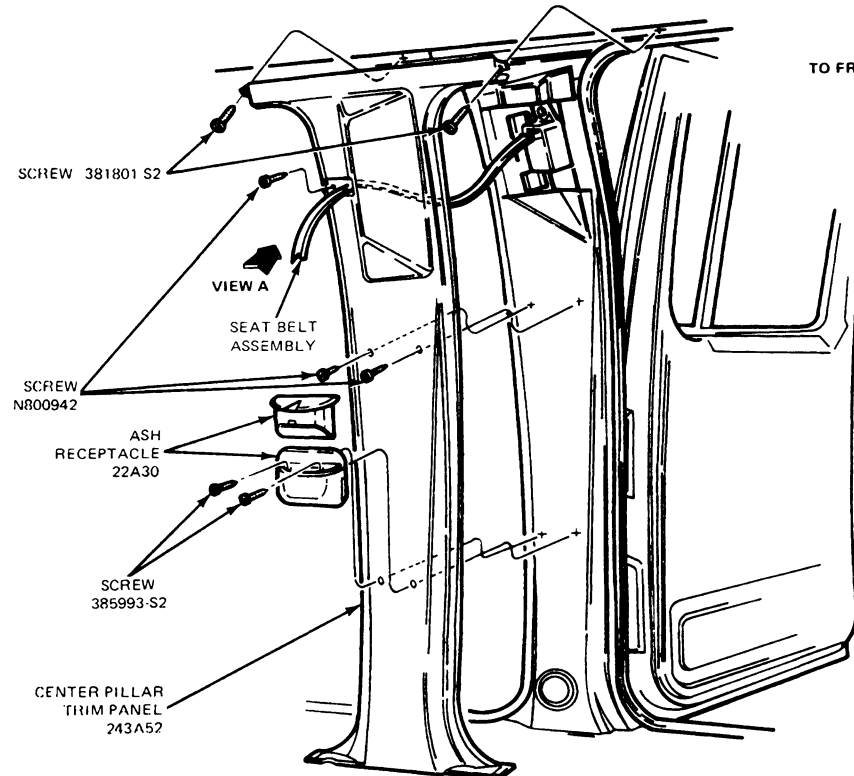
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	278D12	Rear Corner Trim Panel
2	60230	Shoulder Strap Opening Cover
3	61A42	Radio Speaker Grille

(Continued)

Item	Part Number	Description
4	N800942-S58	Screw and Washer, Oval Trim Head (1 Req'd Each Side, 2 Req'd Each Side for Lo-Series)
5	381801-S58	Screw, Round Washer Head (1 Req'd Each Side)
6	N801946-S58	Screw, Oval Head (4 Req'd Each Side)

Center Pillar Trim Panel, F-350 Crew Cab



R3754-2A

REMOVAL AND INSTALLATION (Continued)

Body Interior Trim Panels, F-150-250-350 and F-Super Duty Chassis Cab

VIEW A

R8371-A

Item	Part Number	Description
1	281A32	Center Body Trim Panel
2	519A96	Roof Side Rear Trim Panel
3	278012	Rear Corner Trim Panel
4	40374	Back Lower Trim Panel

(Continued)

Item	Part Number	Description
5	381801-S58	Screw
6	N800942-S58	Screw
7	N802900-S	Pushpin
8	381801-S58	Screw
9	56928-S58	Screw

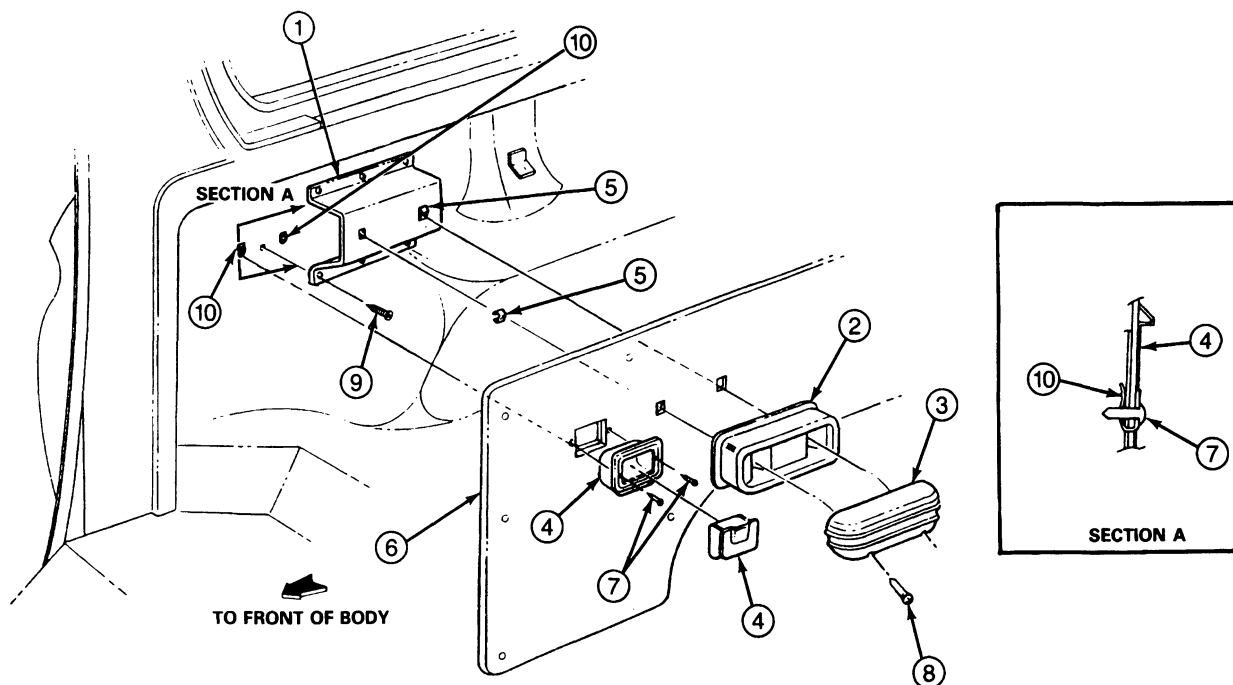
Side Trim Panels, Bronco

Refer to the following illustration for removal and installation of trim panels.

NOTE: When removing panels retained by pushpins, use the Trim Pad Removing Tool from Rotunda Moulding / Trim Kit 107-00401 or equivalent to carefully pry trim panel from inner panel. Replace any bent, damaged or missing pushpins.

REMOVAL AND INSTALLATION (Continued)

Body Side Trim Panel, Lo-Series, Bronco



R8375-A

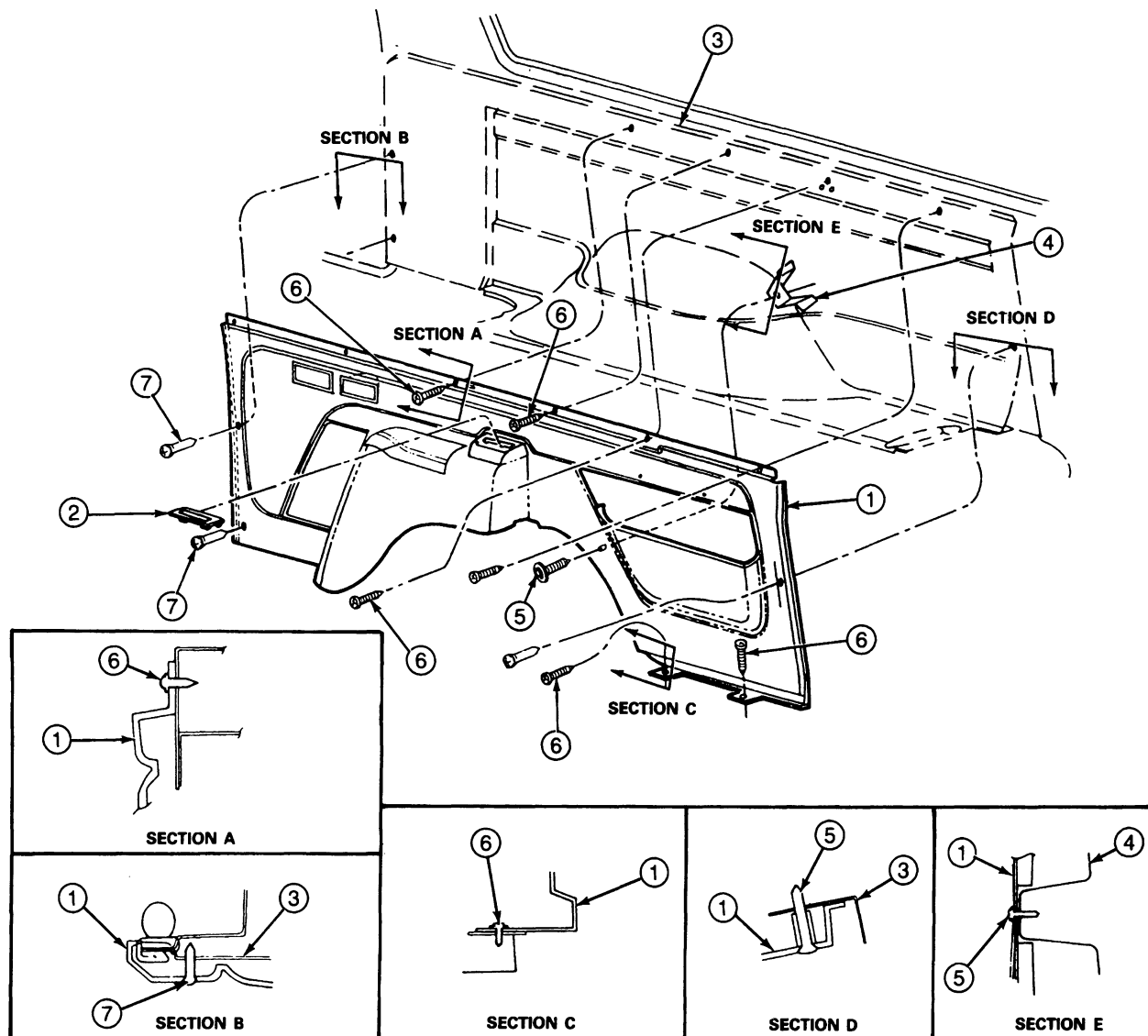
Item	Part Number	Description
1	31608	Arm Rest Support
2	31604	Arm Rest Base
3	24100	Door Pad
4	62866	Ash Receptacle Assembly
5	24146	Arm Rest Clip
6	Ref.	Side Trim Panel

(Continued)

Item	Part Number	Description
7	N803414-S58	Screw (2 Req'd Each Side of Body)
8	N610963-S58	Screw and Washer Assembly (2 Req'd Each Side of Body)
9	380934-S36	Screw, Drill Point (4 Req'd Each Side of Body)
10	N803103-S58	U-Nut (2 Req'd Each Side of Body)

REMOVAL AND INSTALLATION (Continued)

Body Side Trim Panel, Hi-Series, Bronco

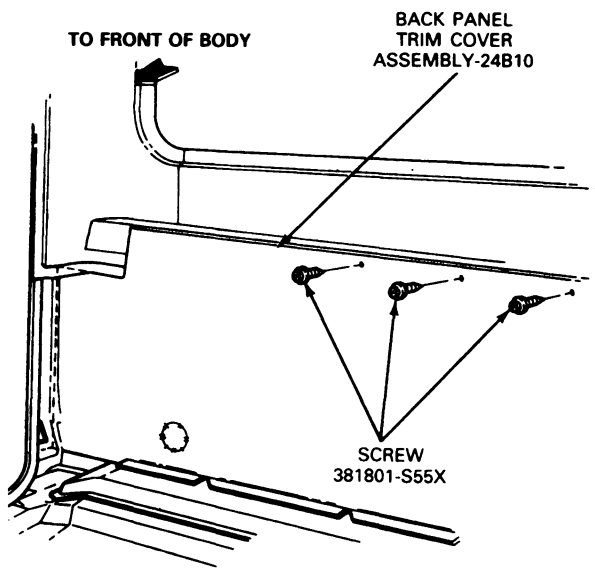


R8377-A

Item	Part Number	Description
1	31012	Side Trim Panel
2	601B30	Shoulder Strap Opening Bezel
3	Ref.	Body / Side

(Continued)

Item	Part Number	Description
4	Ref.	Bracket
5	N801157-S58	Screw and Washer, Oval Head
6	381801-S58	Screw, Round Washer Head
7	N800942-S58	Screw and Washer, Oval Head

REMOVAL AND INSTALLATION (Continued)**Back Panel Trim Cover Assembly**

2. Remove the screw retaining the door inside handle and remove the handle.
3. Remove the screw retaining the door window regulator handle and remove the handle and washer, if so equipped.
NOTE: On units with power windows, remove the power window switch housing. Refer to Section 01-11.
4. Remove the door lock control, if so equipped. Refer to Section 01-14.
NOTE: On units with power door locks, remove the power door lock switch housing. Refer to Section 01-14.
5. Remove power rearview outside mirror switch housing, if so equipped. Refer to Section 01-09, Mirrors.
6. Using the Trim Pad Removing Tool From Rotunda Moulding / Trim Kit 107-00401 or equivalent, carefully pry the trim panel and pushpins away from door inner panel and remove the trim panel.

NOTE: At no time should the trim panel be used to remove pushpins from the inner panel holes.

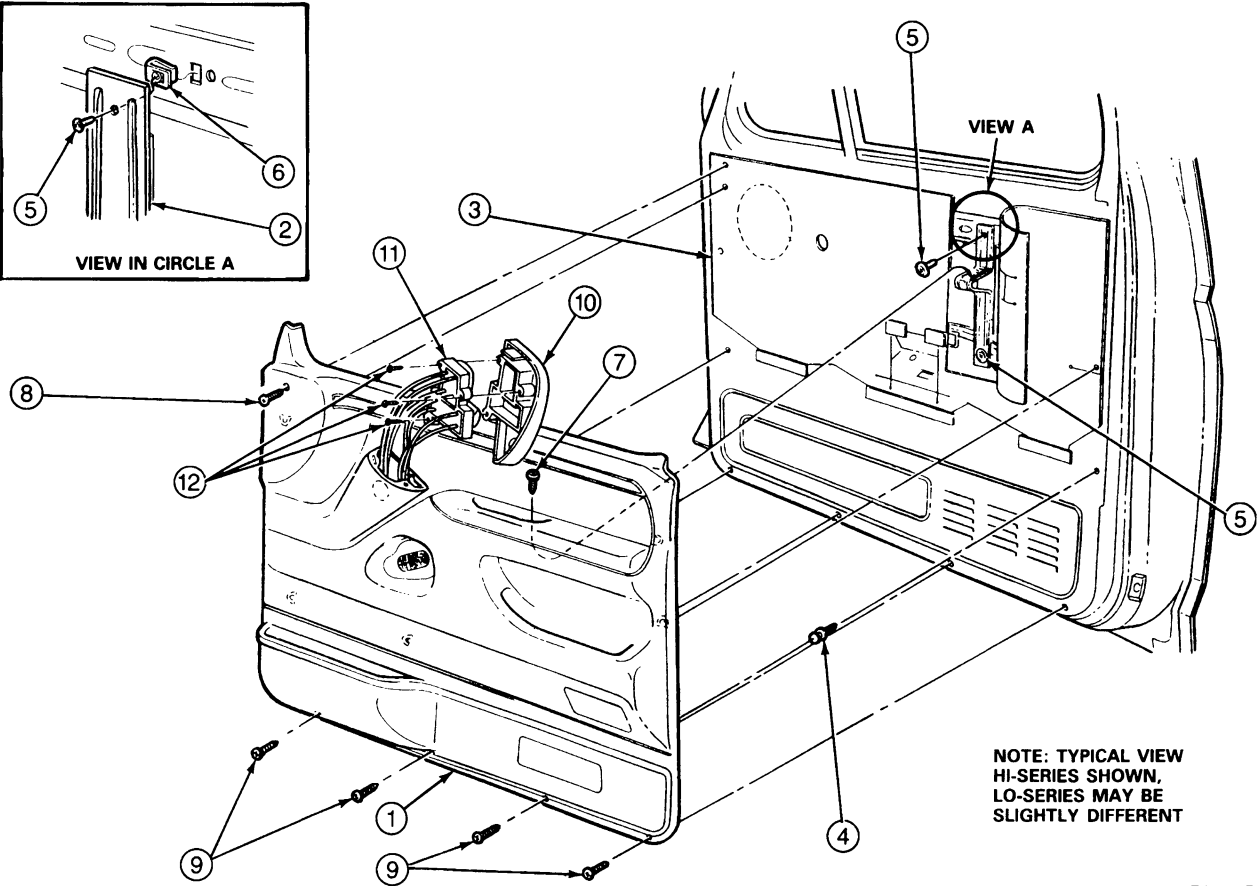
For installation, follow removal procedures in reverse order. Tighten screw and washer assembly 1-2 N-m (9-17 in-lb).

Door Trim Panel, F-150-250-350, F-Super Duty Chassis Cab and Bronco**Removal and Installation**

1. Remove the screw(s) retaining the arm rest area of the trim panel to the door inner panel.

REMOVAL AND INSTALLATION (Continued)

Door Trim Panel



Item	Part Number	Description
1	23942	Door Trim Panel
2	24022	Armrest Support
3	Ref.	Watershield
4	N802900-S	Pushpin (6 Req'd Each Side)
5	56911-S58	Screw and Washer 1-2 N-m (9-17 In-Lb)
6	N802539-S100	Spring — Nut
7	56930-S2	Screw (1 Req'd Each Side)

(Continued)

Item	Part Number	Description
8	N806578-S58	Screw and Washer (1 Req'd Each Side)
9	N801157-S58	Screw and Washer Assembly (4 Req'd Each Side)
10	14A335	Window Regulator Control Housing
11	Ref.	Window Regulator Control Wiring
12	55928-S2	Screw (3 Req'd Each Side)

Floor Carpet / Mat

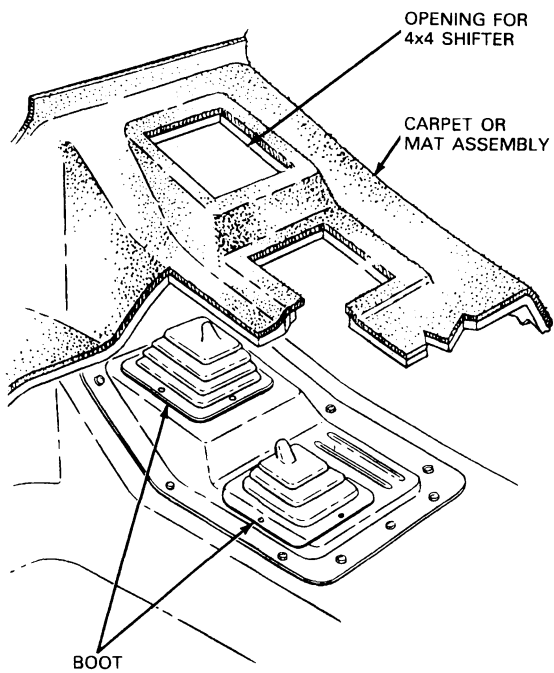
Removal

1. Remove the seat(s). Refer to Section 01-10A and Section 01-10B.
2. If equipped with manual transmission, remove shift boot bezel.

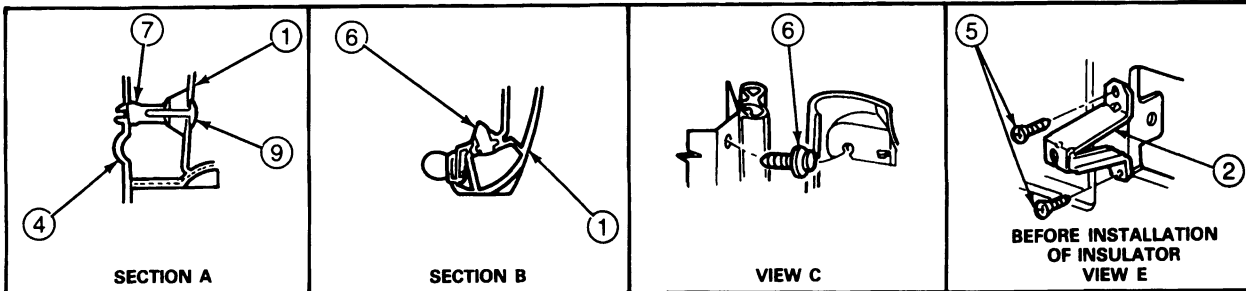
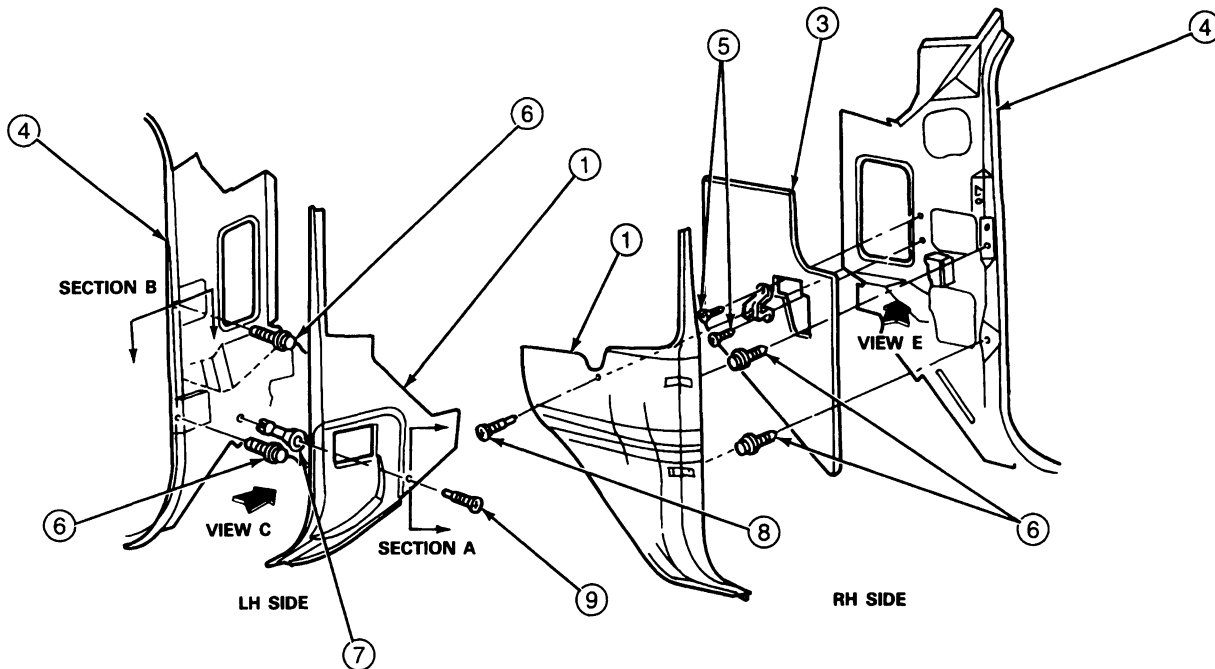
3. Grasp the carpet or mat surrounding edge beneath the convoluted floor shifter boot and pull outward and upward away from the boot.
4. Remove floor console. Refer to Section 01-12A.

REMOVAL AND INSTALLATION (Continued)

5. Remove the screws retaining the right and left cowl side trim panels.



R2832-D

REMOVAL AND INSTALLATION (Continued)**Cowl Side Trim Panel F-150-250-350, F-Super Duty and Bronco**

R8385-A

Item	Part Number	Description
1	02344	Cowl Side Trim Panel
2	02354	Cowl Side Trim Panel Retainer (RH)
3	Ref.	Cowl Side Insulator (RH)
4	Ref.	Cowl Side Sheet Metal (RH and LH)

(Continued)

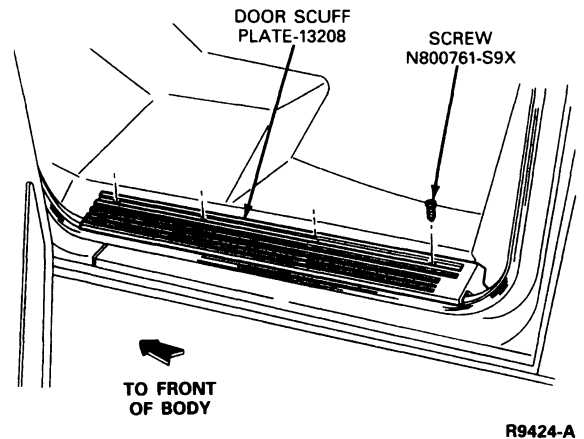
Item	Part Number	Description
5	56910-S55	Screw
6	N801925-S	Pushpin
7	N806854-S	Nut
8	N802734-S	Pushpin
9	6302354	Cowl Side Trim Panel Retainer (LH)

6. Remove the screws retaining the right and left door sill scuff plates and remove the scuff plates. Remove cowl side trim panels.
7. Remove all carpet or mat retaining screws.

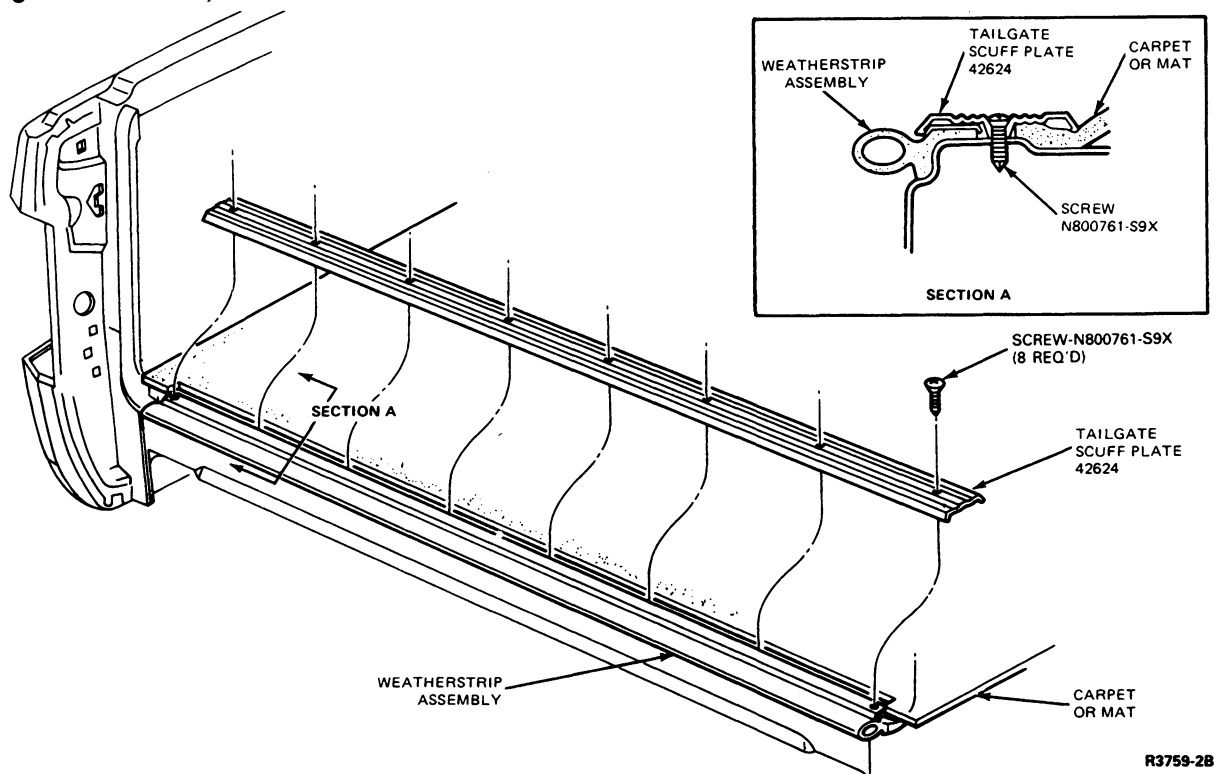
REMOVAL AND INSTALLATION (Continued)**8. Remove carpet or mat.**

For installation, follow the removal procedures in reverse order.

NOTE: Use old carpet as a template to cut hole for shifter(s), if required.



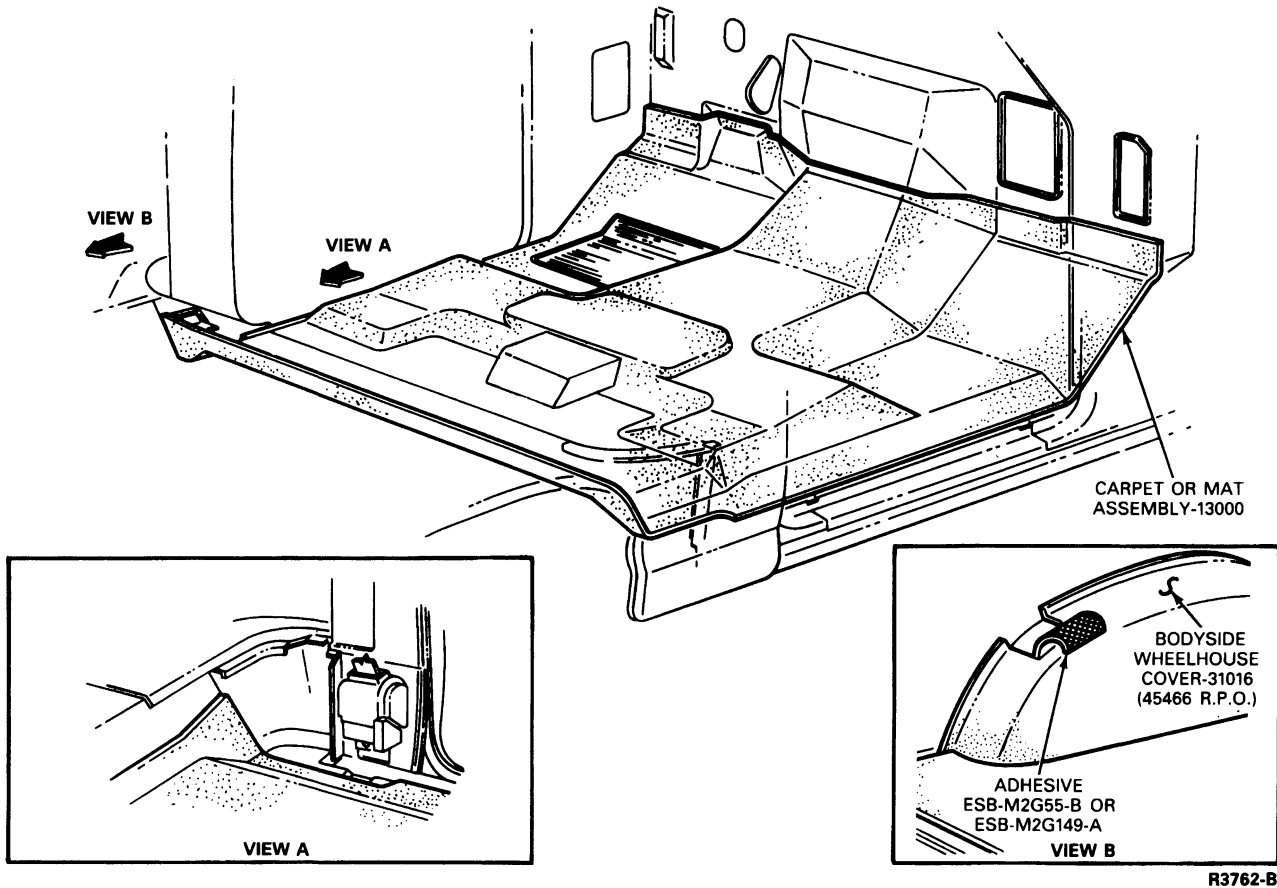
R9424-A

Tailgate Scuff Plate, Bronco

R3759-28

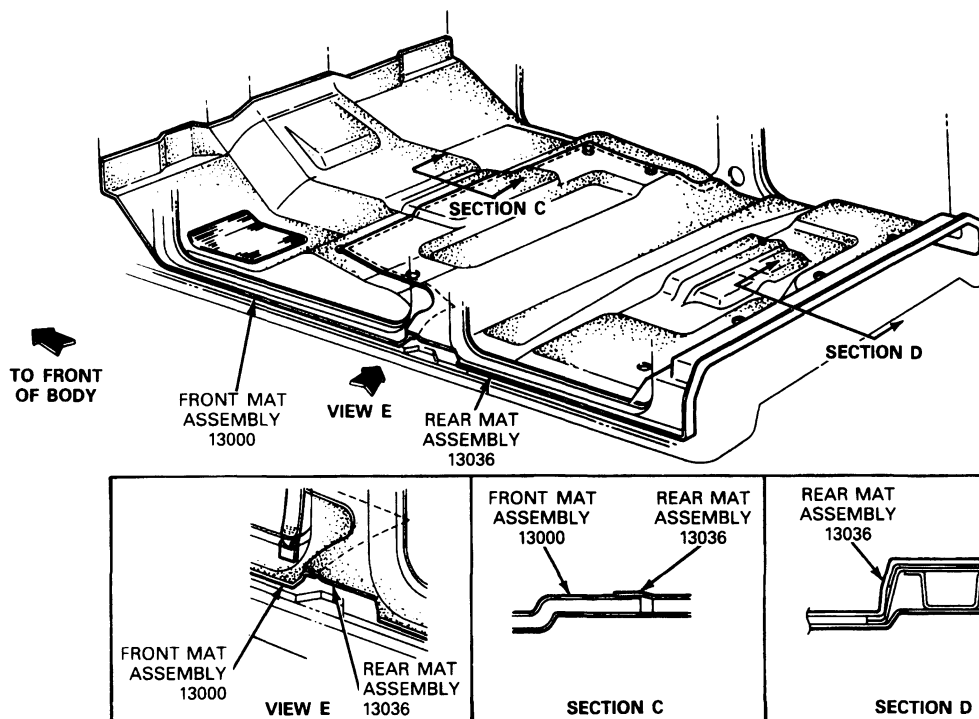
REMOVAL AND INSTALLATION (Continued)

Floor Mat and Carpet, Typical View



REMOVAL AND INSTALLATION (Continued)

Floor Mat and Carpet, Typical View



Headlining

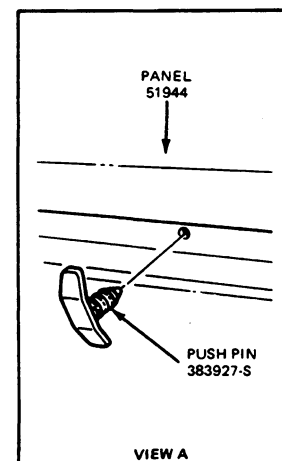
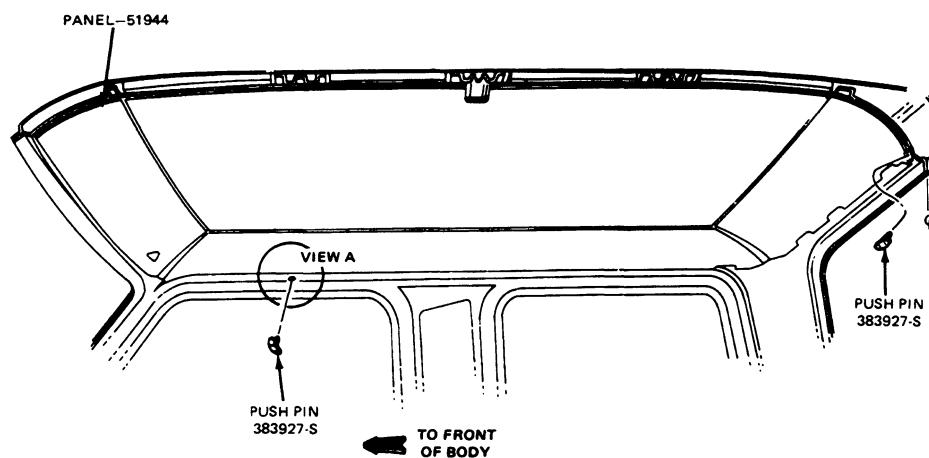
Removal

1. Remove the three screws retaining each sun visor to the roof and remove the sun visors.

2. Remove the screws retaining the garnish mouldings and remove the mouldings.
3. Remove the two drive pins retaining the headliner to the roof structure. Remove the headliner.

For installation, follow removal procedures in reverse order.

Roof Headlining, Typical View

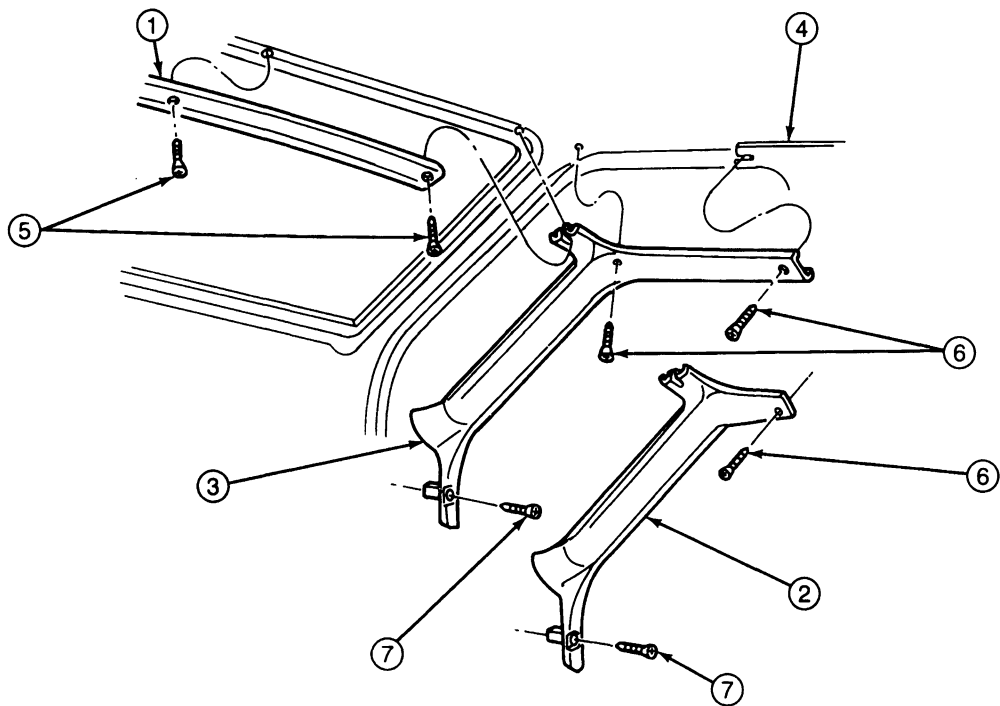


REMOVAL AND INSTALLATION (Continued)

Mouldings

The installation of the plastic and steel interior mouldings are shown in the following illustrations. In most instances, one moulding overlaps another moulding. If this condition is found, it will be necessary to loosen or remove the overlapping moulding before removal of the desired moulding.

Windshield Interior Garnish Mouldings



R8387-A

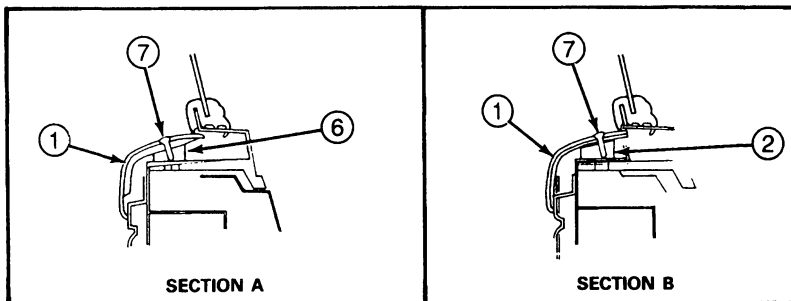
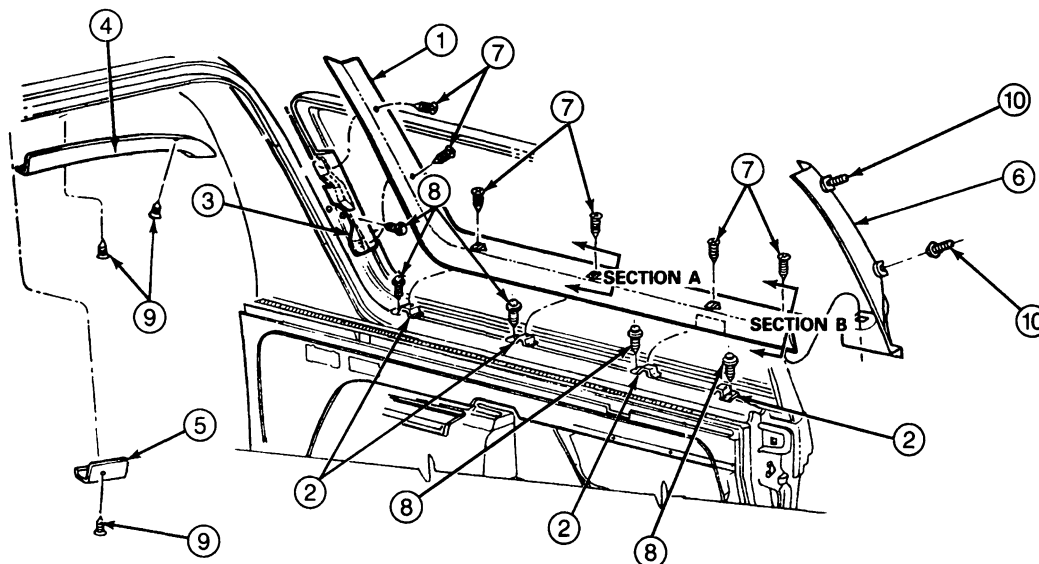
Item	Part Number	Description
1	03606	Windshield Garnish Upper Moulding
2	025A84	Front Body Pillar Inside Moulding

(Continued)

Item	Part Number	Description
3	025A84	Front Body Pillar Inside Moulding
4	Ref.	Body Pillar Trim Panel
5	N610132-S58	Screw (3 Req'd)
6	N801157-S58	Screw and Washer
7	N806578-S58	Screw and Washer (1 Req'd Each Side)

REMOVAL AND INSTALLATION (Continued)

Body Side and Roof Rear Garnish Mouldings, Bronco



R8389-A

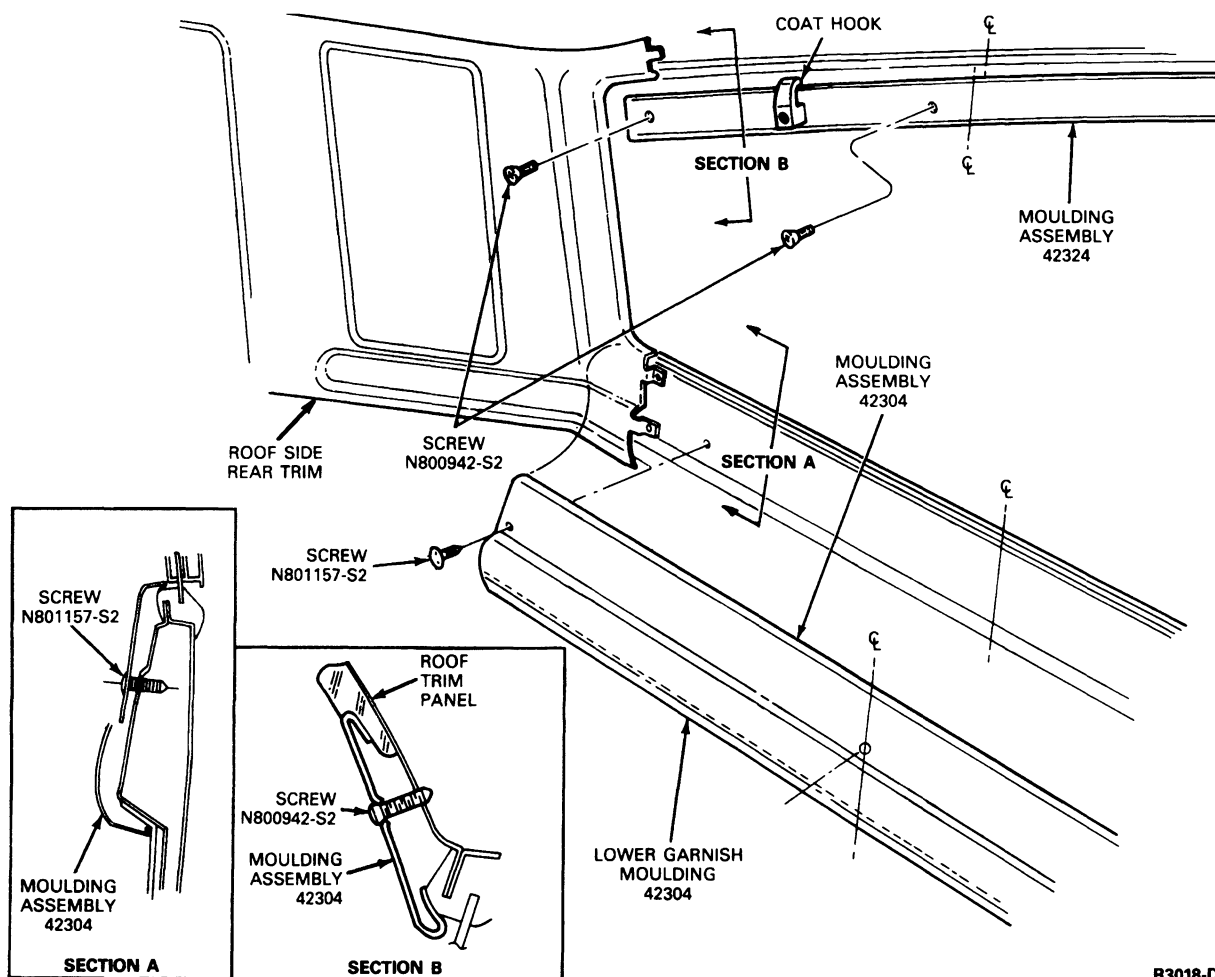
Item	Part Number	Description
1	29004	Quarter Window Garnish Lower Front Moulding
2	29126	Body Side Window Garnish Moulding Front Bracket
3	29070	Body Side Window Garnish Moulding Front Bracket
4	517C04	Roof Trim Rear Moulding

(Continued)

Item	Part Number	Description
5	518B34	Roof Trim Rear Moulding Joint Cover
6	29010	Quarter Rear Window Garnish Rear Moulding
7	N800942-S58	Screw and Washer, Oval Trim Head
8	Ref.	Bolt and Washer
9	N801157-S58	Screw and Washer (2 Req'd Each Side, 1 Req'd Center)
10	N802900-S	Pushpin (2 Req'd Each Side)

REMOVAL AND INSTALLATION (Continued)

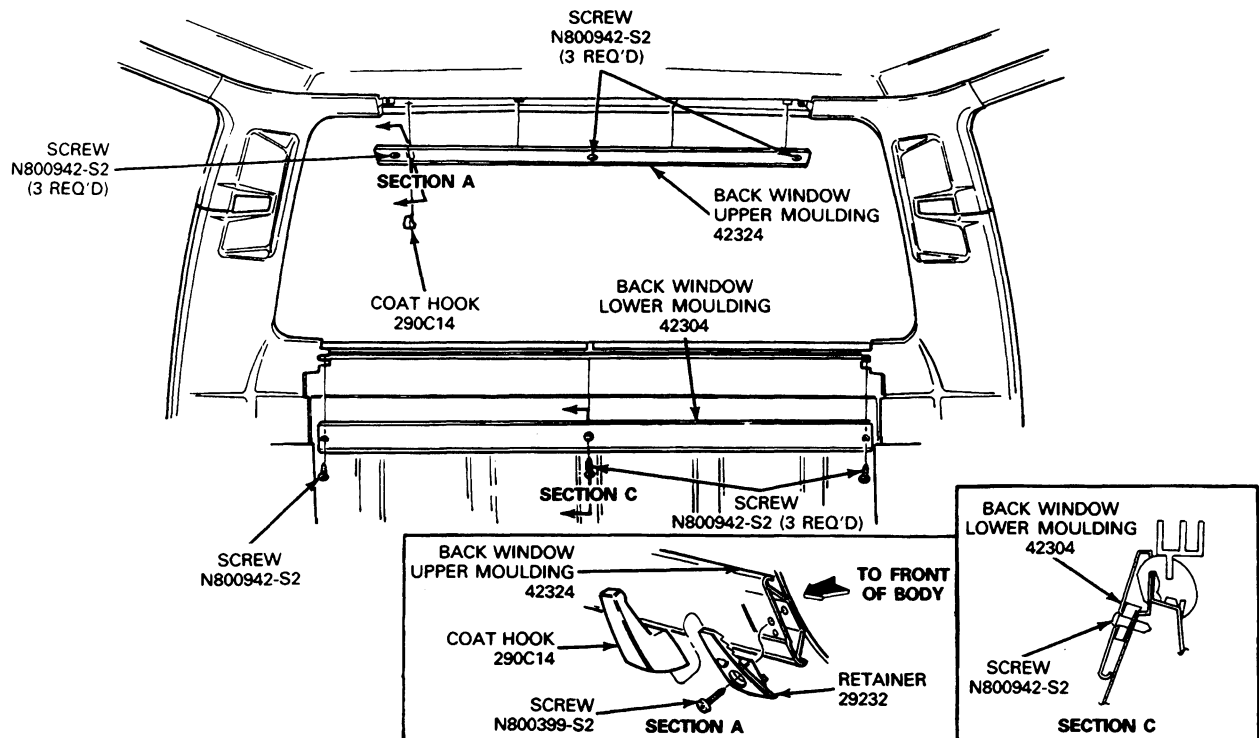
Rear Quarter Garnish Moulding, Typical View



R3018-D

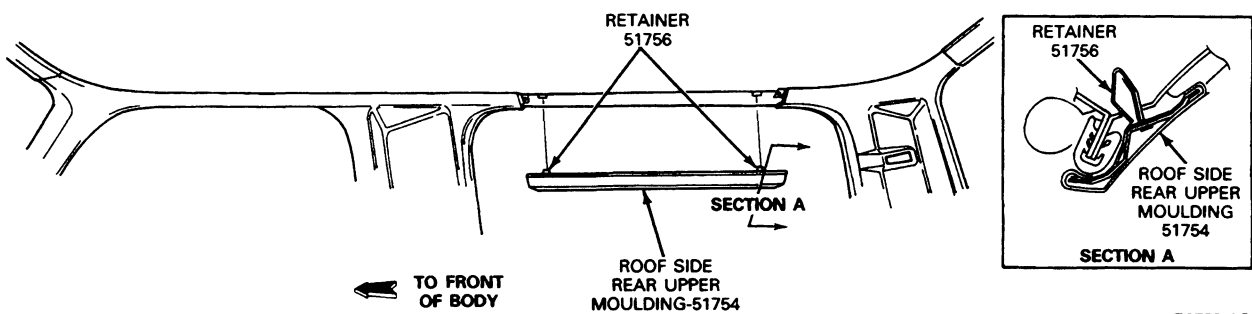
REMOVAL AND INSTALLATION (Continued)

Back Window Moulding and Coat Hook, F-350 Crew Cab



R3755-2B

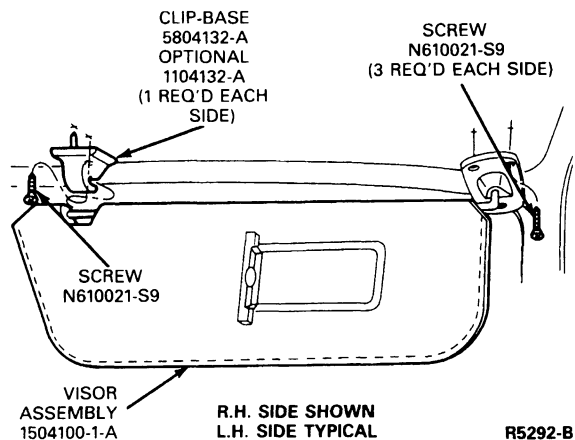
Roof Side Moulding, F-350 Crew Cab



R3757-2C

REMOVAL AND INSTALLATION (Continued)**Sun Visors**

To remove sun visors, remove attaching screws to headliner and remove headliner. For installation, position sun visor assembly and tighten screws.

**CLEANING AND INSPECTION**

Refer to Vehicle Owner Guide for recommended cleaning procedure.

SPECIFICATIONS**Torque Specifications**

Description	N·m	In-Lb
Hi-Series Armrest Support Screw and Washer	1-2	9-17

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
107-00401	Moulding / Trim Kit

SECTION 01-05B Trim, Interior, Econoline

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING AND INSPECTION	01-05B-21	REMOVAL AND INSTALLATION (Cont'd.)	
DESCRIPTION AND OPERATION		Quarter Trim Panel, Left Side	01-05B-11
Color Codes	01-05B-1	Quarter Trim Panel, Right Side	01-05B-9
REMOVAL AND INSTALLATION		Scuff Plates	01-05B-20
A-Pillar Moulding	01-05B-17	Side Cargo and Back Door Trim Panels,	
B-Pillar Trim Panel	01-05B-18	Hi-Series	01-05B-6
Coat Hooks	01-05B-20	Side Cargo and Back Door Trim Panels,	
Cowl Side Trim Panels	01-05B-17	Lo-Series	01-05B-4
Engine Cover	01-05B-14	Sliding Door Track Cover	01-05B-19
Floor Carpet/Mat	01-05B-14	Sliding Door Trim Panel and Garnish Moulding,	
Front Door Trim Panel, Hi-Series	01-05B-2	Hi-Series	01-05B-8
Front Door Trim Panel, Lo-Series	01-05B-1	Sliding Door Trim Panel, Lo-Series	01-05B-7
General Trim Panel Information	01-05B-1	Sun Visors	01-05B-19
Headlining, Roof	01-05B-15	SPECIAL SERVICE TOOLS/EQUIPMENT	01-05B-21
Mouldings	01-05B-17	VEHICLE APPLICATION	01-05B-1
Quarter Trim Finish Panel Insert, Left			
Side	01-05B-11		

VEHICLE APPLICATION

E-150-250-350 Vehicles

DESCRIPTION AND OPERATION

Color Codes

When replacing trim, always make sure the correct color of trim is ordered. See the Trim Codes on the Safety Compliance Certification Label on the passenger's side door. For coding information, refer to Section 00-01.

REMOVAL AND INSTALLATION

General Trim Panel Information

Since all interior trim panels are retained to the body panels with screws and / or metal strips, the removal and installation procedures are apparent, as shown in the assembly illustrations. Access to some of these panels, however, requires prior removal of other parts. Applicable removal procedures are outlined as follows.

Front Door Trim Panel, Lo-Series

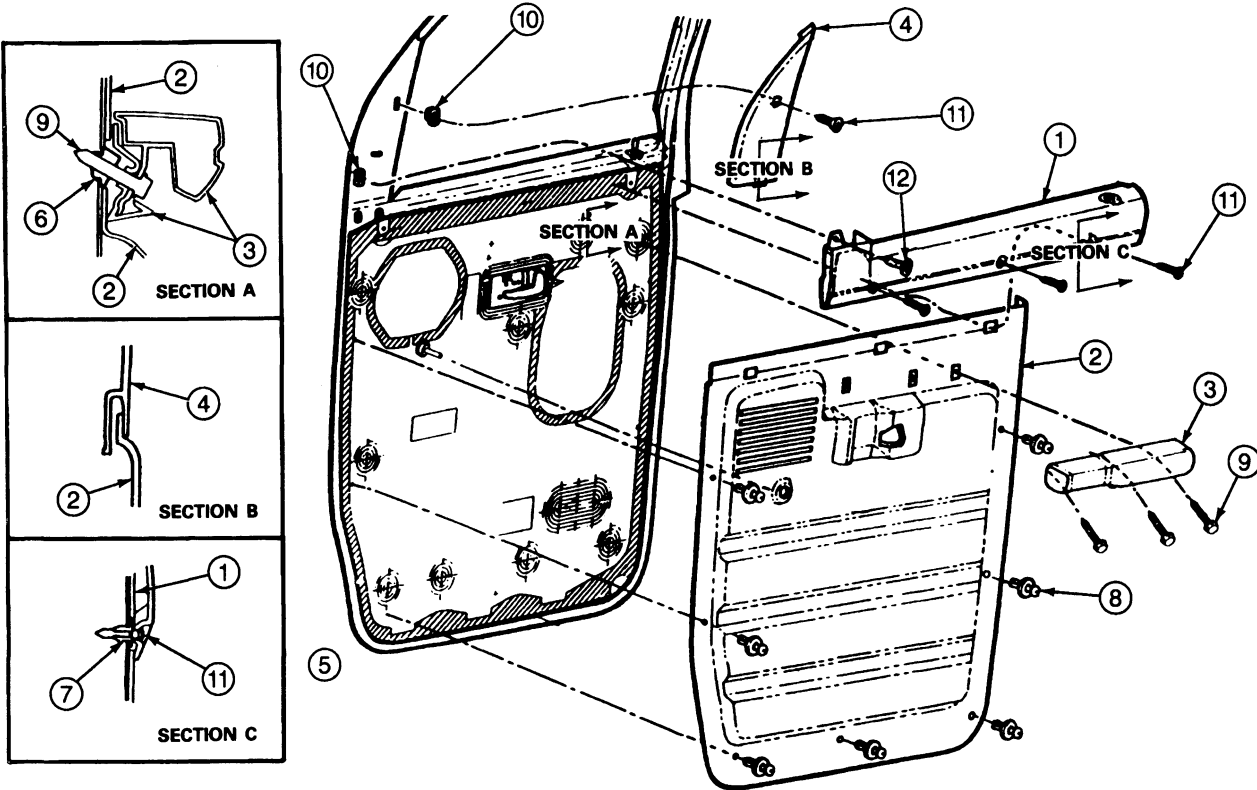
Removal and Installation

1. Remove screw in sail panel and lift out panel, for outside remote mirror.
2. Remove screws in upper panel and remove panel by lifting upward.
3. Remove window crank.
4. Remove arm rest (three screws).
5. Remove scrivenets by turning heads counterclockwise with a screwdriver until they are loose.
6. Remove panel.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Front Door Trim Panel, Lo-Series



R8303-A

Item	Part Number	Description
1	23942 / 3	Front Door Upper Trim Panel, RH / LH
2	23902 / 3	Front Door Lower Trim Panel, RH / LH
3	24140 / 1	Door Trim Armrest, RH / LH
4	17K709-RH 170691-LH	Outside Mirror Mounting — Hole Cover
5	Ref.	Water Shield
6	Ref.	Spring Nut

(Continued)

Item	Part Number	Description
7	Ref.	Push-in Nut
8	N806322-S	Scrivet (7 Req'd Each Side)
9	55917-S58	Hex Head Screw (3 Req'd Each Side)
10	N806577-S	Push-in Nut (2 Req'd Each Side)
11	N610130-S58	Screw, Oval Trim Heading — Tapping
12	56912-S58	Screw, Round Washer Head — Tapping

Front Door Trim Panel, Hi-Series

Removal

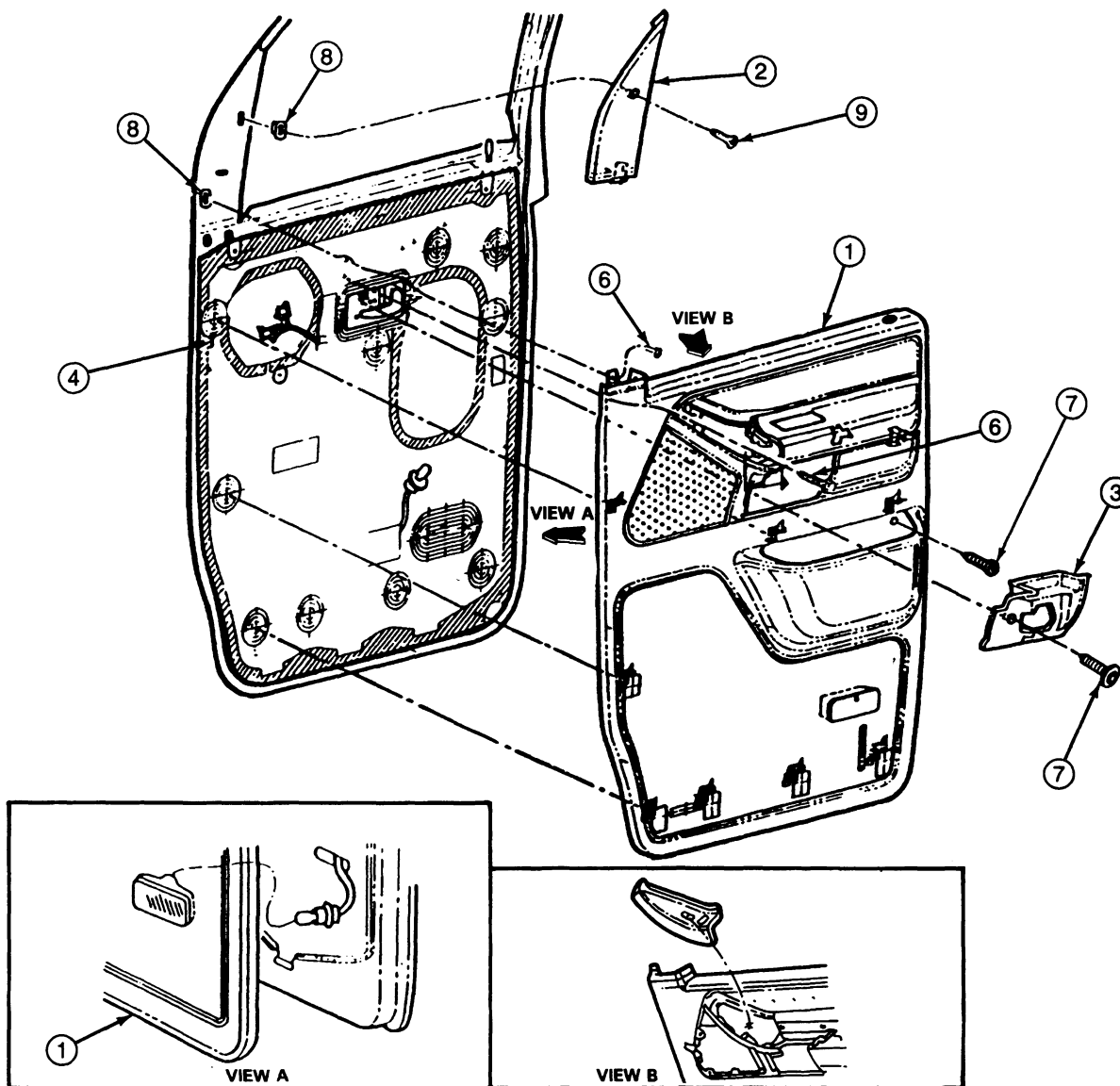
CAUTION: Do not pry panels. Prying on panels will break the hook retainers.

1. Remove screw in sail panel and lift panel out, for outside remote mirror.

2. Remove screw from inside door handle cup. Remove cup.
3. Remove screw from switch housing.
4. Lift housing and slide forward to gain access to switch retaining screws.

REMOVAL AND INSTALLATION (Continued)

5. Remove door lock and window regulator switches.
 6. On left side, disconnect power mirror at connector, if equipped.
 7. Remove trim retaining screw from inside front of arm rest.
 8. Remove screw from inside of map pocket.
 9. Remove screw at top front of panel.
 10. Lift panel straight up to disengage panel hooks from door panel. Rest panel on lower hood so panel can be tilted for wiring access.
 11. Carefully pull out wiring at top.
 12. Disconnect courtesy lamp socket.
 13. Remove panel.
- For installation, follow removal procedures in reverse order.

Front Door Trim Panel, Hi-Series

R8305-B

Item	Part Number	Description
1	23942/3	Front Door Trim Panel, RH/LH
2	17K709/ 17D691	Outside Mirror Mounting Hole Cover, RH/LH

(Continued)

Item	Part Number	Description
3	22634	Inside Handle Cup
4	Ref.	Water Shield
5	Ref.	Clip

(Continued)

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
6	56914-S58	Screw, Round Washer Head, Tapping (1 Req'd Each Side)
7	56912-S58	Screw, Washer Head, Tapping (1 Req'd Each Side)

(Continued)

Item	Part Number	Description
8	N806577-S	Push-in Nut (3 Req'd Each Side)
9	N610130-S58	Screw, Oval Trim Head, Tapping (1 Req'd Each Side)

Side Cargo and Back Door Trim Panels, Lo-Series

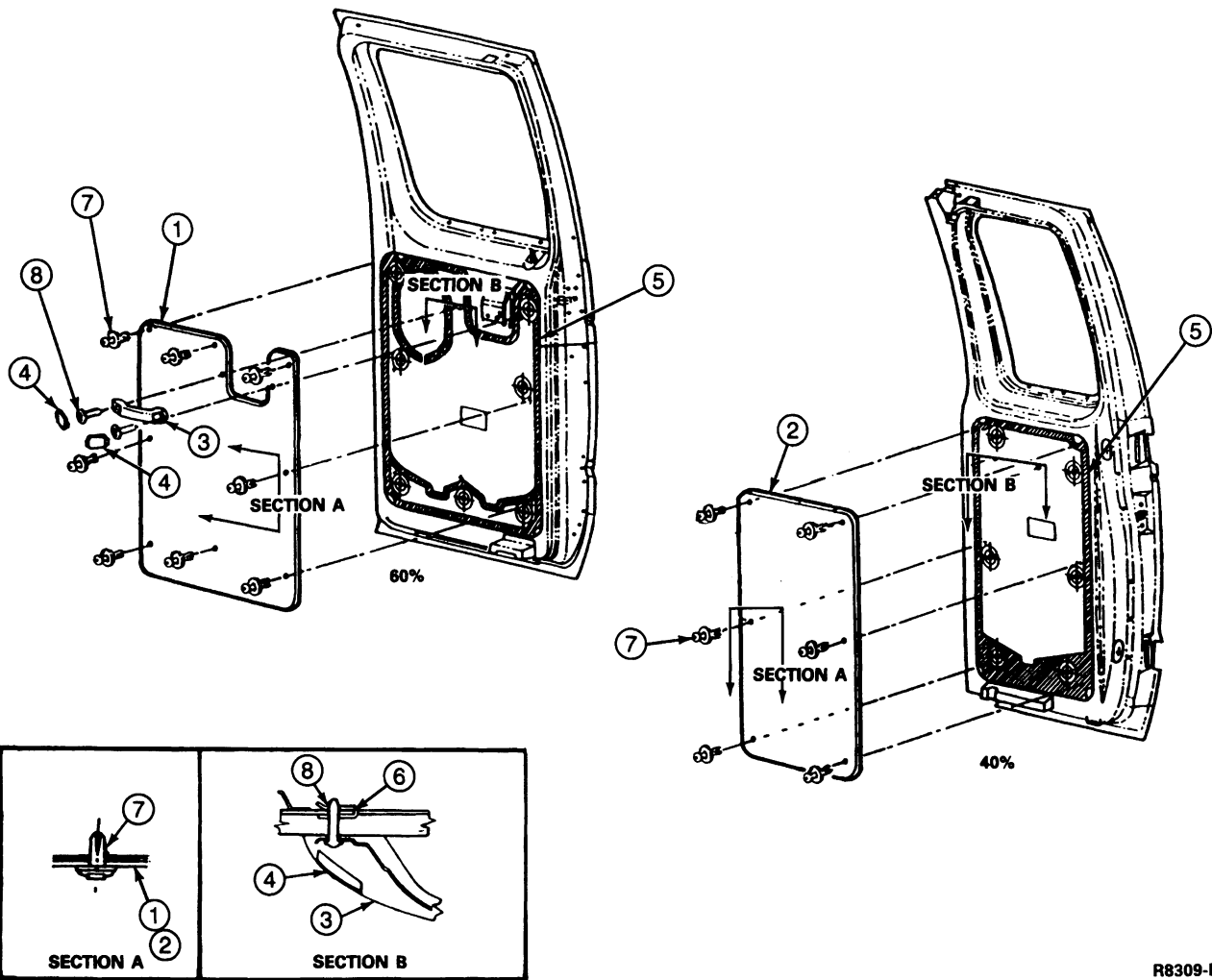
Removal and Installation

- 1. Remove pull-handle cover and screws.

- 2. Remove handle.
- 3. Remove all scrivenets.
- 4. Remove panel.

For installation, follow removal procedures in reverse order. Push scrivenets screw into seat.

Side Cargo Door Trim Panel, Lo-Series



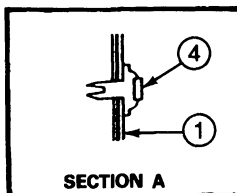
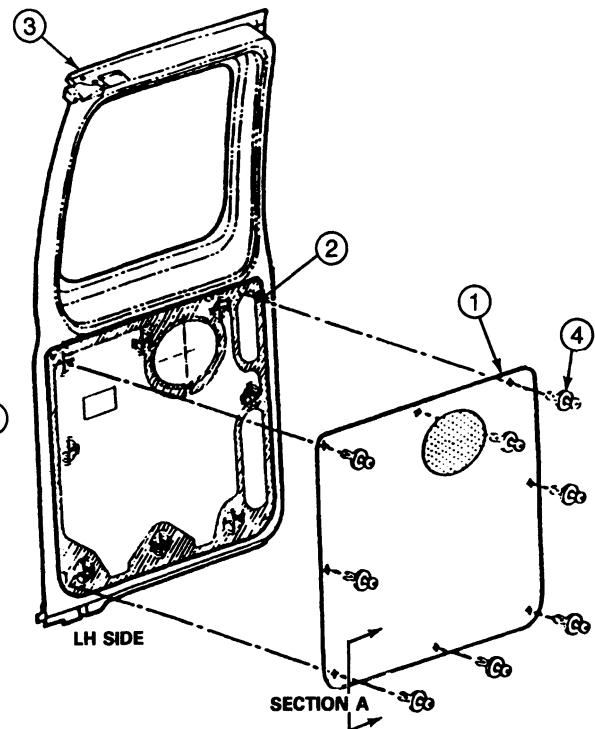
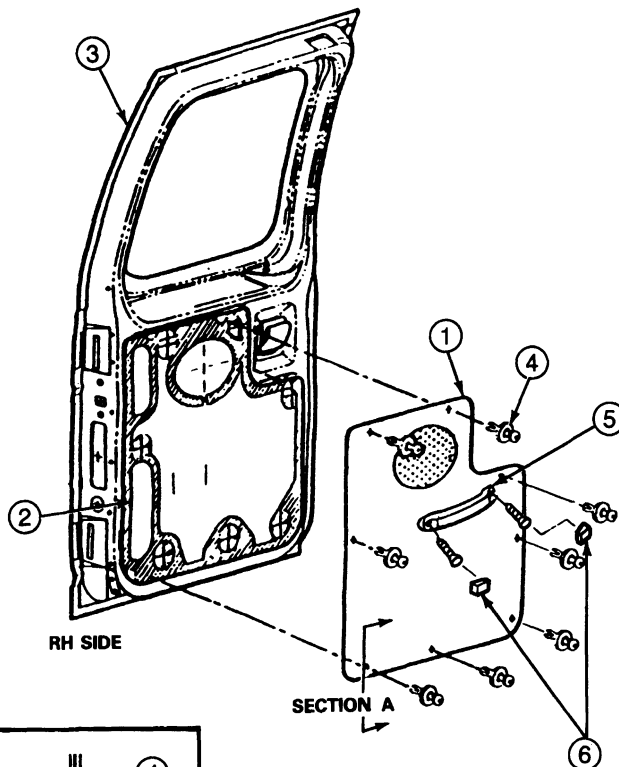
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	27472	Door Trim Panel, 60% Front Door
2	27473	Door Trim Panel, 40% Rear Door
3	26656	Door Pull Handle

(Continued)

Item	Part Number	Description
4	22678	Handle Cover Retainer (2 Req'd)
5	Ref.	Water Shield
6	Ref.	U-Nut
7	N806322-S	Scrivet (14 Req'd Both Doors)
8	56917-S58	Screw, Washer Head (2 Req'd Each Door)

Back Door Trim Panels, Lo-Series



R8321-B

Item	Part Number	Description
1	46320	Trim Panel
2	Ref.	Water Shield
3	Ref.	Door Assembly

(Continued)

Item	Part Number	Description
4	N806322-S	Scrivet (8 Req'd Each Door)
5	1544094-A	Handle Assembly
6	1522678-A	Handle Assembly Retainer (2)

REMOVAL AND INSTALLATION (Continued)

Side Cargo and Back Door Trim Panels, Hi-Series

Removal and Installation

CAUTION: Do not pry door trim panel. Prying on panels will break the hook retainers.

1. Remove screws from window to door latch mechanism.

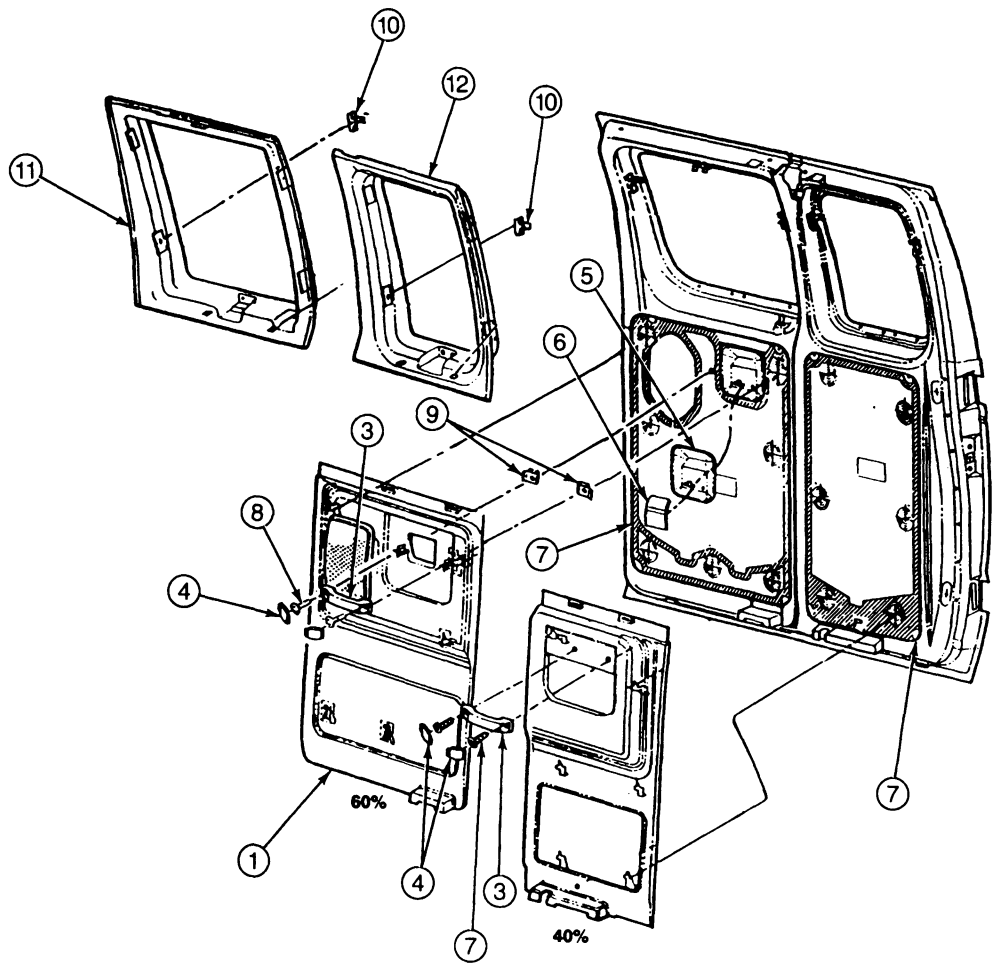
2. Remove window garnish moulding (halo) by pulling away from door.

3. Snap off pull-handle screw covers.

4. Remove all screws.

5. Lift door trim panel straight up to disengage hook retainers.
- For installation, follow removal procedures in reverse order.

Side Cargo Door Trim Panel and Garnish Moulding, Hi-Series



R8311-B

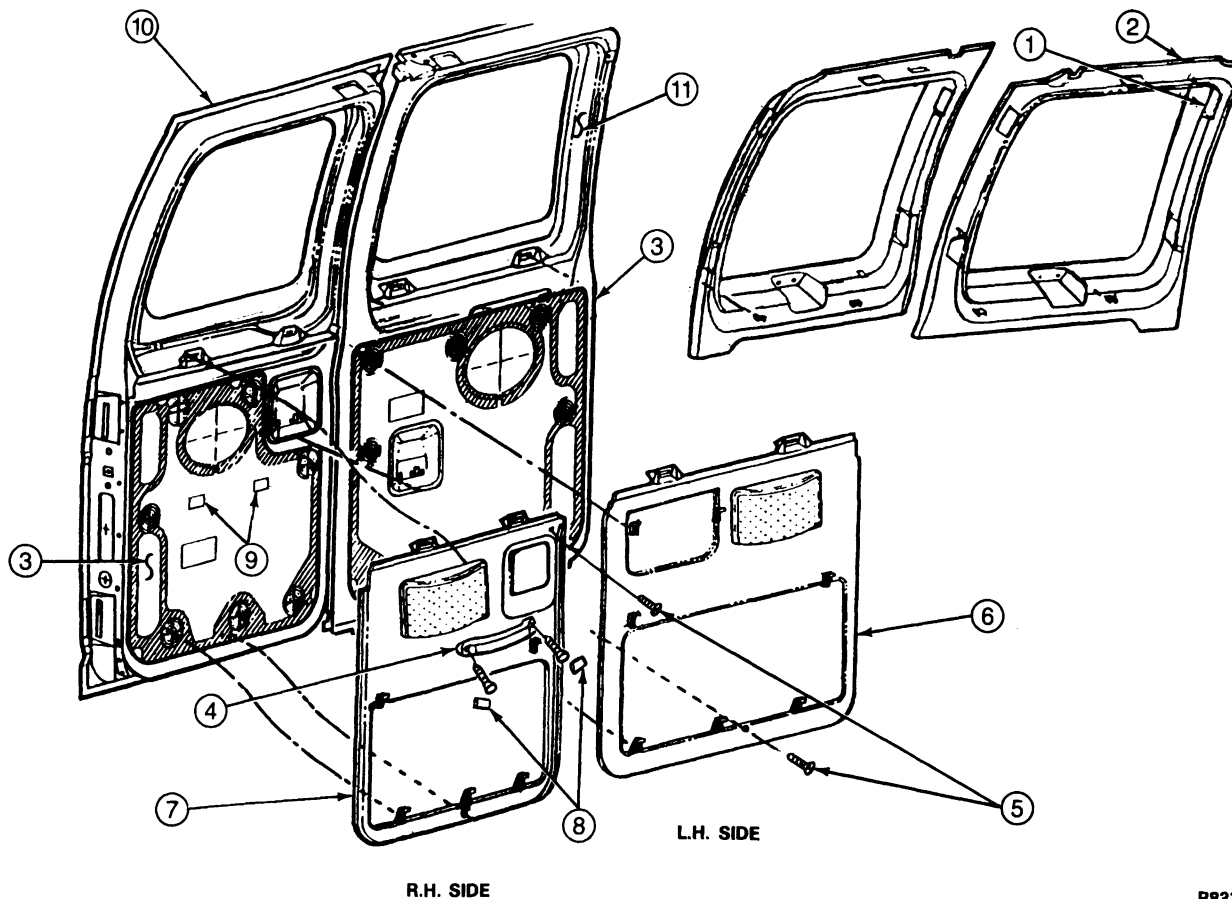
Item	Part Number	Description
1	27411	Door Trim Panel, 60% Front Door
2	27419	Door Trim Panel, 40% Rear Door
3	26656	Door Pull Handle
4	22678	Handle Retainer Cover
5	266A55	Handle Opening Cover

(Continued)

Item	Part Number	Description
6	Ref.	Handle Assembly
7	Ref.	Water Shield
8	56917-S58	Screw, Washer Head (2 Req'd Each Door)
9	N802539-S100	Spring Nut (2 Req'd Each Door)
10	25612	Window Garnish Retainers
11	255560 60%	Window Garnish Moulding
11	255561 40%	Window Garnish Moulding

REMOVAL AND INSTALLATION (Continued)

Back Door Trim Panels and Garnish Moulding, Hi-Series



R8323-B

Item	Part Number	Description
1	25612	Garnish Moulding Retainer
2	42325	Garnish Moulding (LH)
3	Ref.	Water Shield
4	Ref.	Interior Handle Assembly

(Continued)

Item	Part Number	Description
5	N807860-S58	Screw(s), Oval Head, Tapping
6	1645220	Door Trim Panel (RH)
7	1645221	Door Trim Panel (LH)
8	1522678-A	Handle Retainer(s) (2 Req'd)
9	—	U-Nuts (2 Req'd)
10	Ref.	Door Assembly

Sliding Door Trim Panel, Lo-Series

Removal and Installation

CAUTION: Do not pry bottom of door trim panel. Prying will break the hook retainers.

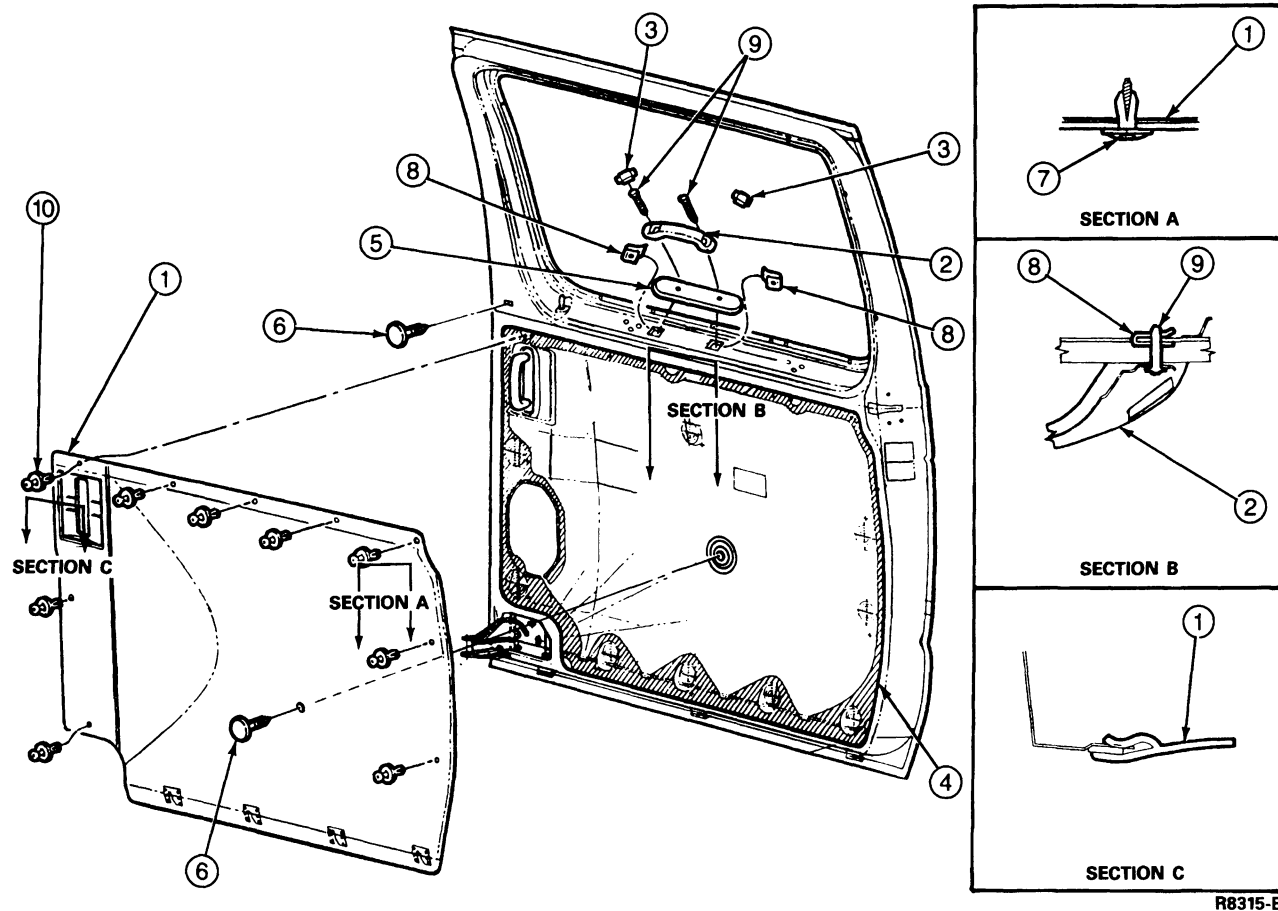
1. Loosen and remove all scrivenets.
2. To disengage hidden hook at door handle bezel, pull top of panel and bow it, while pushing bezel rearward.

3. Lift panel to disengage four hooks at bottom edge.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Sliding Door Trim Panel, Lo-Series



R8315-B

Item	Part Number	Description
1	26411	Door Trim Panel Assembly
2	26656	Door Pull Handle Assembly
3	22678	Handle Retainer Cover
4	Ref.	Water Shield
5	266B12	Handle Mounting Cover

(Continued)

Item	Part Number	Description
6	388930	Push-in Plug
7	N806322-S	Scrivet (10 Req'd)
8	N802539-S100	Spring Nut (2 Req'd)
9	56912-S58	Screw, Round Washer Head, Tapping (2 Req'd)
10	N806471-S	Scrivet (1 Req'd)

Sliding Door Trim Panel and Garnish Moulding, Hi-Series

Removal and Installation

CAUTION: Do not pry door trim panel. Prying on panels will break the hook retainers.

NOTE: Partially open door to perform following steps.

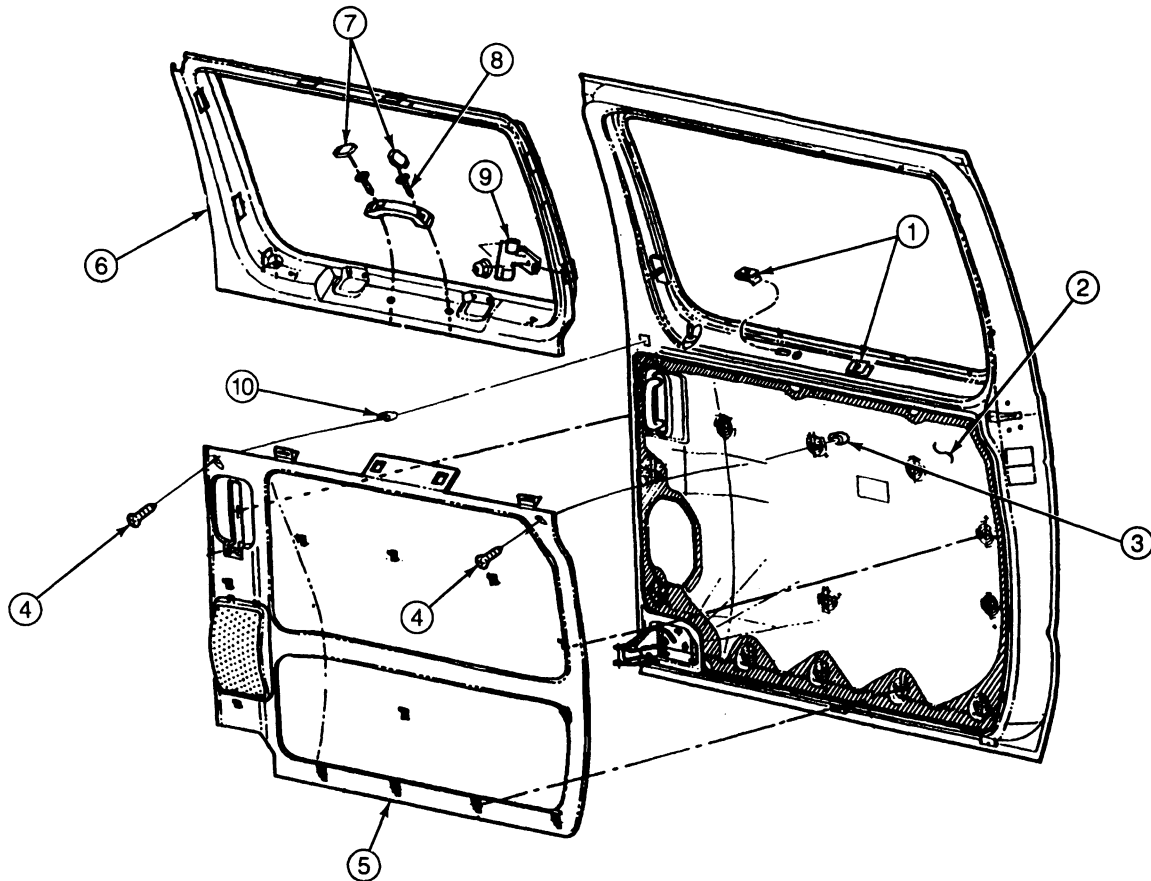
1. Remove pull handle cover and screws.
2. Remove screws from flipper window latches. Push out window and rest latches on outside of door.

3. Pull garnish moulding away from window frame. Start at the front lower corner and work rearward.
4. Remove all screws.
5. Lift panel straight up to separate from door.

For installation, follow removal procedures in reverse order. When installing window garnish moulding, start at lower front.

REMOVAL AND INSTALLATION (Continued)

Sliding Door Trim Panel and Window Garnish Moulding, Hi-Series



R8317-B

Item	Part Number	Description
1	N802539-S100	Spring Nut (2 Req'd)
2	Ref.	Water Shield
3	806577-S	Push Nut
4	N807430-S58	Screw(s)
5	27411	Door Trim Panel

(Continued)

Item	Part Number	Description
6	25560	Garnish Moulding
7	22678	Handle Retainer Cover
8	55922-S2	Screw, Round Washer Head, Tapping (2 Req'd)
9	25612	Garnish Moulding Retainer
10	806577-S	Push Nut

Quarter Trim Panel, Right Side

Removal

CAUTION: Do not pry on trim panels. Prying on panels will break the hook retainers used on the right and left lower panels. These retainers are disengaged by lifting panel upward approximately 25mm (1 inch) before pulling panel inboard.

- On extended van it may be necessary to remove the fifth seat, if equipped.
- Remove jack storage cover. Pull handle inboard and the pull cover rearward to disengage.

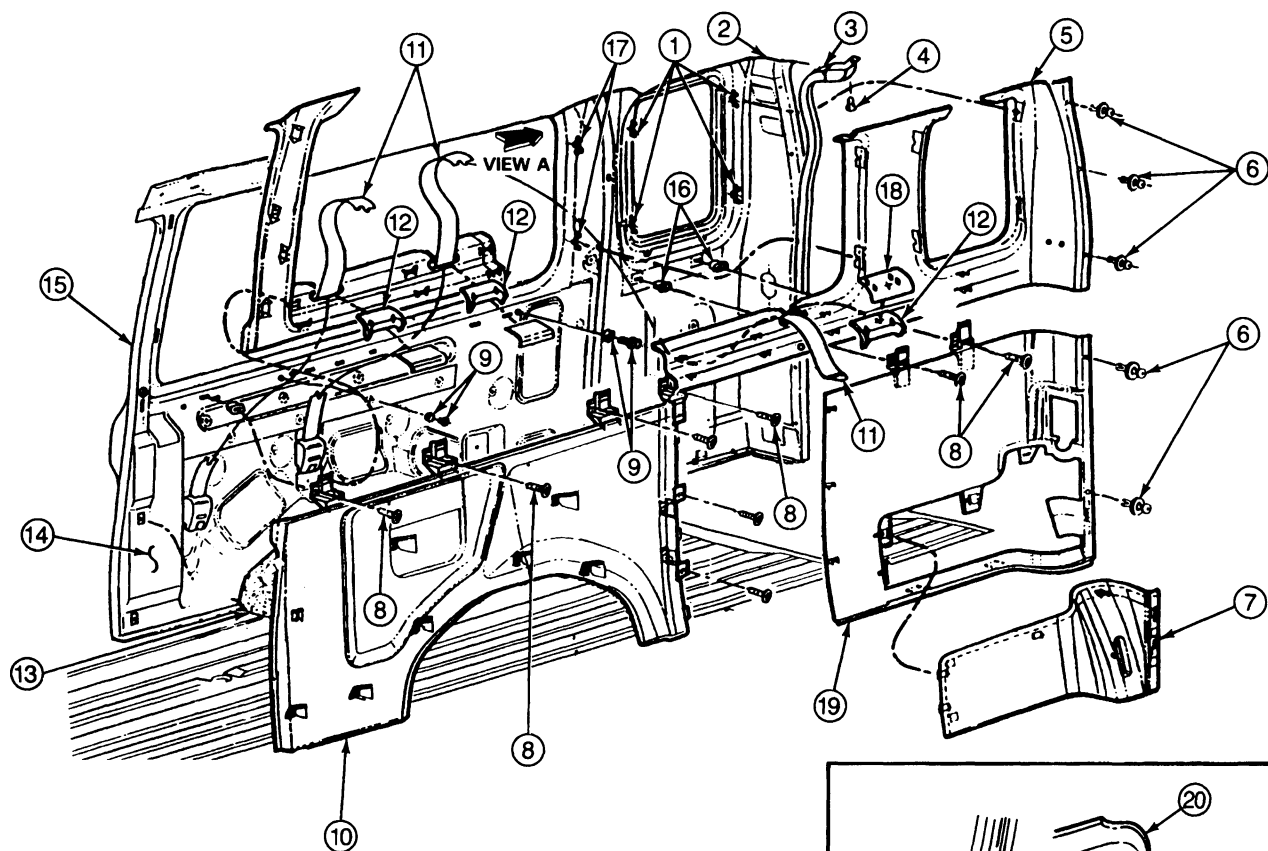
- Pull weld flange cover weatherstrip off at rear door opening to gain access to scriveners at rear edge of panel.
- Snap out seat belt bezels or covers at belt line.
- Remove scriveners from rear of upper rear panel.
- To remove upper panel, start by pulling inboard at top forward edge of rearmost pillar.
NOTE: On extended model, also pull at top rear of second pillar from rear.
- Work down the pillar(s) and then from rear to front along belt line. Keep panel vertical while pulling inboard at belt line to separate upper panel from lower panel.

REMOVAL AND INSTALLATION (Continued)

8. On extended van, remove screws and scriveners from lower rear panel. Remove by pulling straight inboard.
9. Remove cap at upper rear sliding door track.
10. Remove screw at rear of upper front trim panel.
11. Start pulling at upper rear of pillar then rearward along belt line.
12. Remove screws from front lower panel.
13. Lift panel straight up to disengage retainer hooks.

Installation

1. Follow removal procedures in reverse order.
2. If any metal clips remained in the slots on the body, remove and re-install on the trim panels before proceeding.
3. When installing the front upper panel, start at the trim-to-trim front lower corner, then the lower edge and finally the pillar portion.
4. When installing the rear upper panel, start at the front lower part, work back and up the pillar(s).

Quarter Trim Panel, Right Side

R8331-B

Item	Part Number	Description
1	310A90	Upper Rear Panel Retainer
2	Ref.	Body Side
3	410A68	Rear Corner Panel Flange Cover
4	N802900	Pushpin
5	31010	Upper Rear Trim Panel

(Continued)

Item	Part Number	Description
6	N806322-S	Scriveners (3 Req'd)
7	312A06	Lower Rear Trim Panel
8	569129-S	Screw(s), Round Washer Head, Tapping Hole, Stud and Eyelet
9	31010	Hole, Stud and Eyelet
10	31486	Lower Front Trim Panel

(Continued)

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
11	Ref.	Belt and Retractor Assembly
12	601B30	Shoulder Strap Bezel
13	Ref.	Wheelhouse Cover
14	Ref.	Body Side
15	Ref.	Weatherstrip

(Continued)

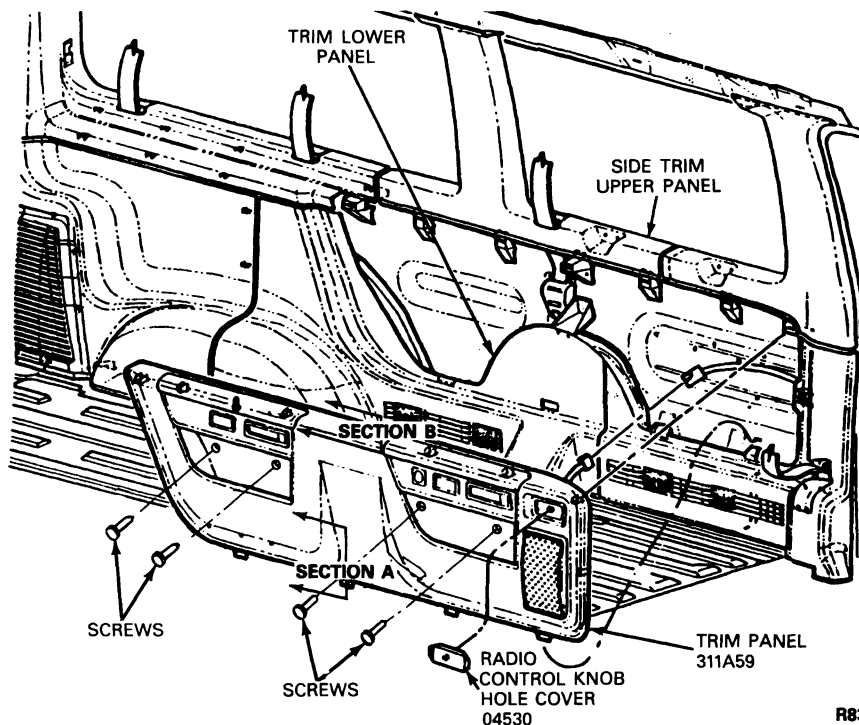
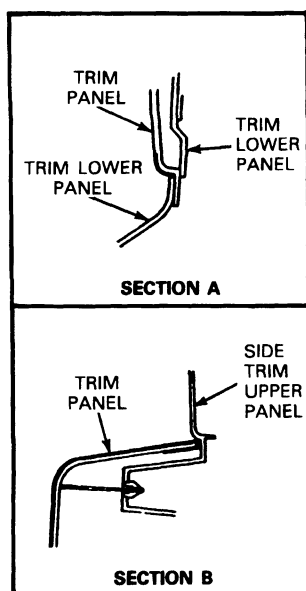
Item	Part Number	Description
16	N806577-S	Push-in Nuts (2 Req'd)
17	310A90	Upper Rear Panel Retainer
18	601B26	Shoulder Strap Cover
19	312A06	Lower Rear Trim Panel
20	Ref.	Window Garnish Moulding

Quarter Trim Finish Panel Insert, Left Side**Removal and Installation**

1. Remove seats.
2. Remove pushpins from inside stowage bins. (One forward, two rear.)

3. Pull panel upper edge to disengage clips.
4. Disconnect all wiring on back side.
5. Lift panel up out of lower edge slots.

For installation follow removal procedures in reverse order.

Quarter Trim Finish Panel Insert, Left Side

R8333-B

Quarter Trim Panel, Left Side**Removal**

CAUTION: Do not pry on the lower trim panels. Prying on panels will break the hook retainers used on the lower panels. These retainers are disengaged by lifting panel upward approximately 25mm (1 inch) before pulling panel inboard.

1. Remove seats.
2. Pull flange cover from weld flange in rear door opening to gain access to scrivenets in trim panels.

3. Remove finish panel from forward lower trim.
4. Remove seat belt bezels or covers from upper trim panels.
5. Remove scrivenets at rear edge of panel.
6. Remove screw at forward end of upper rear panel located under seat belt.
7. Pull upper trim panel off, starting at forward upper corner of pillar(s). Continue removing panel working down pillar(s) and then along belt line.

REMOVAL AND INSTALLATION (Continued)

8. Remove screws and scriveners from lower rear panel.
9. Pull forward edge of panel to separate from front trim panel. Disengage clip at auxiliary heater housing. Remove panel.
10. Remove screws from window latches. Push window open and allow latches to rest outside.
11. Pull inboard at top rear of front pillar of front upper trim panel.
12. Repeat at next pillar. Remove panel.
13. Remove seat belt bezel at lower panel.
14. Remove all screws and scriveners.
15. If panel is to be replaced, seat belt has to be disconnected at header (roof) and at floor anchor.

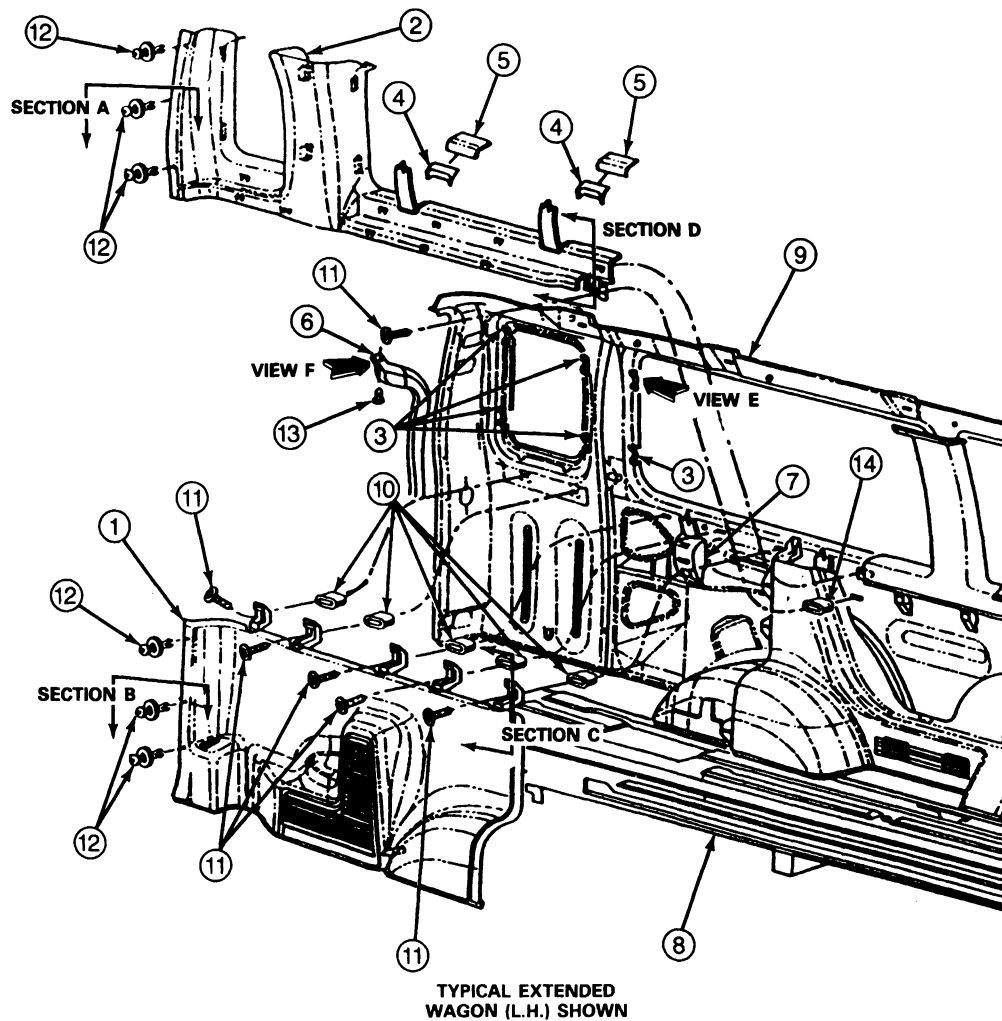
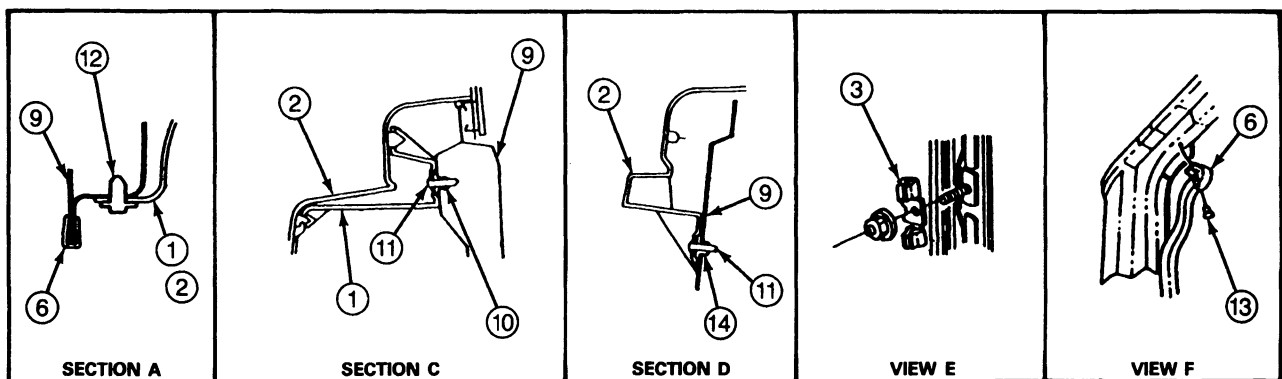
16. Lift panel straight up approximately 25mm (1 inch) to disengage from body.
17. Pass seat belt through opening to completely remove panel.

Installation

1. Follow removal procedures in reverse order.
2. When installing front upper panel, start at front lower pillar then second lower pillar.
3. When installing rear lower panel, start with the clip to heater housing, then snap in the panel-to-panel clips.
4. When installing the rear upper panel, start with rear lower portion at pillar.

REMOVAL AND INSTALLATION (Continued)

Quarter Trim Panel

TYPICAL EXTENDED
WAGON (L.H.) SHOWN

R8337-B

Item	Part Number	Description
1	312A07	Lower Rear Trim Panel
2	31011	Upper Rear Trim Panel
3	310A90	Upper Rear Trim Panel Retainer

(Continued)

Item	Part Number	Description
4	601B31	Shoulder Strap Opening Bezel
5	601B27	Shoulder Strap Cover
6	410A68	Corner Panel Flange Cover

(Continued)

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
7	Ref.	Belt and Retractor Assembly
8	Ref.	Floor Pan
9	Ref.	Quarter Extended Sheet Metal, LH
10	N806577-S	Push-in Nut (5 Req'd)

(Continued)

Item	Part Number	Description
11	56912-S9	Screw, Round Washer Head, Tapping
12	N806322-S	Scrivet (3 Req'd)
13	N802900	Pushpin (1 Req'd)
14	N800841-S	Push-in Nut (1 Req'd)

Engine Cover**Removal**

1. Move both front seats to the full rearward position.
2. Unfasten the four engine cover latches.
3. Lift the engine cover up and off the floor and remove from the vehicle through the passenger front door.

Installation

1. Move front seat in full rearward position.
2. Lift the engine cover so the interior trim side is facing you and proceed to slide the cover over the passenger seat and into position.
3. Before securing cover with the latches, place your hand under the seal bulb to verify the guide brackets **are not** on top of the sheet metal. If the guide brackets are on top of the sheet metal sealing surface, tilt cover and push spear bracket in toward engine so it is off the sheet metal. If necessary repeat for the other side. Then secure cover with the four attached latches. If there is a misalignment, one or both of the following conditions will occur:
 - a. Latches will be hard to fasten and secure.
 - b. Seal bulb will not compress by guide brackets.

If misalignment occurs, repeat Step 3.

NOTE: The purpose of the guide brackets on the engine cover is to aid in installation, keep wings from bowing outboard when latches are secured and to hold insulator in place to keep from resting on seal.

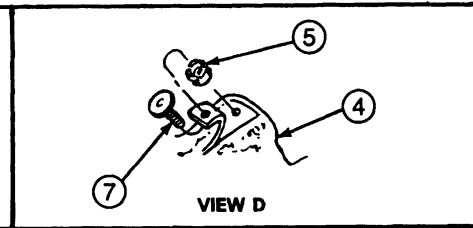
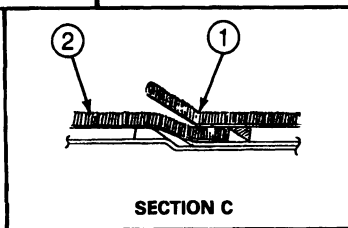
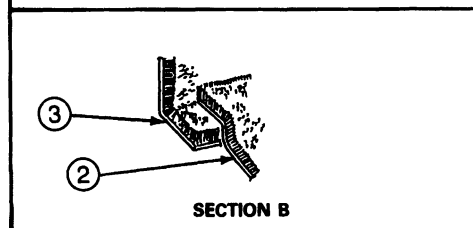
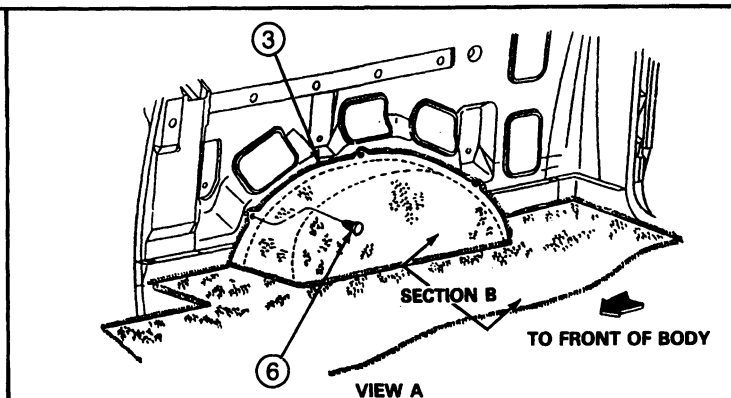
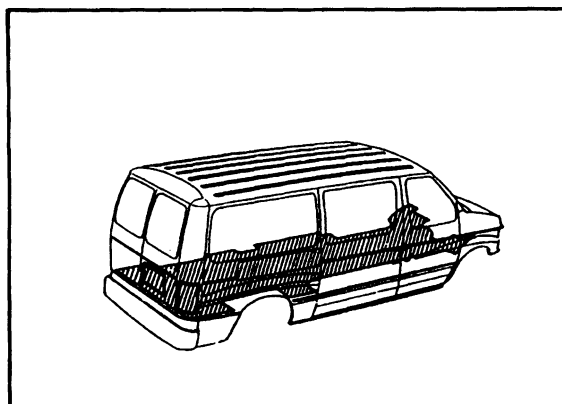
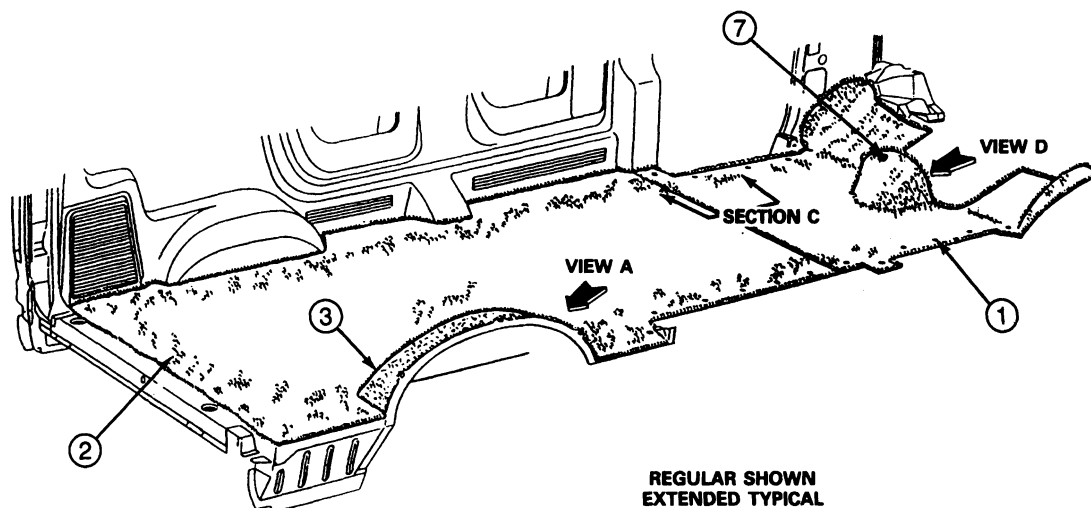
Floor Carpet / Mat**Removal and Installation**

1. Remove the seat(s). Refer to Sections 01-10A and 01-10B.
2. Remove the right and left cowl side trim panels.
3. Remove all carpet or mat retaining screws.
4. Remove the right and left door sill scuff plates.
5. Remove the carpet or mat.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Floor Carpets, Wagons



R8347-A

Item	Part Number	Description
1	13000	Front Floor Carpet Assembly
2	13046	Rear Floor Carpet Assembly
3	13048	Wheelhouse Carpet

(Continued)

Item	Part Number	Description
4	Ref.	Quarter Trim Panel
5	20884	Retainer
6	N802734-S	Pushpin (3 Req'd RH Side)
7	E866249-S	Pushpin (1 Req'd)

Headlining, Roof

Removal and Installation

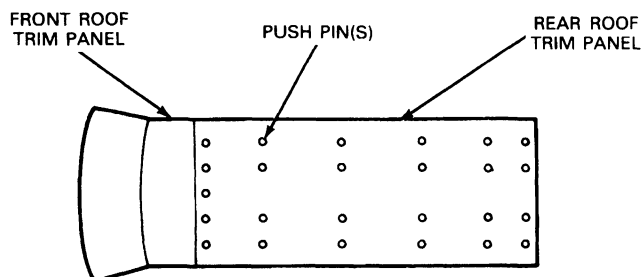
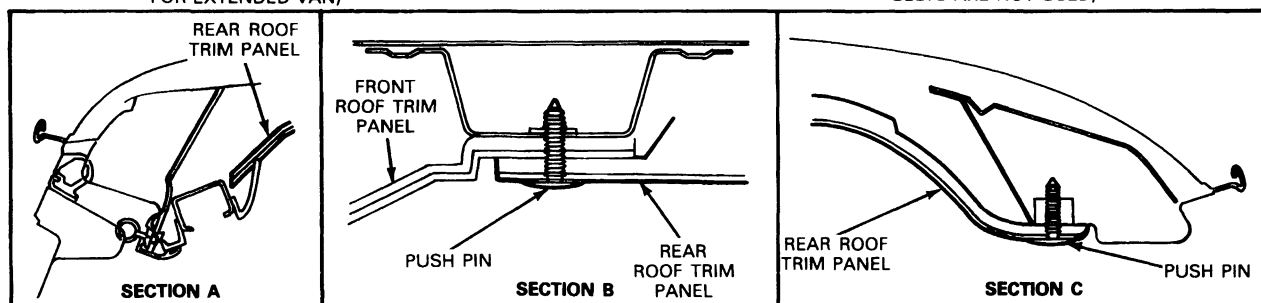
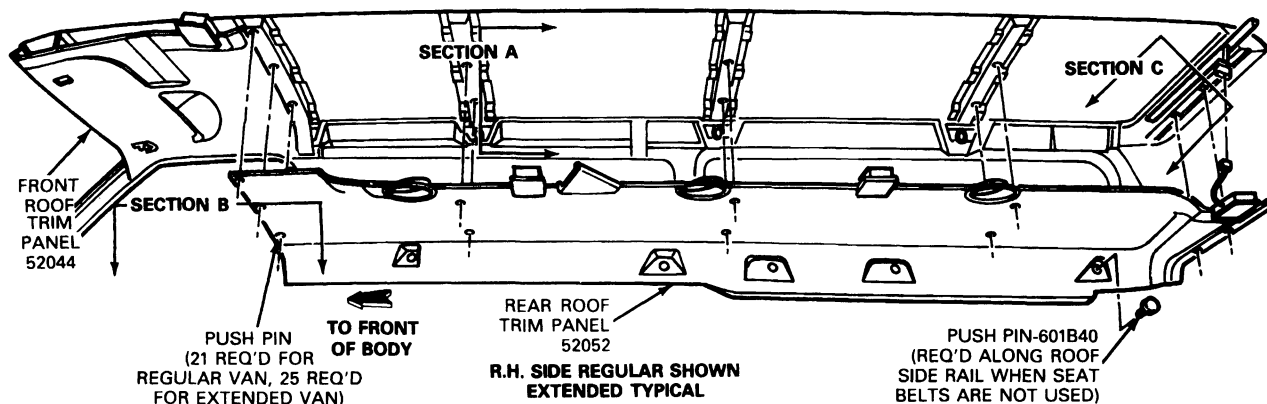
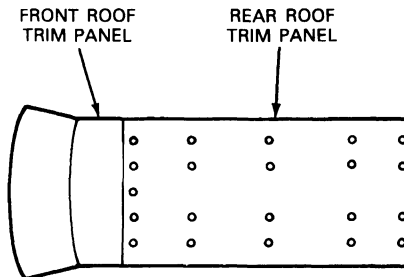
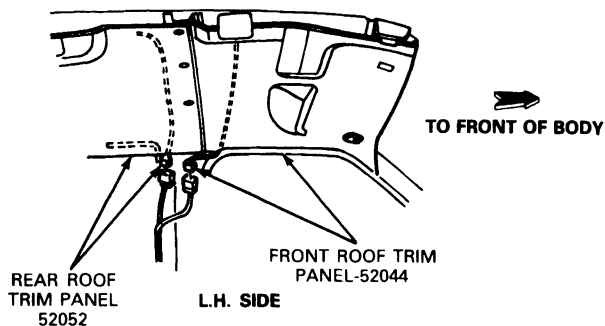
1. Remove the pushpins holding the front headlining to the roof. Discard pushpins.
2. Pull the headliner out from behind the weatherstripping at the doors.

3. Remove the headliner from the vehicle being careful not to distort the headliner if it is being re-used.

NOTE: The A-pillar and B-pillar mouldings may have to be removed or loosened to remove the front headliner. Refer to the procedures in this section.

REMOVAL AND INSTALLATION (Continued)

For installation, follow removal procedures in reverse order. Install new pushpins in front headliner.

Roof Headlining, Front and Rear**EXTENDED LOCATION FOR ITEM 4****REGULAR LOCATION FOR ITEM 4**

R8361-B

REMOVAL AND INSTALLATION (Continued)**Mouldings**

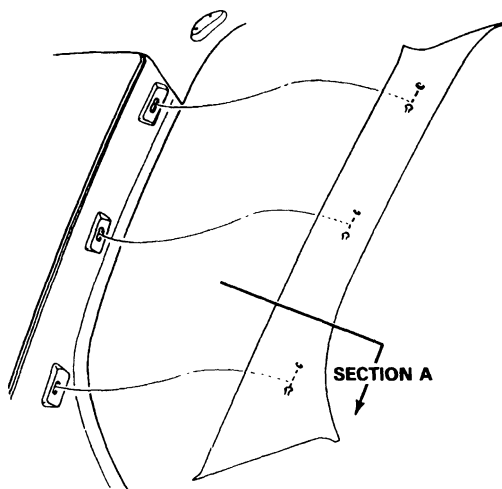
The installation of the plastic and steel interior mouldings is shown in the following illustrations. In most instances, one moulding overlaps another moulding. If this condition is found, it will be necessary to loosen or remove the overlapping moulding before removal of the desired moulding.

A-Pillar Moulding**Removal and Installation**

Remove by pulling at the top and working down.

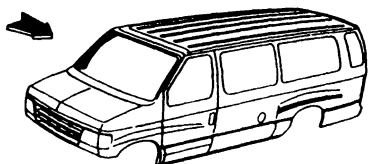
Install by pushing, starting at bottom.

Position weatherstripping lip over moulding.



R.H. SHOWN
L.H. TYPICAL

SECTION A



R8357-B

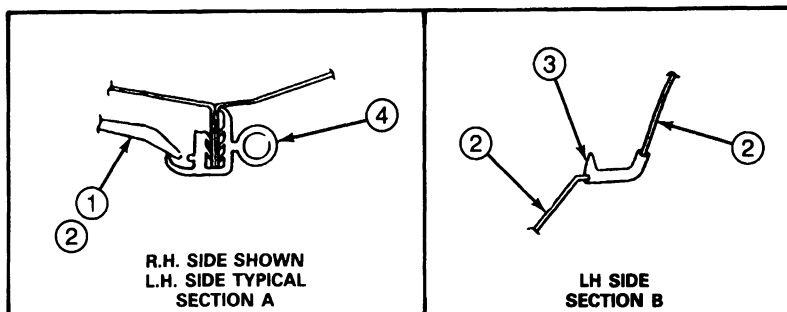
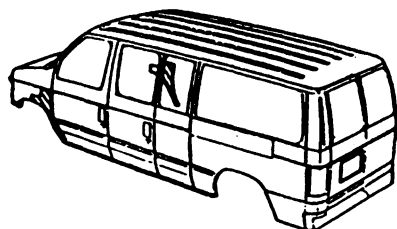
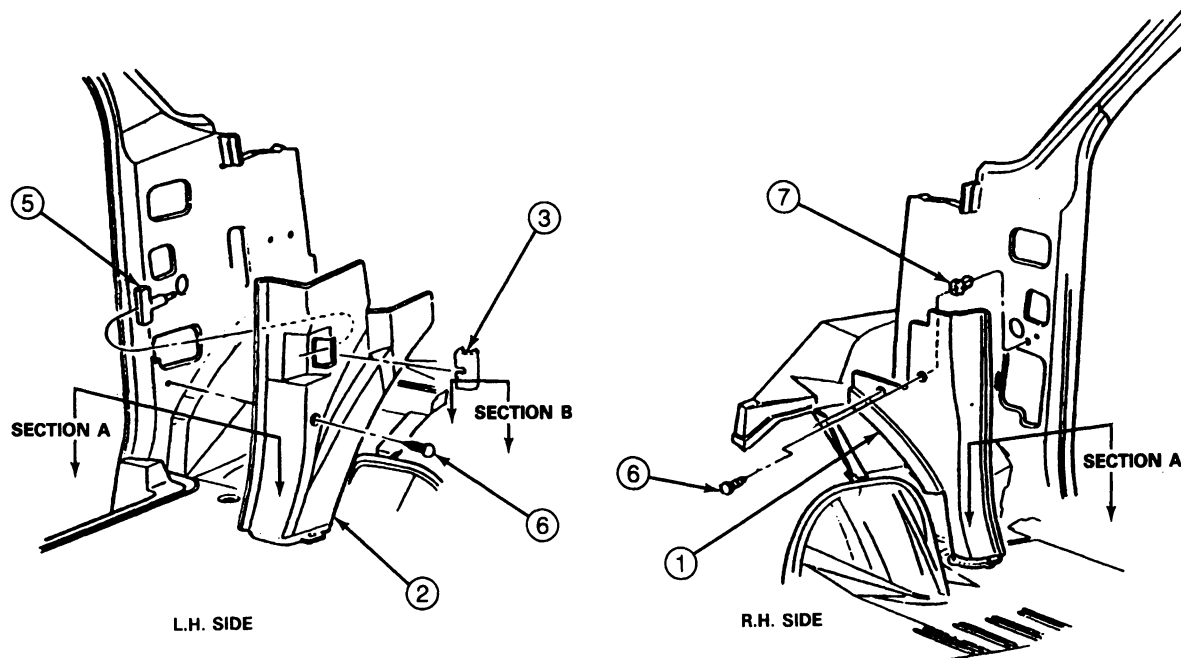
Cowl Side Trim Panels**Removal and Installation**

1. On left side only, remove hood release handle bezel.
2. Remove pushpin(s).
3. Pull panel rearward starting at top.
4. Unhook bottom flange from under scuff plate.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Cowl Side Trim Panels



R8359-B

Item	Part Number	Description
1	02348	Cowl Side Trim Panel
2	02349	Cowl Side Trim Panel
3	16B999	Hood Opening Cable Bezel

(Continued)

Item	Part Number	Description
4	Ref.	Door Opening Weatherstrip
5	Ref.	Hood Latch Cable
6	N806441-S	Pushpin (1 Req'd Each Side)
7	N806918-S	Nut (1 Req'd Right Side)

B-Pillar Trim Panel

Removal and Installation

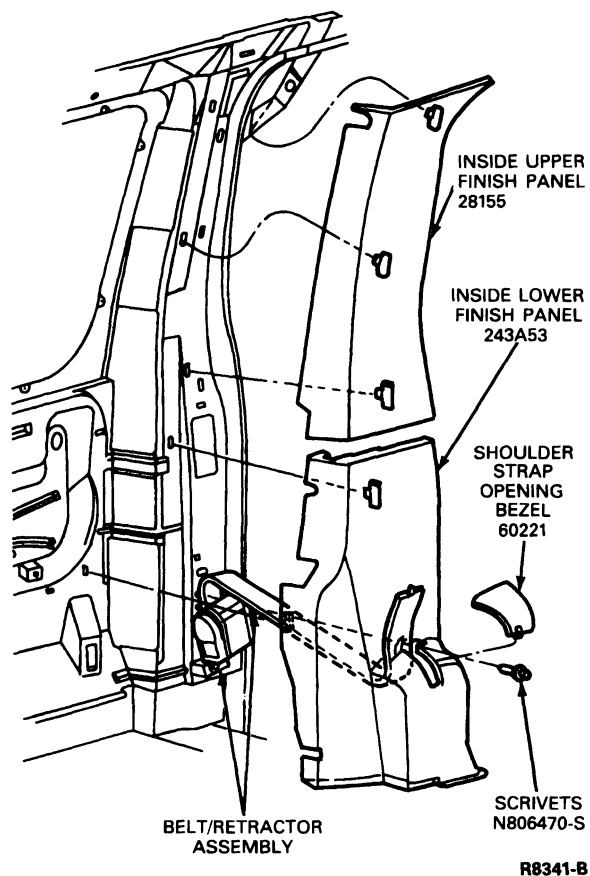
1. Remove upper panel by pulling, starting at the top.
2. Remove front door and cargo door scuff plates. Refer to scuff plate removal in this section.
3. Remove seat belt bezel from lower panel.
4. Remove one scrivet from floor and one scrivet from behind seat belt.

5. Lift panel straight up to remove.
6. To completely remove panel, unscrew seat belt at floor and roof header. Pass belt through seat belt opening.

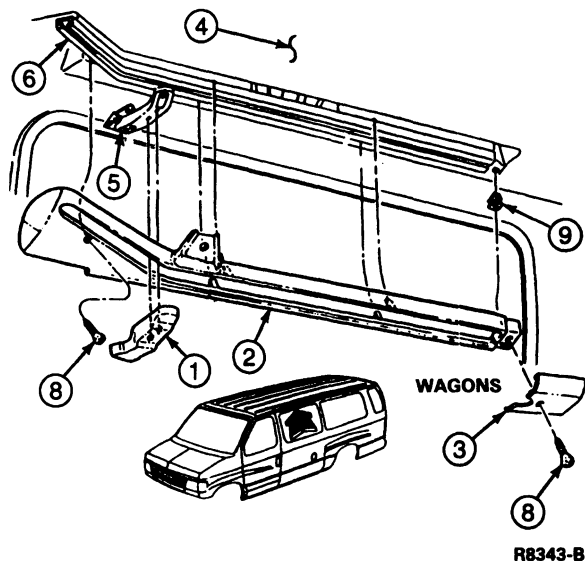
For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

B-Pillar Trim Panel



Sliding Door Track Cover



Item	Part Number	Description
1	25094	Door Track Upper Cover
2	25514	Door Header Moulding
3	255A92	Door Header Moulding, Garnish
4	Ref.	Roof Trim Panel
5	Ref.	Sliding Door Track Arm
6	Ref.	Upper Track Assembly
7	25453	Door Header Moulding
8	N610132-S58	Screw (2 Req'd)
9	N800841-S	Push-in Nut (1 Req'd)

Sliding Door Track Cover

Removal and Installation

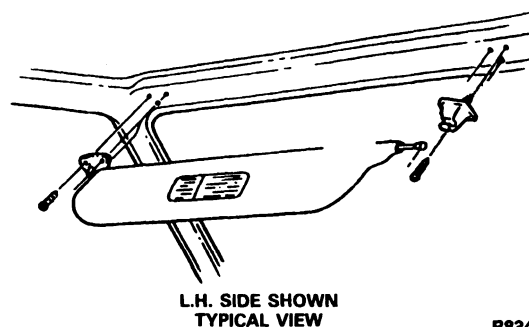
1. Remove screws at front of cover.
2. Remove screw at rear end cap.
3. Pull cover down to unsnap and then pull forward to remove.

For installation, follow removal procedures in reverse order.

Sun Visors

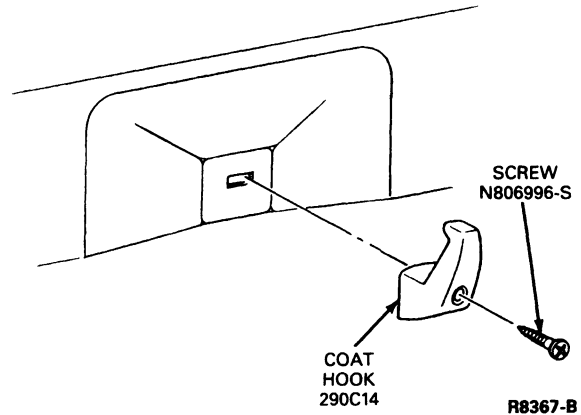
Removal and Installation

Refer to the following illustration for removal and installation.



REMOVAL AND INSTALLATION (Continued)**Coat Hooks****Removal and Installation**

Remove the screw(s) holding the coat hook(s) to the roof trim panel and remove the hook(s) from the vehicle. For installation position the coat hook(s) to the vehicle and install the holding screw(s).

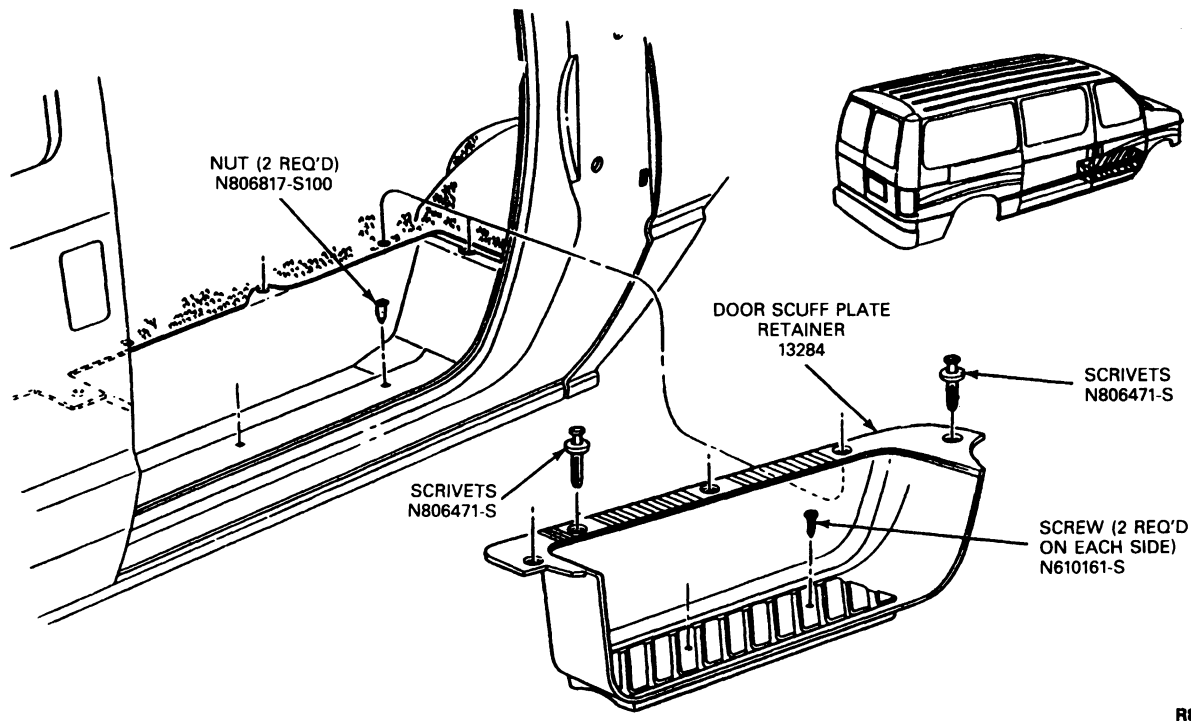
**Scuff Plates****Removal and Installation**

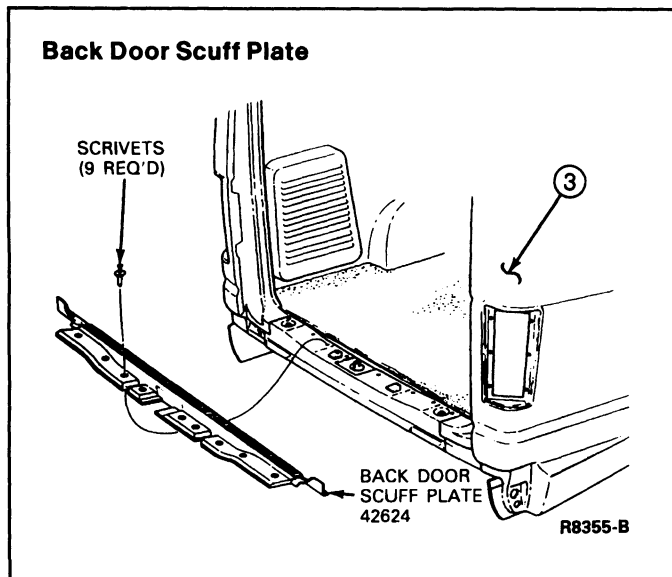
1. Remove all scrivenets by backing out center screw, lift out and discard.
2. Remove all screws.
3. Remove scuff plate.

4. To remove small scuff plate in cargo door step well behind B-pillar, remove one screw and one pushpin.

For installation, follow removal procedures in reverse order.

NOTE: Replace all scrivenets with new scrivenets.

Front Door Scuff Plates

REMOVAL AND INSTALLATION (Continued)**CLEANING AND INSPECTION**

Refer to Vehicle Owner Guide for recommended cleaning procedure.

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Model	Description
107-00401	Moulding / Trim Kit

SECTION 01-08A Trim, Exterior, F-Series and Bronco

SUBJECT	PAGE	SUBJECT	PAGE
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VEHICLE APPLICATION

F-150-250-350, F-Super Duty and Bronco Vehicles

REMOVAL AND INSTALLATION

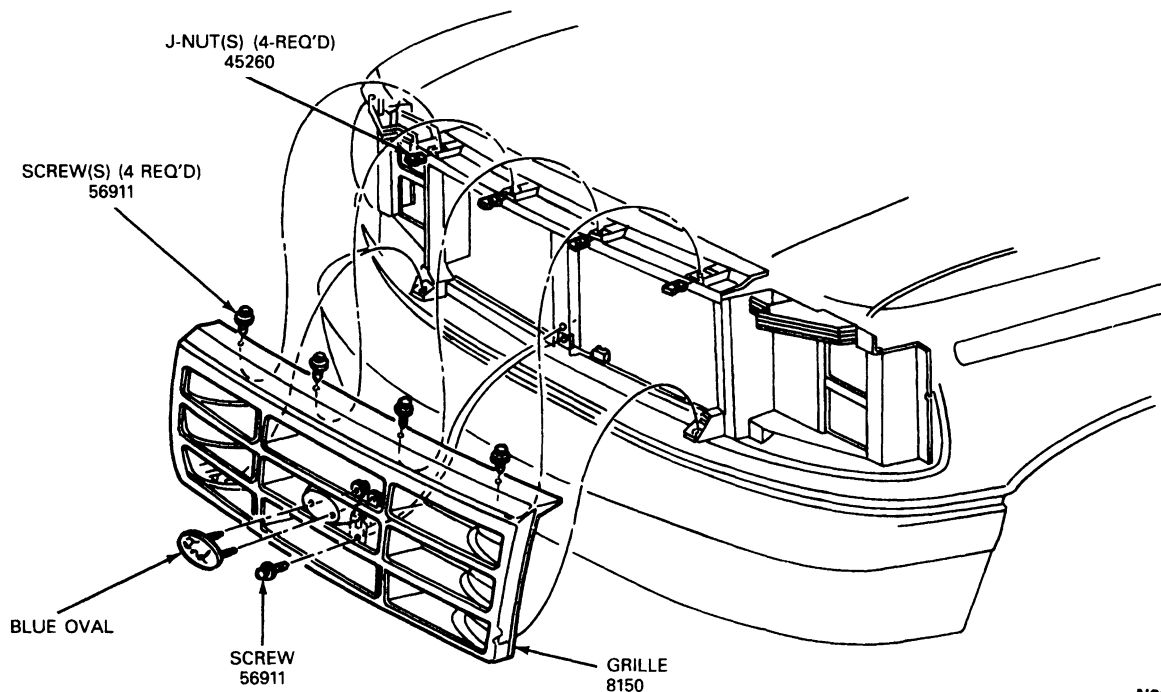
Radiator Grille

Removal and Installation

1. Remove five screws retaining grille assembly to grille opening reinforcement.

2. Remove grille assembly from vehicle.

For installation, follow removal procedure in reverse order.



N9923-B

REMOVAL AND INSTALLATION (Continued)**Front Fender****Removal**

1. Clean all dirt from the fender attaching screws, bolts and nuts.
2. Remove headlamp assemblies from the vehicle as described in Section 17-01.
3. Remove the screws attaching the front of the fender to the radiator support at upper and lower locations.
4. Remove one screw attaching the rear lower end of the fender to the lower corner of the cab.
5. Remove one screw from inside the cab attaching the rear lower end of the fender to the cowl.
6. Remove the screws attaching the top edge of the fender at the rear, to the cowl extension.
7. Remove screws around wheel opening attaching the fender apron.
8. Remove the bolts along top of apron that attach to fender.
9. Remove bolts attaching battery tray to fender (right side) and bolts attaching auxiliary battery tray or tool box (both R.P.O.) (left side).
10. Remove hood latch cable from left fender and main wiring harness from right fender.
11. Remove the screw attaching the hood prop spring to the fender and remove fender.

For installation, follow removal procedure in reverse order. Loosely install all mounting screws. Adjust fender and tighten mounting screws.

Fiberglass Roof, Bronco**Removal and Installation**

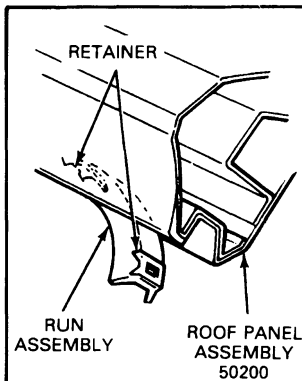
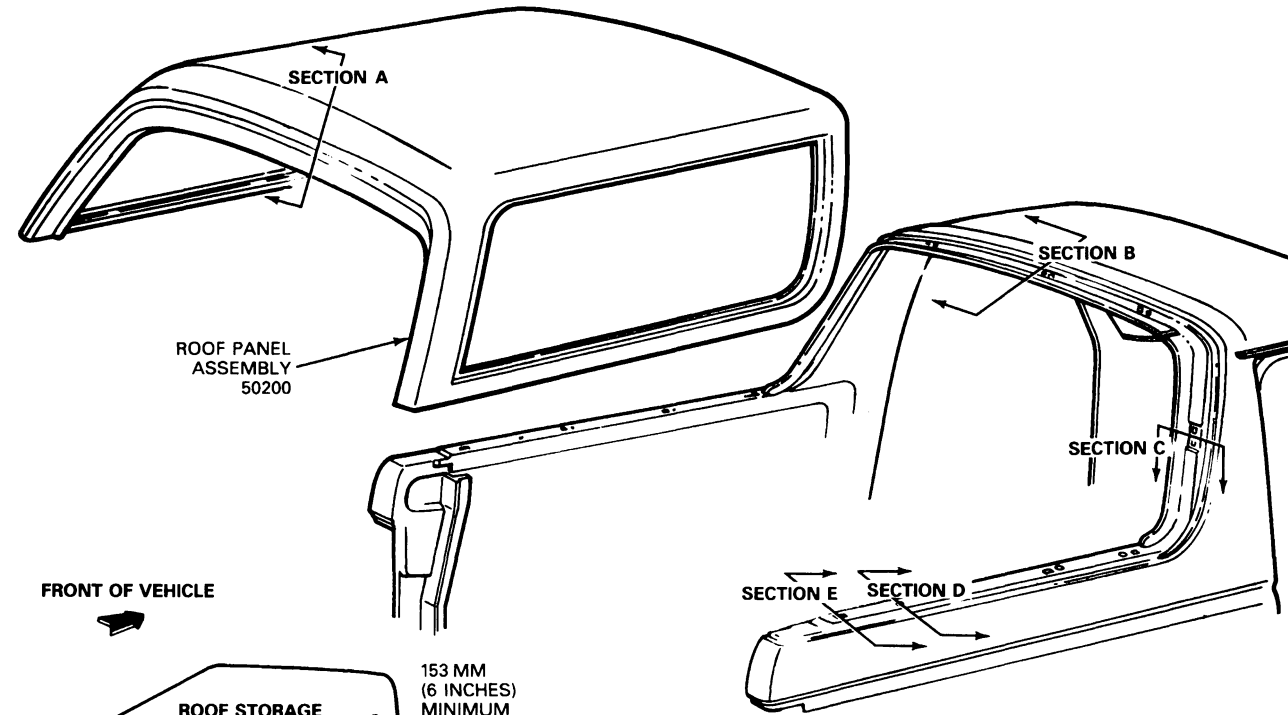
1. Lower the tailgate window to the full down position.
2. Lower tailgate.
3. Remove the lower trim moulding attaching screws and the plastic trim mouldings.
4. Scribe the location of the moulding attaching brackets on the fiberglass roof's surface and number each bracket as it is removed for reference during installation.
5. Remove all the roof attaching bolts and moulding attaching brackets.
6. Carefully lift the roof off the vehicle to prevent tearing or separating the weatherstrip from the fiberglass roof. The roof weighs 264 kg (120 lb).

NOTE: The tailgate window must always remain in the full down position when the roof is off the vehicle to prevent possible window breakage.

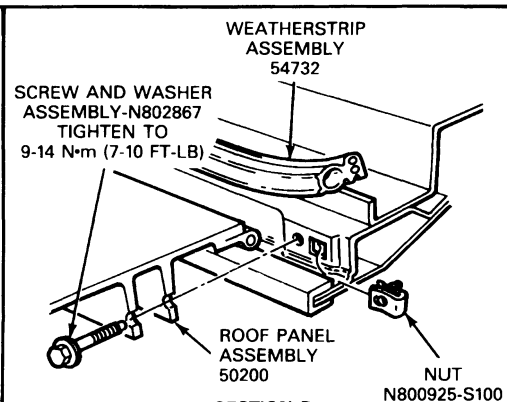
For installation, follow removal procedure in reverse order.

REMOVAL AND INSTALLATION (Continued)

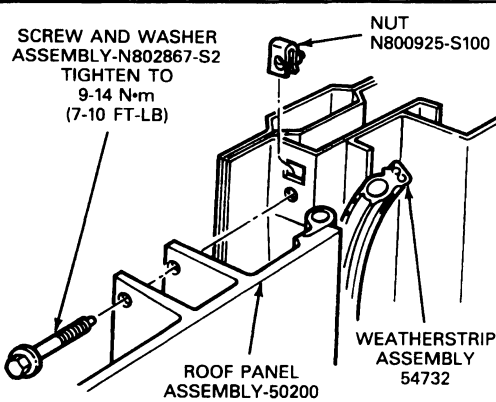
Fiberglass Roof Removal and Installation, Bronco



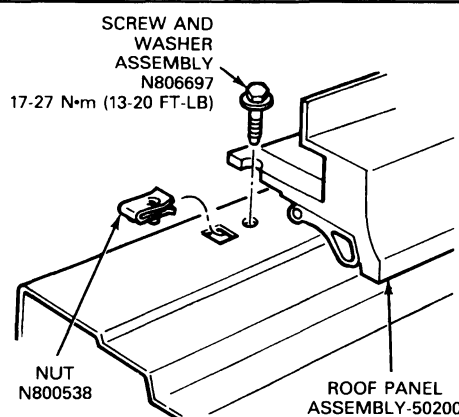
SECTION A



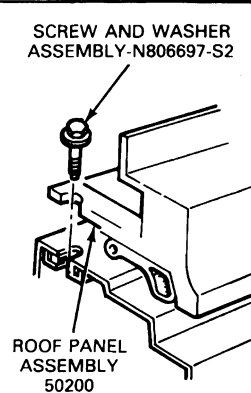
SECTION B



SECTION C



SECTION D



SECTION E

N4277-H

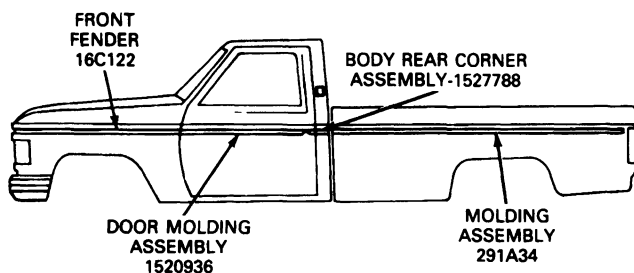
REMOVAL AND INSTALLATION (Continued)

Exterior Mouldings

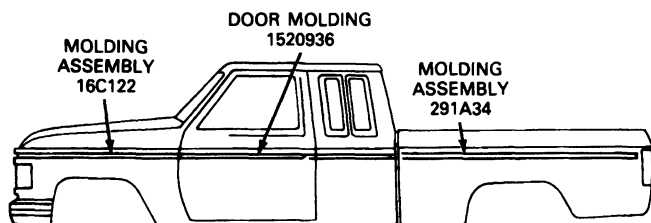
Removal and Installation

Before removing the exterior mouldings, determine the type of retainer used if it is necessary to remove an interior trim panel. SuperCab models use conventional exterior mouldings except in the area of the cab extension. If a weld stud is distorted or broken off, it should be replaced with a drill point screw 379560.

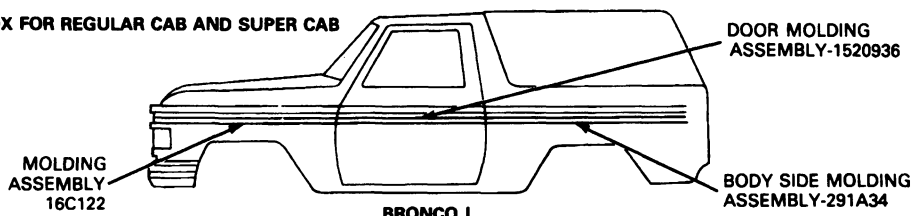
Exterior Ornamentation, Body Side Mouldings with Tu-Tone Paint Only



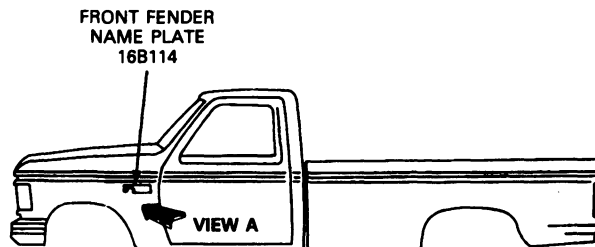
REGULAR CAB - 8' BOX FOR REGULAR CAB AND SUPER CAB



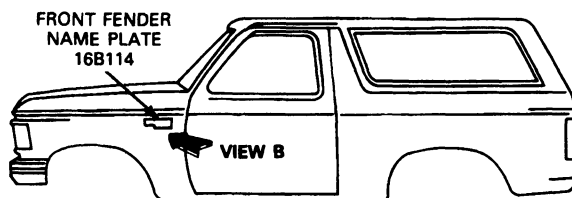
SUPER CAB - 6 3/4' BOX FOR REGULAR CAB AND SUPER CAB



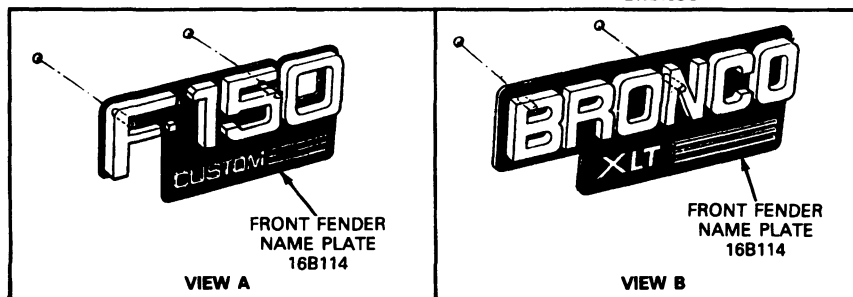
BRONCO I



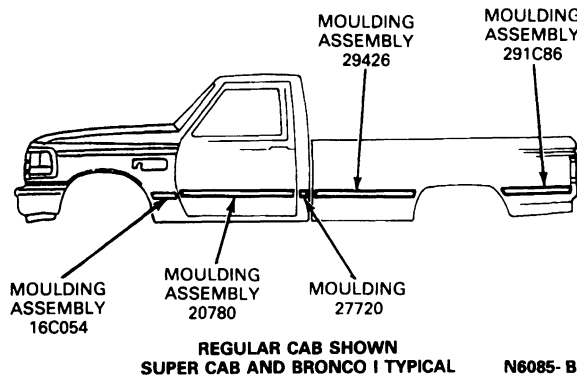
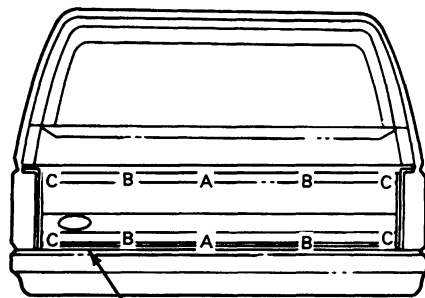
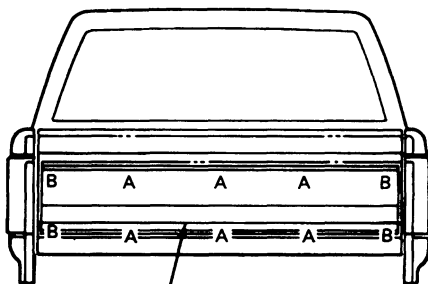
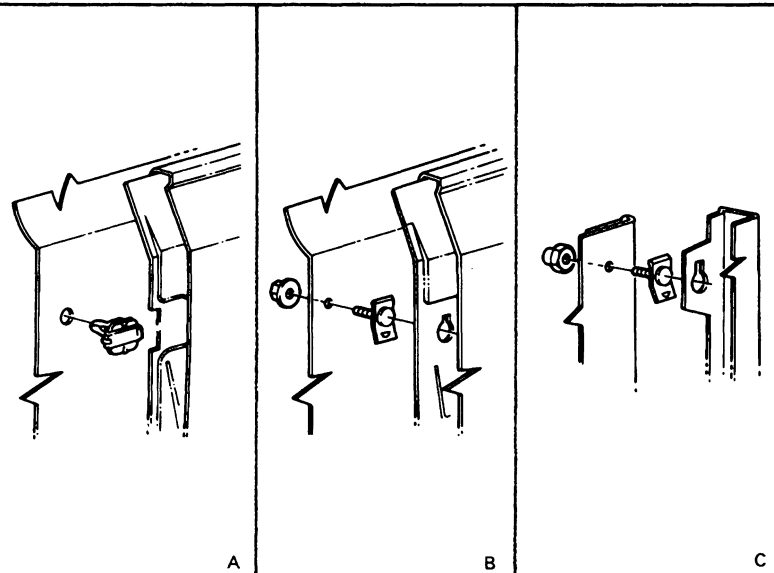
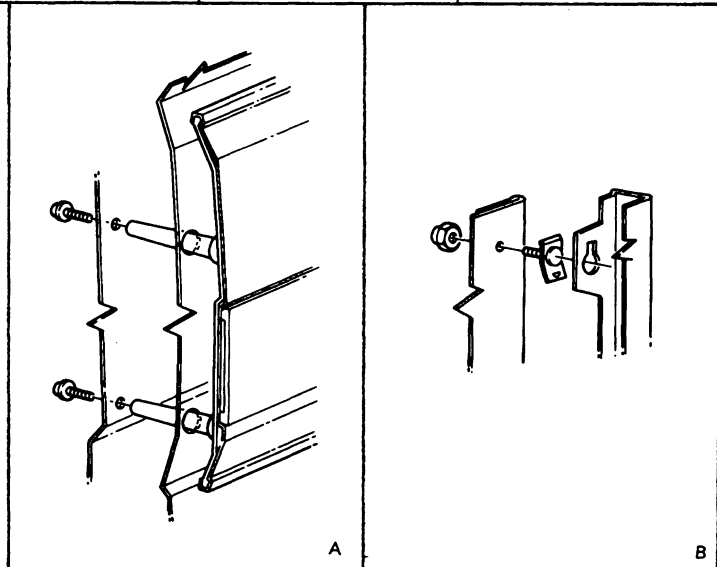
ALL REGULAR CABS - F-150 - 350

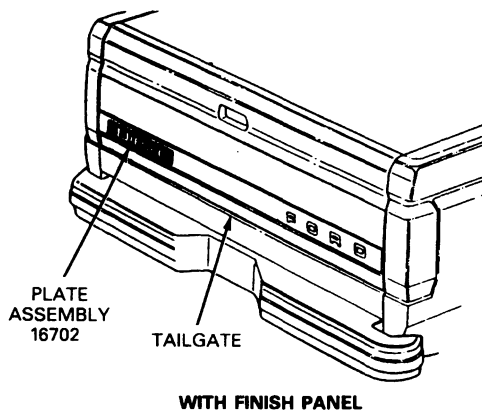
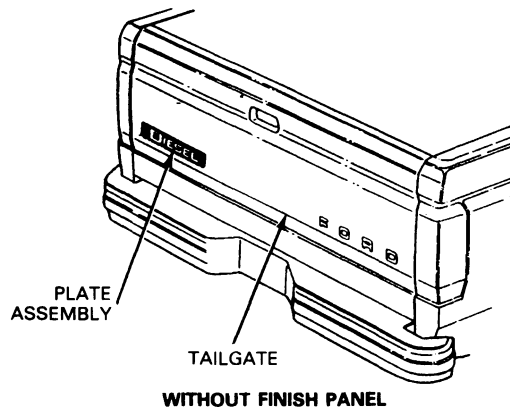


BRONCO



N5309-E

REMOVAL AND INSTALLATION (Continued)**Exterior Ornamentation, Wheel Lip and Body Side Moulding, F-150-250-350 Shown, Bronco Similar****Exterior Ornamentation and Tailgate Mouldings, Bronco, F-150-250-350**FINISH PANEL
42507TAILGATE OUTSIDE
FINISH PANEL
42507**F150-350 STYLE SIDE****N5310-2D**

REMOVAL AND INSTALLATION (Continued)**Exterior Ornamentation, Diesel Nameplate, F-150 and F-Super Duty**

N9925-B

GT Bar, Pickup Box Mounted, F-150-250-350

The roll bar is painted gloss black and normal painting procedure can be used when a repair is required.

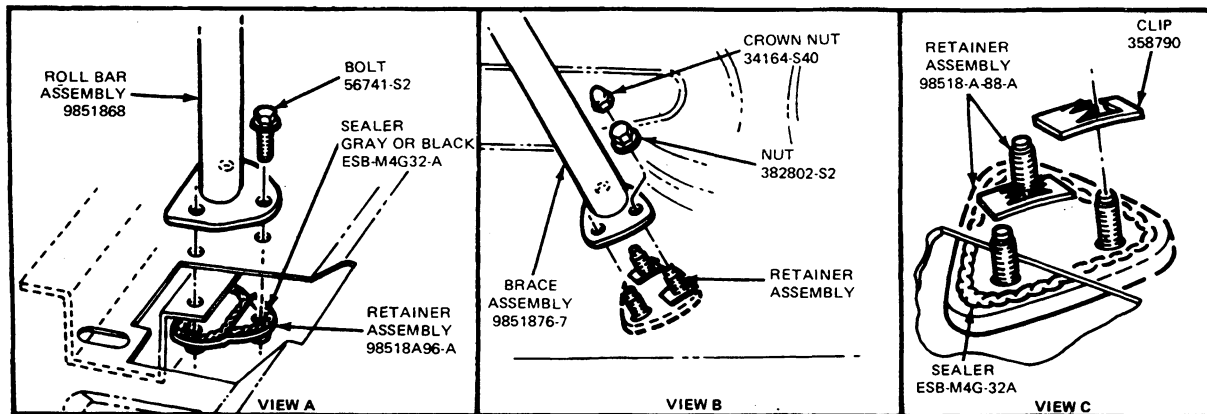
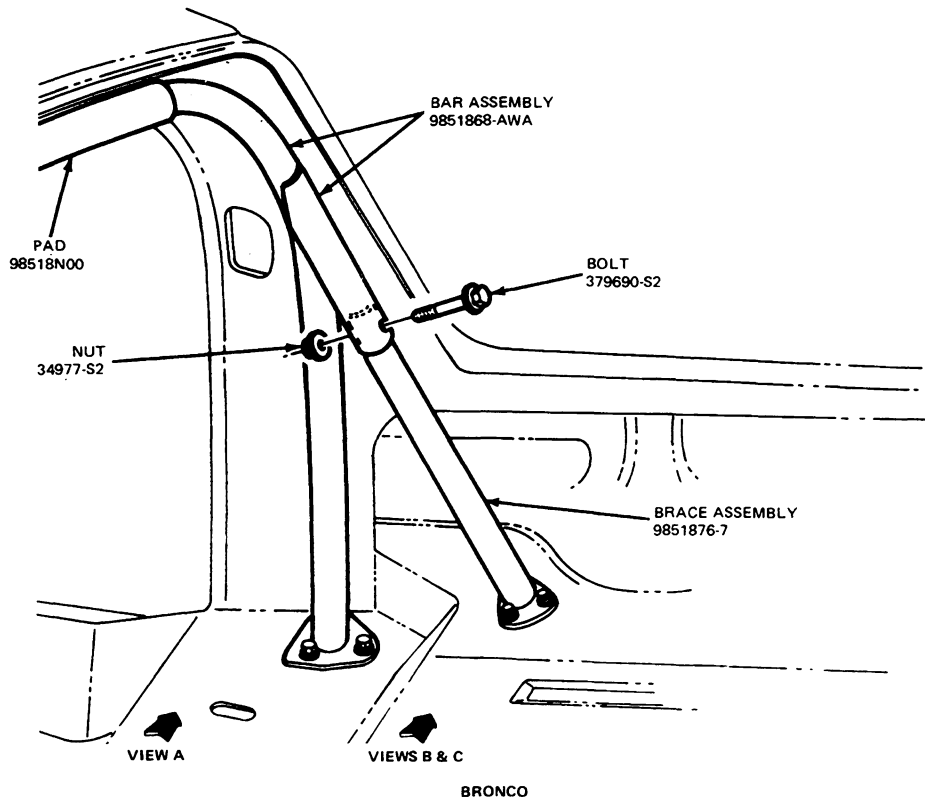
Removal

1. Remove nuts and bolts that secure GT bar to the front panel of the pickup box.
2. From the underside of the vehicle, remove nuts that secure GT bar and braces to the floor of the pickup box.
3. Lift and remove complete GT bar and brace assembly from vehicle.

NOTE: When replacing any one section of the GT bar, it is only necessary to remove the attaching nuts and bolts that secure that particular section to the vehicle.

Installation

1. Position the GT bar and brace assembly to the vehicle and secure with nuts and bolts.
2. Tighten all attaching nuts to 17-27 N·m (12-20 ft-lb).

REMOVAL AND INSTALLATION (Continued)**GT Bar, Pickup Box Mounted, F-150-250-350**

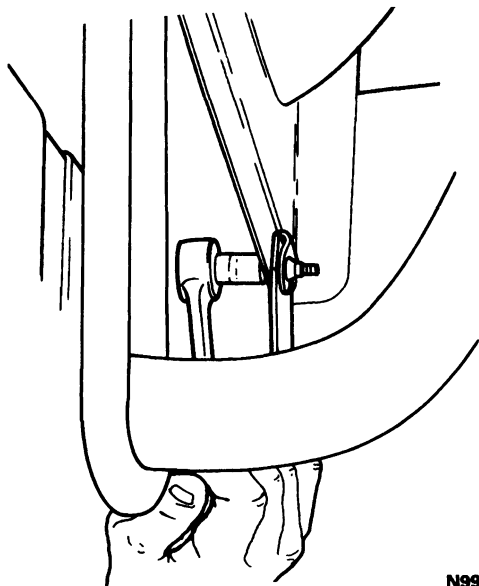
N2428-20

Cab Step, F-150 Flareside**Removal and Installation**

1. Remove the cab step mat from the step.

REMOVAL AND INSTALLATION (Continued)

2. Remove step-to-body frame bolts.



N9927-A

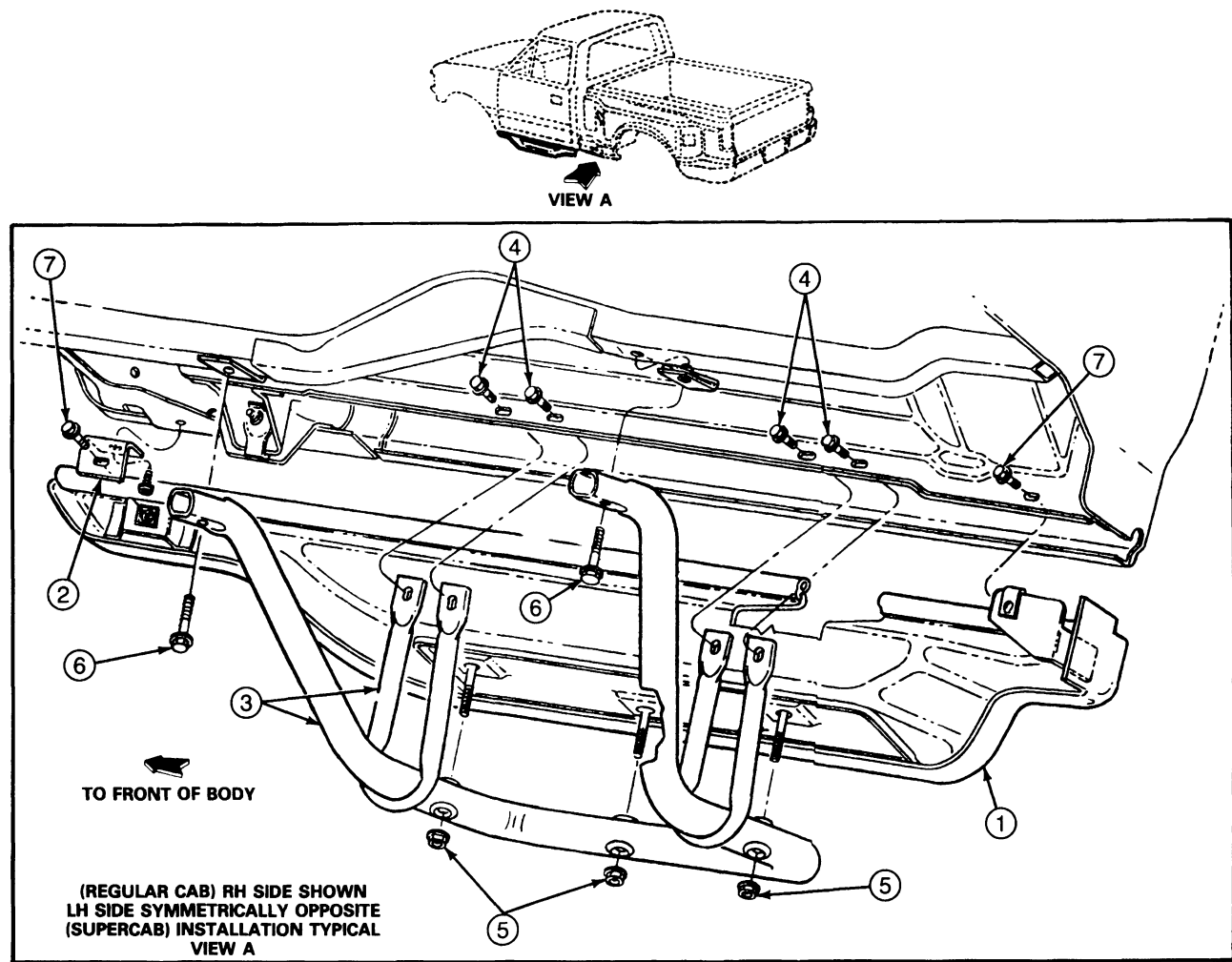
3. Remove the cab step bracket-to-frame bolts.
4. Remove the step and bracket assembly from the vehicle. The step can now be removed from the bracket by removing the stud nuts.

NOTE: If the cab step front fender brackets are damaged they can be removed for replacement by removing the bracket bolts. Refer to the following illustration. Tighten bracket bolts to 8-11 N·m (70-97 in-lb).

For installation, follow removal procedures in reverse order. Tighten all step bracket-to-frame bolts to 20-28 N·m (15-20 ft-lb) and step-to-frame bolts to 8-11 N·m (70-97 in-lb).

REMOVAL AND INSTALLATION (Continued)

Cab Step Installation



N9928-A

Item	Part Number	Description
1	16A470	Cab Step
2	16C078	Front Fender Bracket
3	—	Cab Step Bracket

(Continued)

Item	Part Number	Description
4	N605905-S55	Bolt 20-28 N·m (15-20 Ft-Lb)
5	N620481-S55	Nut 20-28 N·m (15-20 Ft-Lb)
6	N605909-S55	Bolt 20-28 N·m (15-20 Ft-Lb)
7	N605891-S55	Bolt 8-11 N·m (70-97 In-Lb)

CLEANING AND MAINTENANCE

Chrome and Bright Metal Care

Many parts of the vehicle, such as the bumpers and body hardware, are chrome-plated or anodized aluminum. These finishes are susceptible to corrosion due to salt air near coastlines (or salt spray during winter), factory smoke and other conditions found in today's cities. When such conditions exist, frequent washing and the use of Custom Bright Metal Cleaner 8A-19522-A (ESR-M5B194-B) or equivalent wax or polish is recommended.

CAUTION: Do not use steel wool, abrasive-type cleaners or strong detergents containing highly alkaline or caustic agents on chrome plated or anodized aluminum parts. These methods or cleaners may damage the protective coating and cause discoloration and/or paint deterioration.

Vinyl Insert Moulding Care

Rinse vinyl to remove loose dirt and grime. Exceptionally dirty areas should be pre-cleaned with Extra Strength Whitewall Tire Cleaner E0AZ-19526-BA (ESR-M14P15-A) or Ford Multi-Purpose Cleaner Concentrate B8A-19523-AA (ESR-M14P4-A) diluted to proper concentration per label directions or mild soap solution. Next, apply Ford Vinyl Hardtop Cleaner and Conditioner E3AZ-19F535-A (ESR-M14P6-A) or equivalent following label directions.

Commercial hot waxes applied at automatic car washes have been known to affect cleanability of vinyl material.

CAUTION: To avoid damage to the vinyl insert mouldings, use only an approved Ford cleaner or equivalent. The use of stiff bristle brushes or abrasive material or cleaners must be avoided.

Bumpers and Trim

The bumpers and trim on the vehicle require no special care. Periodic cleaning will preserve the beauty and life of these finishes. Wash with clear water or, if the parts are very dirty, use Multi-Purpose Cleaner Concentrate B8A-19523-AA (ESR-M14P4-A) or an equivalent compound. Using a clean soft cloth or a sponge and water, rinse and wipe the parts dry. Custom Bright Metal Cleaner 8A-19522-A (ESR-M5B194-B) or equivalent may be used sparingly to remove rust or salt corrosion from chrome-plated parts.

CAUTION: Do not scour aluminum- or chrome-finished parts with steel wool or polish with products containing abrasives. A coating of wax will provide excellent protection for all bright metal parts.

Body Maintenance

Regular body maintenance preserves the vehicle's appearance and reduces the cost of maintenance during the life of the vehicle. The following steps are suggested as a guide for regular body maintenance:

1. Vacuum the interior thoroughly and wash the vehicle.
2. Check all openings for water leaks, and seal where necessary.
3. Inspect loose weatherstrips for width of channel. Crimp as required to ensure retention to body flange.
4. Replace all door and tailgate weatherstrips which are unfit for service.
5. Replace all cracked, fogged or chipped glass.
6. Align the hood and doors if necessary.
7. Inspect the windshield wiper blades and replace, if necessary.
8. Tighten the sill plate and garnish moulding screws.
9. Clean the seats, door trim panels and headlining.
10. Touch up or paint chipped or scratched areas.
11. Periodically clean drain holes located on the underside of each rocker panel, quarter panel and door.

Fiberglass Roof Storage, Bronco

To prevent permanent deformation to the portion of the belt weatherstrip extending below the lower edge at the rear of the fiberglass roof, store the removed roof right side up on a level surface at least 152mm (6 inches) above the ground.

Trim Moulding Storage, High Series Bronco Only

In order to protect the plastic trim mouldings from damage during storage, it is recommended they be placed inside the removed fiberglass roof.

Tailgate Glass Care, Bronco

When operating the vehicle in an extremely dusty environment, the tailgate glass should be cleaned periodically with Ultra Clear Spray Glass Cleaner E4AZ-19C507-A (ESR-M14P5-A) or equivalent to prevent buildup of surface dust. This will ensure the best possible performance and the greatest number of years of trouble-free service.

REPAIR OPERATIONS

Fiberglass Repair

Safety Precautions

Always use rubber gloves or the special hand cream supplied with epoxy resin repair kits. REMOVE ANY RESIN FROM HANDS AS SOON AS POSSIBLE AND PARTICULARLY BEFORE THE MIXTURE STARTS TO GEL. Any resin that adheres to the hands may be removed with lacquer thinner followed by a thorough washing with soap and water.

1. Use a respirator when grinding the fiberglass surface.
2. Use a vacuum attachment when operating a belt sander.
3. Always work in a well ventilated area to avoid possible toxic fumes that result from using resin mixtures.
4. Do not get any resin on clothing.
5. Keep all materials, utensils and the work area clean and dry as resin repairs involve chemical reactions. Any dirt, foreign material or moisture may upset the chemical reaction and result in an unsatisfactory repair.

Repair Procedure, General

1. Grind or sand away all loose or broken material at the damaged area.
2. Scuff sand the surface approximately 25.4mm (1 inch) around the area to provide a good bonding surface.
NOTE: Surface to be repaired must be clean, dry, oil and paint free.
3. For cracks, form a shallow V-shape along the crack with a file or grinder. Fill the area with a good quality polyester or epoxy body repair compound. Follow the manufacturer's directions with regard to mixing procedures.
4. Allow the compound to harden and then sand smooth. If the surface is not level or smooth, use an additional filling and sand to a final smooth finish.
5. For larger broken areas use five layers of fiberglass cloth impregnated with the resin, to cover the area. Overlap the damaged portion by 25.4-50.8mm (1-2 inches).
6. When the material has hardened, file or grind and sand smooth. If low spots exist, fill them with resin mixture to which short fibers cut from the fiberglass cloth have been added. Add enough on the cloth to form a putty-like resin mixture.

Painting

After the desired repaired surface has been obtained, prime and paint the surface in the normal manner.

Fiberglass Rear Roof, Bronco

Weatherstrip Replacement on Roof

To repair or replace the weatherstrips, remove the roof panel assembly as described in this section. Rest the roof in an upside down position on the floor, then proceed to service the weatherstrips.

Fiberglass Laminate Repair, Bronco

1. Clean the affected area with a Silicone and Wax Remover and inspect the area closely to determine the exact extent of the damage.
2. Using a burr bit on a power drill, form a V-groove the length of the scratch or gouge. The sides of the V should be angled no more than 45 degrees.

NOTE: Avoid cutting all the way through the laminate during routing operations.

3. Remove all flaky edges and feather the painted surface back approximately 13mm (1/2 inch) beyond the damaged area by hand-sanding or power-sanding with 360-grit sandpaper.
4. Clean the repair area with dry, oil-free, high-velocity compressed air.
5. Following the instructions in the fiberglass repair kit, mix enough filler material on a clean hard surface to re-establish the laminate surface.
6. Just prior to application of the filler material, preheat the repair area using a 375-watt lamp placed 254mm (10 inches) from the repair surface until hot to the touch.
7. Using a plastic squeegee, spatula or putty knife, apply and spread the filler material into the repair area, rolling it into the depression and over the surface to avoid excessive air entrapment.

NOTE: Apply sufficient filler material so that the applied repair surface is at least 1.6mm (1/16 inch) above the adjacent laminate surface.

8. Let the filler set up until it is firm to the touch. Then, re-establish the original contour by filing off the excess, leaving the filler level slightly higher than that of the original surface.
9. Pre-shrink the filler, using a Rotunda Heat Gun 107-00301 or heat lamp. A minimum temperature of 48.9°C (120°F) is required for shrinkage.

NOTE: Keep heat source at least 305mm (12 inches) away from the repair area.

10. Power-sand the filler with 360-grit sandpaper until it is smooth and even with the original surface.

NOTE: If the filler surface exhibits fine pinholes, apply a thin coat of glaze wipe or equivalent. If the filler is pockmarked, do not use the glaze wipe. Instead, apply another layer of filler, repeating Steps 5 through 10.

11. Finish by sanding with a sanding block and 400-grit sandpaper.
12. Clean the repair area with dry, oil-free, high-velocity compressed air.

REPAIR OPERATIONS (Continued)

13. Repair the paint (Spatter Texture Coat) using the appropriate painting procedure.

SECTION 01-08B Trim, Exterior, Econoline

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING AND MAINTENANCE		REMOVAL AND INSTALLATION (Cont'd.)	
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Bumpers and Trim.....	01-08B-4	Radiator Upper Air Deflector.....	01-08B-1
Chrome and Bright Metal Care.....	01-08B-3	REPAIR OPERATIONS	
Vinyl Insert Moulding Care.....	01-08B-3	Fiberglass Repair.....	01-08B-4
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Headlamp Door.....	01-08B-2	VEHICLE APPLICATION	01-08B-1

VEHICLE APPLICATION

Econoline Vehicles

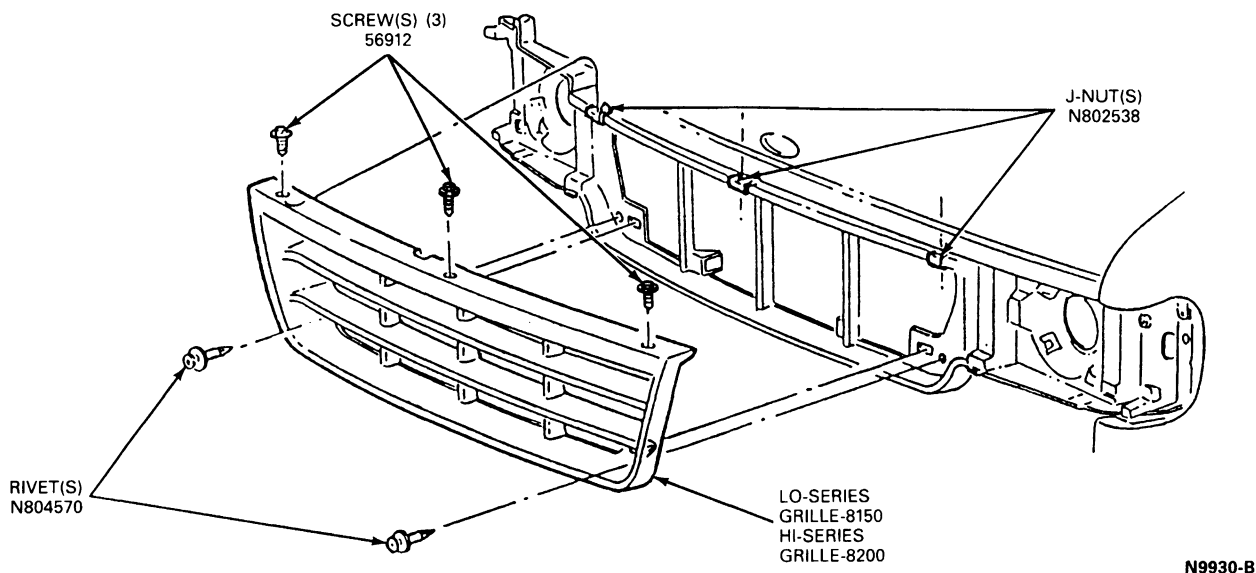
REMOVAL AND INSTALLATION

Radiator Grille

Removal and Installation

1. Raise hood and support.
2. Remove the two plastic rivets which attach the grille to the grille opening reinforcement, one rivet located at each of the two lower attaching tabs.

3. Remove three screws at top of grille.
 4. Separate the grille from the front of the vehicle.
- For installation, follow removal procedures in reverse order.



Radiator Upper Air Deflector

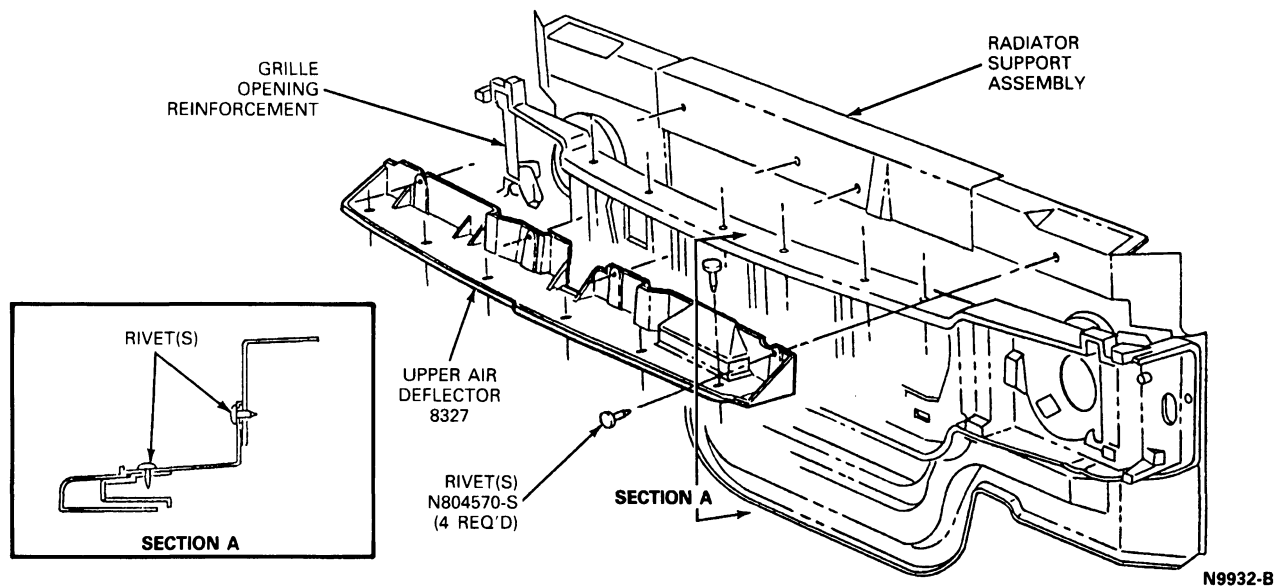
Removal and Installation

1. Raise hood and support.
2. Remove the six plastic rivets that attach the upper air deflector to the grille opening reinforcement.

3. Remove the four plastic rivets that attach the upper air deflector to the radiator support assembly.
 4. Separate the upper air deflector from the front of the vehicle.
- For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Radiator Upper Air Deflector



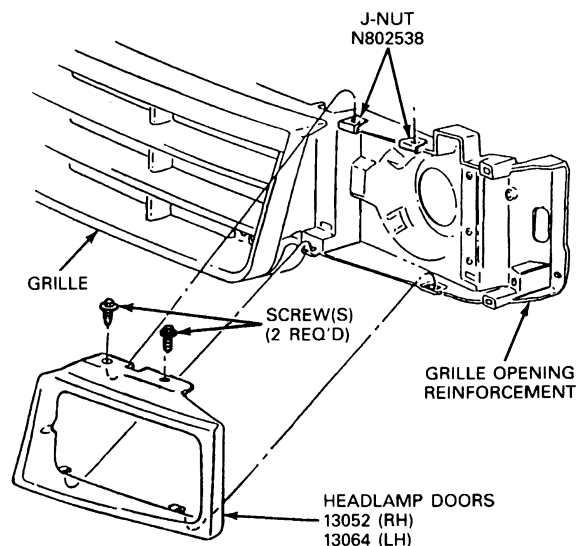
Headlamp Door

Removal

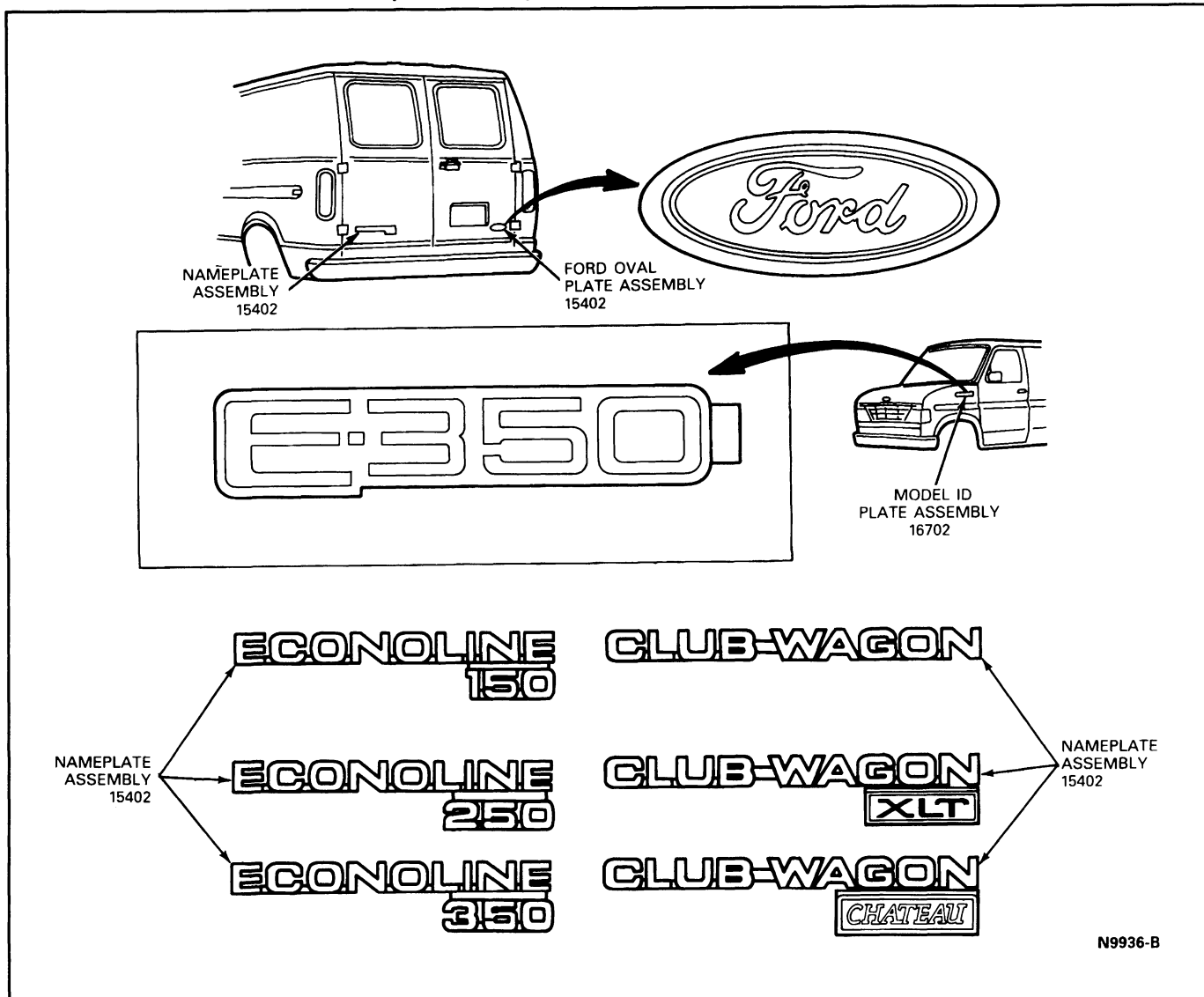
1. Raise hood and support.
2. Remove the two screws at the top of the headlamp door which attach the door to the grille opening reinforcement.
3. Separate the headlamp door from the front of the vehicle.

Installation

1. Position the lower alignment tabs at the bottom of the headlamp door into the slots in the grille opening reinforcement and swing the headlamp door up into position.
2. Install the two screws at the top of the headlamp door.



REMOVAL AND INSTALLATION (Continued)



CLEANING AND MAINTENANCE

Chrome and Bright Metal Care

Many parts of the vehicle, such as the bumpers and body hardware, are chrome-plated or anodized aluminum. These finishes are susceptible to corrosion due to salt air near coastlines (or salt spray during winter), factory smoke and other conditions found in today's cities. When such conditions exist, frequent washing and the use of Custom Bright Metal Cleaner 8A-19522-A (ESR-M5B194-B) or equivalent wax or polish is recommended.

CAUTION: Do not use steel wool, abrasive-type cleaners or strong detergents containing highly alkaline or caustic agents on chrome plated or anodized aluminum parts. These methods or cleaners may damage the protective coating and cause discoloration and/or paint deterioration.

Vinyl Insert Moulding Care

Rinse vinyl to remove loose dirt and grime. Exceptionally dirty areas should be pre-cleaned with Extra Strength Whitewall Tire Cleaner E0AZ-19526-BA (ESR-M14P15-A) or Ford Multi-Purpose Cleaner Concentrate B8A-19523-AA (ESR-M14P4-A) diluted to proper concentration per label directions or mild soap solution. Next, apply Ford Vinyl Hardtop Cleaner and Conditioner E3AZ-19F535-A (ESR-M14P6-A) or equivalent following label directions.

Commercial hot waxes applied at automatic car washes have been known to affect cleanability of vinyl material.

CAUTION: To avoid damage to the vinyl insert mouldings, use only an approved Ford cleaner, or equivalent. The use of stiff bristle brushes or abrasive material or cleaners must be avoided.

CLEANING AND MAINTENANCE (Continued)

Bumpers and Trim

The bumpers and trim on the vehicle require no special care. Periodic cleaning will preserve the beauty and life of these finishes. Wash with clear water or, if the parts are very dirty, use Multi-Purpose Cleaner Concentrate B8A-19523-AA (ESR-M14P4-A) or an equivalent compound. Using a clean soft cloth or a sponge and water, rinse and wipe the parts dry. Custom Bright Metal Cleaner 8A-19522-A (ESR-M5B194-B) or equivalent may be used sparingly to remove rust or salt corrosion from chrome-plated parts.

CAUTION: Do not scour aluminum- or chrome-finished parts with steel wool or polish with products containing abrasives. A coating of wax will provide excellent protection for all bright metal parts.

Body Maintenance

Regular body maintenance preserves the vehicle's appearance and reduces the cost of maintenance during the life of the vehicle. The following steps are suggested as a guide for regular body maintenance:

1. Vacuum the interior thoroughly and wash the vehicle.
2. Check all openings for water leaks, and seal where necessary.
3. Inspect loose weatherstrips for width of channel. Crimp as required to ensure retention to body flange.
4. Replace all door and tailgate weatherstrips which are unfit for service.
5. Replace all cracked, fogged, or chipped glass.
6. Align the hood and doors if necessary.
7. Inspect the windshield wiper blades and replace if necessary.
8. Tighten the sill plate and garnish moulding screws.
9. Clean the seats, door trim panels, and headlining.
10. Touch up or paint chipped or scratched areas.
11. Periodically clean drain holes located on the underside of each rocker panel, quarter panel, and door.

1. Use a respirator when grinding the fiberglass surface.
2. Use a vacuum attachment when operating a belt sander.
3. Always work in a well ventilated area to avoid possible toxic fumes that result from using resin mixtures.
4. Do not get any resin on clothing.
5. Keep all materials, utensils and the work area clean and dry as resin repairs involve chemical reactions. Any dirt, foreign material or moisture may upset the chemical reaction and result in an unsatisfactory repair.

Repair Procedure, General

1. Grind or sand away all loose or broken material at the damaged area.
2. Scuff sand the surface approximately 25.4mm (1 inch) around the area to provide a good bonding surface.
NOTE: Surface to be repaired must be clean, dry, oil and paint free.
3. For cracks, form a shallow V-shape along the crack with a file or grinder. Fill the area with a good quality polyester or epoxy body repair compound. Follow the manufacturer's directions with regard to mixing procedures.
4. Allow the compound to harden and then sand smooth. If the surface is not level or smooth, use an additional filling and sand to a final smooth finish.
5. For larger broken areas use five layers of fiberglass cloth impregnated with the resin, to cover the area. Overlap the damaged portion by 25.4-50.8mm (1-2 inches).
6. When the material has hardened, file or grind and sand smooth. If low spots exist, fill them with resin mixture to which short fibers cut from the fiberglass cloth have been added. Add enough on the cloth to form a putty-like resin mixture.

Painting

After the desired repaired surface has been obtained, prime and paint the surface in the normal manner.

REPAIR OPERATIONS

Fiberglass Repair

Safety Precautions

Always use rubber gloves or the special hand cream supplied with epoxy resin repair kits. Remove any resin from hands as soon as possible and particularly before the mixture starts to gel. Any resin that adheres to the hands may be removed with lacquer thinner followed by a thorough washing with soap and water.

SECTION 01-09 Mirrors

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Mirrors, Inside	01-09-1	Outside Rearview Mirror, F-150-250-350 and	
Outside Rearview Mirror	01-09-1	Bronco	01-09-6
DIAGNOSIS AND TESTING		Conventional Type	01-09-6
Mirrors, Power	01-09-1	Western Type, Swing-Away, F-150-250-350	
REMOVAL AND INSTALLATION		and Bronco	01-09-7
Glass Replacement, Fixed Glass, Except		Rearview Mirror, E-150-250-350.....	01-09-9
Recreation Swing-Out	01-09-8	Recreation Swing-Out Mirror, Dual	
Inside Rearview Mirror	01-09-5	Position.....	01-09-8
Installation	01-09-6	SPECIAL SERVICE TOOLS/EQUIPMENT	01-09-9
Movable Mirror Glass	01-09-8	VEHICLE APPLICATION	01-09-1
Outside Rearview Mirror, Electric,			
F-150-250-350 and Bronco.....	01-09-7		

VEHICLE APPLICATION

All Vehicles

DESCRIPTION AND OPERATION

Mirrors, Inside

The inside mirror is a windshield mounted, hand set day / night mirror.

Outside Rearview Mirror

The outside mirrors are manually operated. Dual electric remote controlled mirrors are available on E-150-250-350, F-150-250-350 and Bronco. Dual Western Low Mount Swing Away Mirrors are available on Bronco and F150-250-350. Recreation Swing-Out Mirrors are also available.

DIAGNOSIS AND TESTING

Mirrors, Power

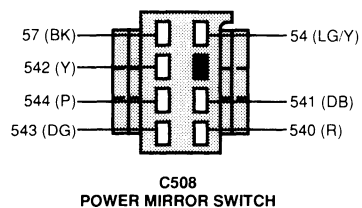
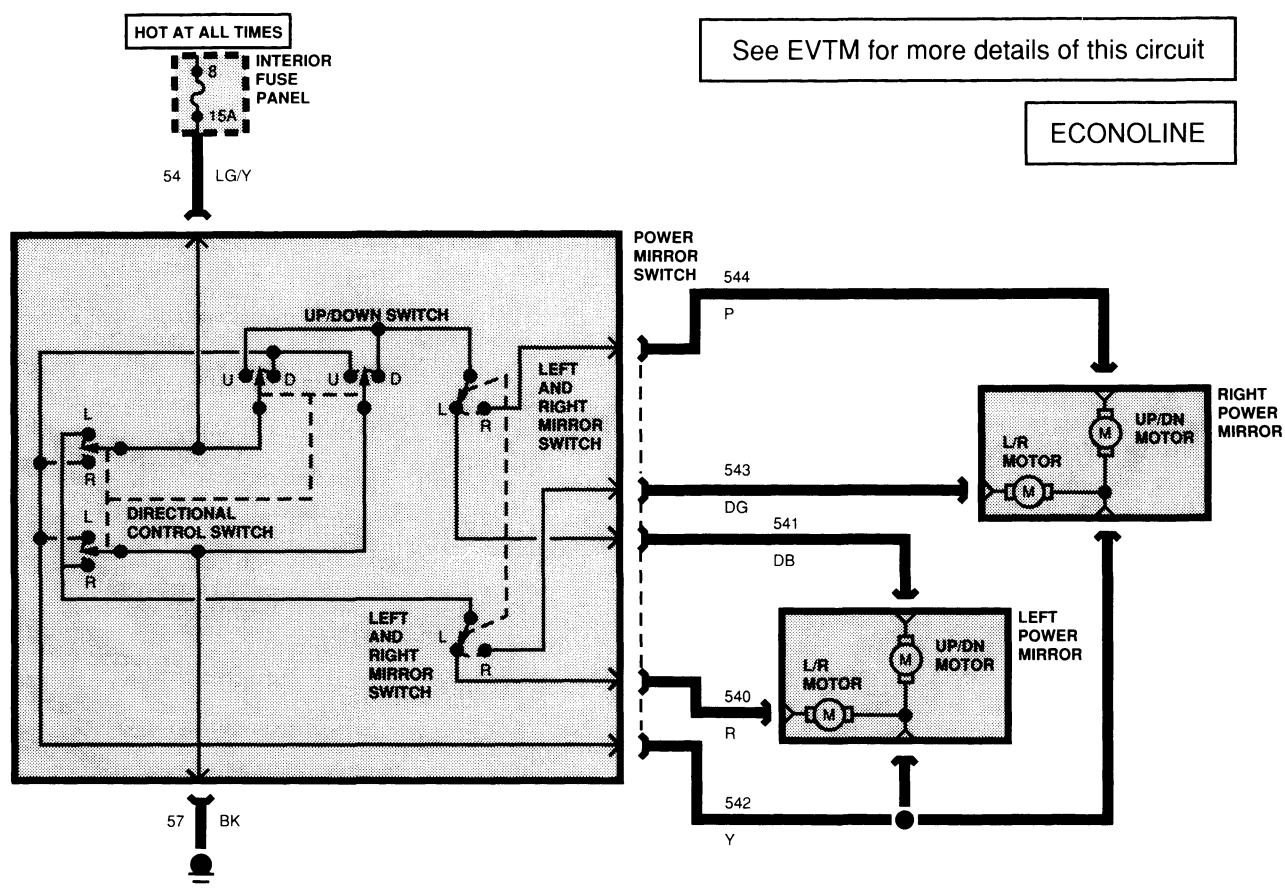
RIGHT/LEFT POWER MIRRORS INOPERATIVE — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	Right / Left Power Mirrors are Inoperative		
	<ul style="list-style-type: none"> Check fuse in panel — Is fuse in panel OK? 	Yes	<p>▶ REMOVE switch. CHECK for power across Circuit 54 using Rotunda Model 007-00001 Digital Volt-Ohmmeter or equivalent. REPLACE switch.</p>
		No	<p>▶ REPLACE fuse.</p>

DIAGNOSIS AND TESTING (Continued)**RIGHT/LEFT POWER MIRRORS INOPERATIVE — TEST A (Continued)**

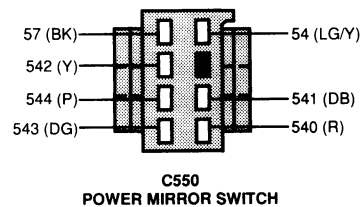
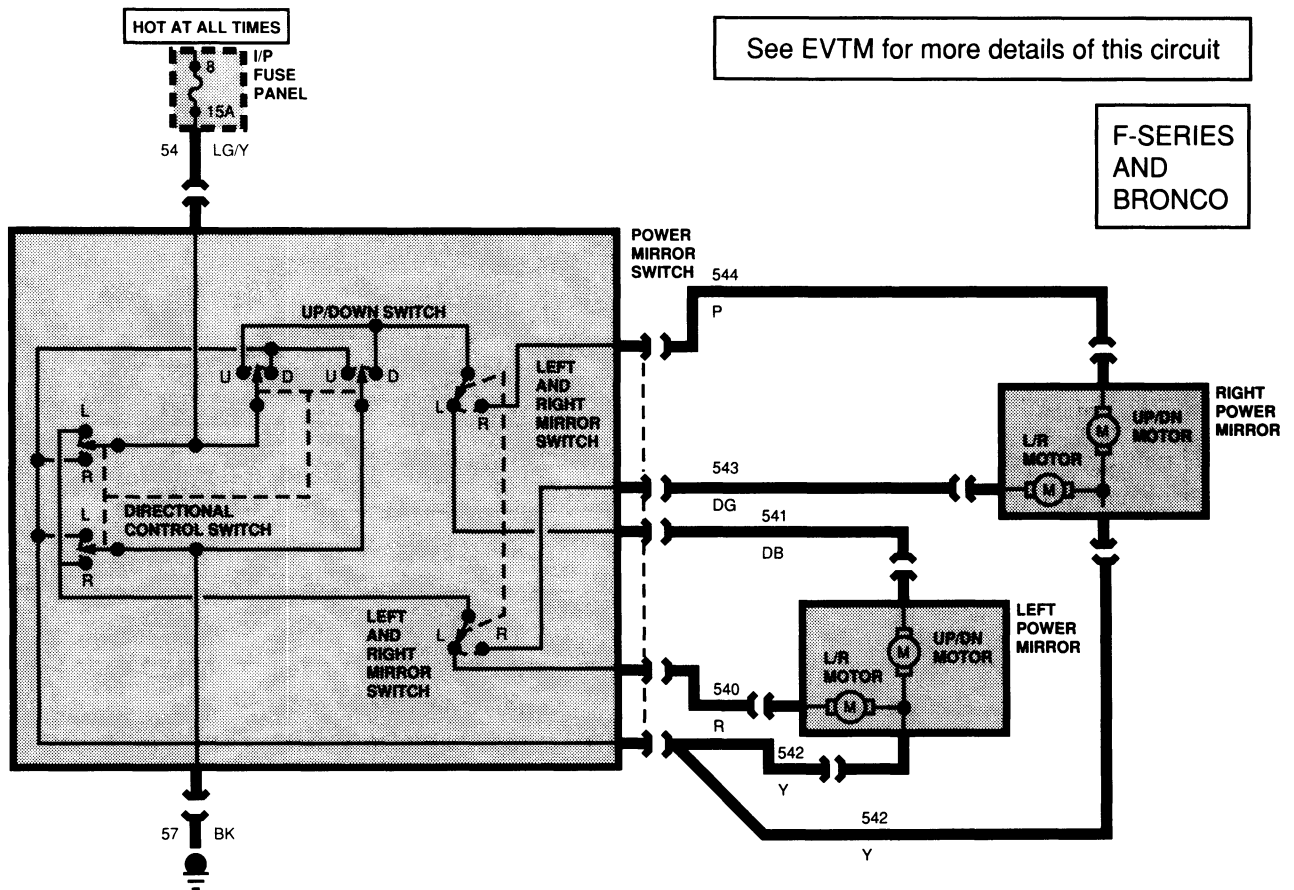
TEST STEP		RESULT	ACTION TO TAKE
A2	Either Right or Left Mirror Does Not Operate		
	<ul style="list-style-type: none"> ● Check continuity in wire harness circuits. <ul style="list-style-type: none"> — Is continuity OK? 	<p>Yes</p> <p>No</p>	<p>▶ REMOVE door panel. CHECK harness connector to mirror. REPLACE mirror.</p> <p>▶ Using Rotunda Model 007-00001 Digital Volt-Ohmmeter or equivalent, CHECK continuity of circuits. TRACE continuity to connector. REPLACE mirror.</p>
A3	Right or Left Mirror Non-Functioning or Functions at Variance with System Logic		
	<ul style="list-style-type: none"> ● Check circuit logic at harness connector. <ul style="list-style-type: none"> — Is circuit logic at harness connector to mirror with switch operating OK? 	<p>Yes</p> <p>No</p>	<p>▶ REPLACE mirror.</p> <p>▶ Using Rotunda Model 007-00001 Digital Volt-Ohmmeter, CHECK circuit continuity in harness to mirror with switch operational. CHECK connector. TRACE along harness to determine cross circuitry location and connect.</p>

DIAGNOSIS AND TESTING (Continued)



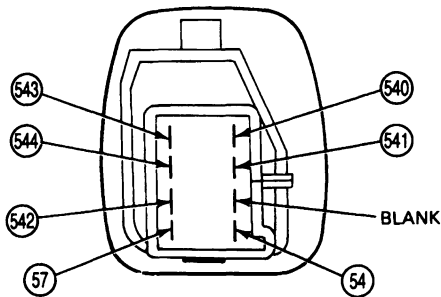
N10283-A

DIAGNOSIS AND TESTING (Continued)



N10284-A

DIAGNOSIS AND TESTING (Continued)



POWER MIRROR LOGIC TABLE

MIRROR OPERATIONAL MODE	DIRECTIONAL MOVEMENT	LH MIRROR		RH MIRROR	
		POS. VOLTAGE (+)	GRD. (-)	POS. VOLTAGE (+)	GRD. (-)
VERTICAL	UP	541	542	544	542
VERTICAL	DOWN	542	541	542	544
HORIZONTAL	LEFT	540	542	543	542
HORIZONTAL	RIGHT	542	540	542	543

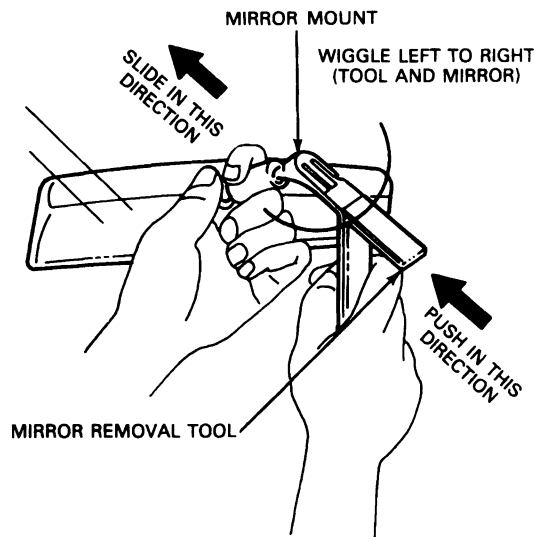
N9754-A

REMOVAL AND INSTALLATION

Inside Rearview Mirror

Removal

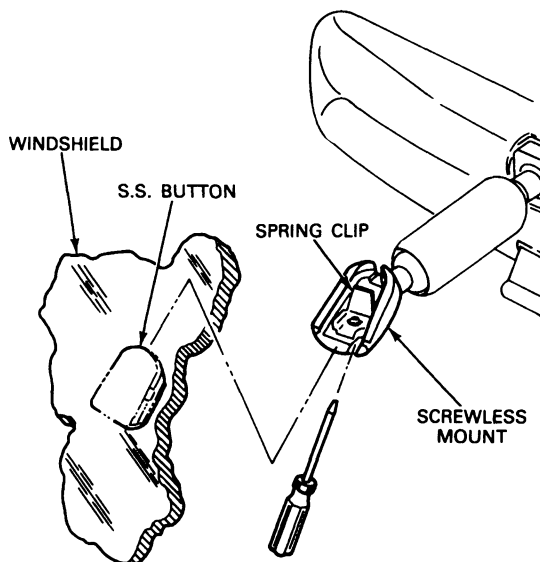
1. Grasp mirror firmly.
2. Insert Rotunda mirror removal tool between mirror mounting button and mirror.
3. Slide tool completely in to release mirror retaining clip.
4. Remove mirror by using an upward force as shown, while wiggling mirror and removal tool from left to right.



N9755-A

Optional Removal Method

1. Grasp mirror firmly.
2. Insert small single blade screwdriver into slot until spring is contacted as shown.
3. While pushing on spring with screwdriver, pull up on mirror to remove from windshield.

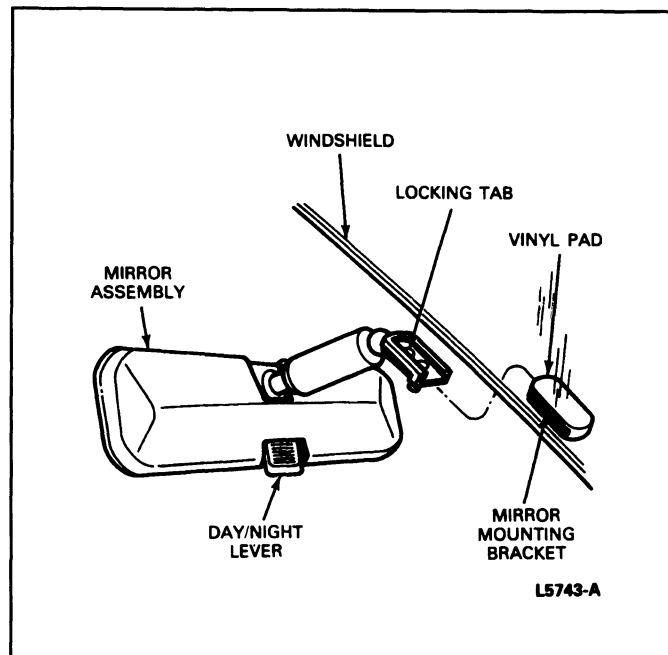


N9756-A

REMOVAL AND INSTALLATION (Continued)

Installation

- Using a wax pencil, locate and mark the mirror mounting bracket on outside windshield surface.
NOTE: If the clear vinyl wafer remained on the windshield glass, apply low heat (heat gun) until the wafer softens. Peel the vinyl wafer from the glass taking care not to scratch or mar the glass surface.
- Thoroughly clean inside of the windshield with mild abrasive cleaning powder and clean cloth saturated in alcohol to remove old adhesive. Then, use a paper towel and remove all cleaner from the windshield.
NOTE: Do not contaminate clean area.
- Use fine sandpaper on mirror mounting bracket to lightly scuff the surface. Wipe clean with alcohol moistened cloth.
- If vinyl wafer is still adhered to the mounting bracket, use low heat (heat gun) until the wafer softens and peel it off. Roughen the bonding surface of the mounting bracket with fine grit sandpaper. Wipe surface clean with a paper towel soaked in alcohol.
NOTE: Do not contaminate cleaned bracket.
- Using the applicator, apply a generous amount of adhesive from Rear View Mirror Adhesive D9AZ-19554-CA (ESB-M2G 176-A) or equivalent, to the bonding surface of the mounting bracket and the windshield glass. Allow the accelerator material to dry for three minutes. Do not touch the mounting surfaces.
- Apply two drops of adhesive from Rear View Mirror Adhesive D9AZ-19554-CA (ESB-M2G 176-A) or equivalent, to the mounting surface of the bracket. Using a clean toothpick or wooden match, quickly spread the adhesive evenly over the mounting surface of the bracket.
- Quickly position the mounting bracket on the windshield, using the locator marked on the outside of the windshield glass.
NOTE: The 9.5mm (3/8-inch) circular depression in the bracket must be down and toward the inside of the passenger compartment.
- Press the bracket against the windshield for about one minute.
- Allow the adhesive to set for five minutes. Remove any excess adhesive material from the windshield with an alcohol-dampened rag.
- Slide mirror mount downward onto mirror mounting button, using a force in direction of windshield plane.



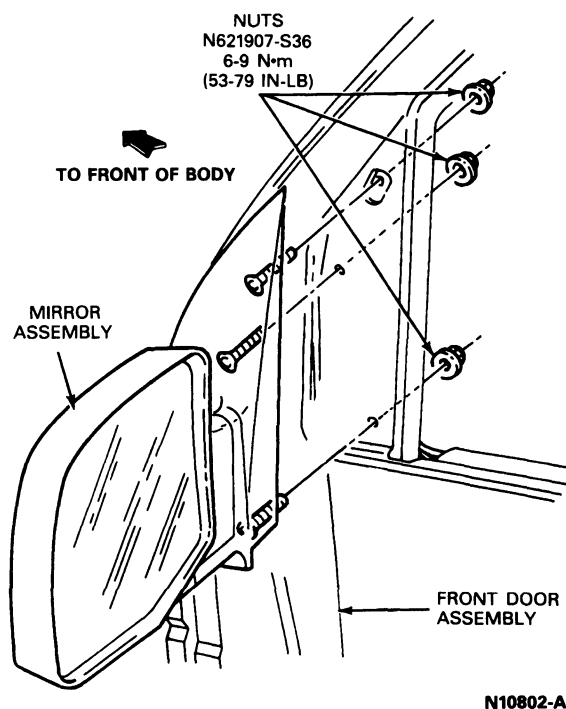
Outside Rearview Mirror, F-150-250-350 and Bronco

Conventional Type

Removal and Installation

- Remove the attaching screws.
- Lift off the mirror and gasket.

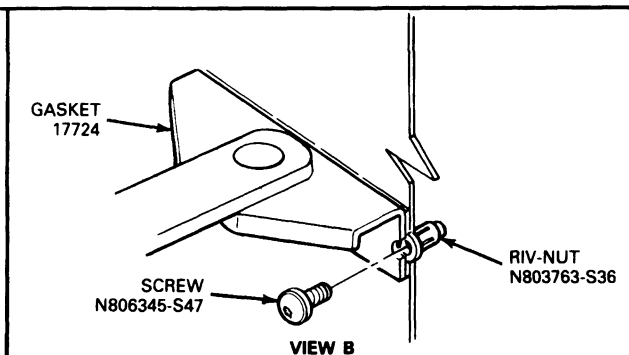
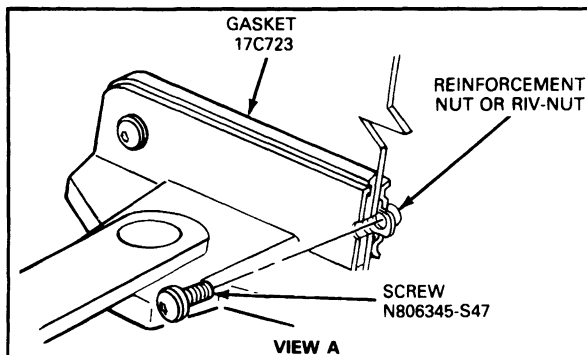
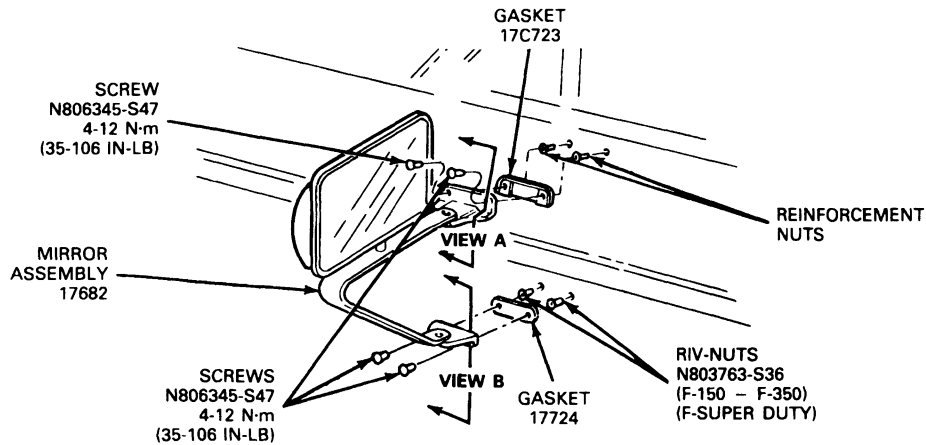
For installation, follow removal procedure in reverse order.



REMOVAL AND INSTALLATION (Continued)**Western Type, Swing-Away, F-150-250-350 and Bronco****Removal and Installation**

1. Remove mirror attaching screw to door.
2. Remove mirror.
3. If mirror is broken, refer to Mirror Replacement in this section.

For installation, follow removal procedures in reverse order.

Mirror, Western Type, Swing-Away, F-150-250-350 and Bronco

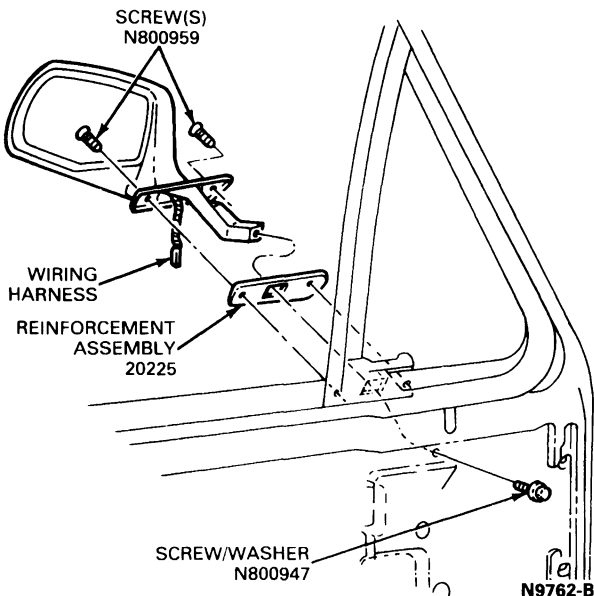
K4138-J

Outside Rearview Mirror, Electric, F-150-250-350 and Bronco**Removal and Installation**

1. Remove door trim panel. Refer to Section 01-05.
2. Disconnect mirror wire harness.
3. Remove two attaching screws from vehicle exterior and one from vehicle interior.

REMOVAL AND INSTALLATION (Continued)

4. To install, reverse Steps 1, 2 and 3.



Glass Replacement, Fixed Glass, Except Recreation Swing-Out

Removal and Installation

CAUTION: The mirror glass must be installed with the reflective coated side exposed to make sure of adequate performance. Touching the glass with the point of a pencil will show a point-to-point image on the reflective surface only.

1. Break out and discard the larger fragments of the broken mirror glass.
2. Remove the smaller fragments from around the perimeter with a flat-bladed knife.
3. If dust or dirt has accumulated inside the mirror base, wash it and allow it to dry thoroughly before proceeding.
4. Using Ford Silicone Rubber D6AZ-19562-AA (ESB-M4G92-A and ESE-M4G195-A) or equivalent, apply a 3.2mm (1/8-inch) by 25.4mm (1.00 inch) diameter bead on each of the four upper mounting pads.
5. Apply a continuous 3.2mm (1/8-inch) diameter bead 101.6mm (4.00 inches) long across the two lower center mounting pads on the mirror head.
6. Press the glass firmly into the case PRIMARY SIDE OUT, and secure with a rubber band pressing a small pad of styrofoam against the center of the glass.

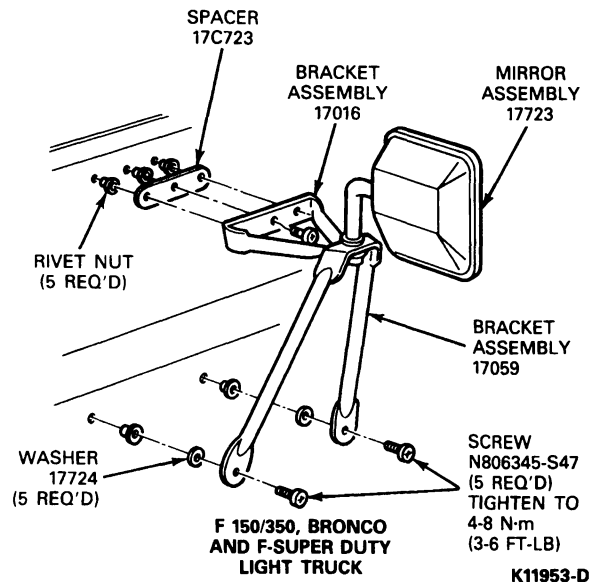
NOTE: The rubber band should remain in place for a minimum of 24 hours to retain the glass until the silastic is cured.

Recreation Swing-Out Mirror, Dual Position

Removal and Installation

1. Remove five screws from door.
2. Remove mirror.

For installation, follow removal procedure in reverse order.



NOTE: If mirror glass is broken, replace the Mirror Assembly 17723 shown above. Do not attempt to replace the glass.

Movable Mirror Glass

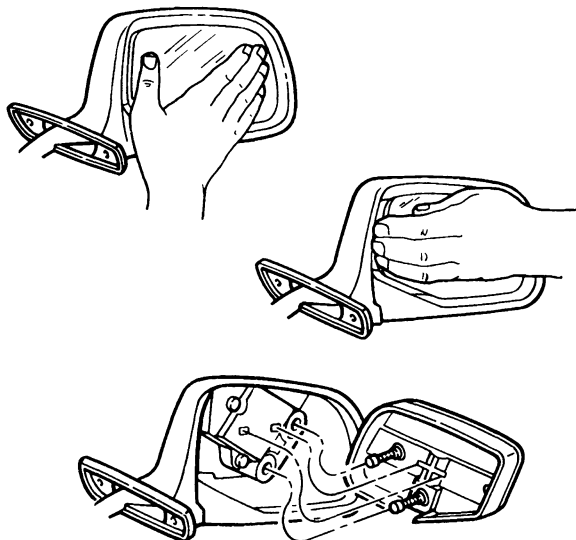
Removal and Installation

1. Push outer edge of mirror glass into housing.
2. Grip inner edge of mirror glass and pull out until mirror glass snaps out of motor assembly.

NOTE: On some vehicles, the cross-tee pivot or drive screw(s) may remain attached to the motor assembly. In this case, carefully pry the pivot out of the motor and turn the drive screw(s) (counterclockwise) out of the motor assembly and discard. Pivot pins are part of the new mirror assembly.

REMOVAL AND INSTALLATION (Continued)

3. Position the mirror glass as shown. Firmly push the glass into place with the palm of the hand, until it locks.



N9761-A

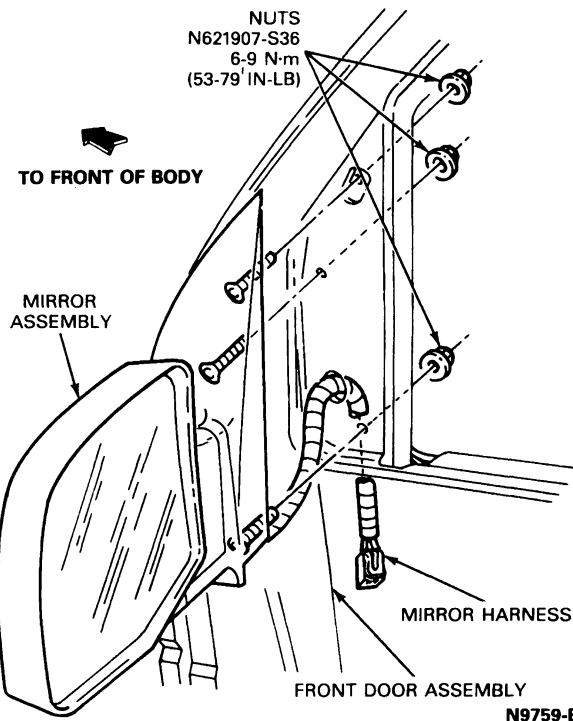
Rearview Mirror, E-150-250-350**Removal**

1. Remove the door trim sail cover and trim panel. Refer to Section 01-05.
2. If vehicle is equipped with electric mirrors, remove the speaker assembly mounted in the door. Refer to Section 01-05.
3. Disconnect the mirror harness. Refer to Section 18-01.
4. Remove the mirror assembly-to-door nut and washer assemblies.
5. Remove the mirror assembly.

Installation

1. Position the gasket and mirror assembly to the door and install. Tighten the nut and washer assemblies to 6-9 N·m (53-79 in-lb).

2. If vehicle is equipped with electric mirrors, connect the mirror wire harness. Refer to Section 18-01.
3. Install the speaker assembly to the door. Refer to Section 01-05.
4. Install the door trim panel and sail cover. Refer to Section 01-05.



N9759-B

SPECIAL SERVICE TOOLS / EQUIPMENT**ROTUNDA EQUIPMENT**

Model	Description
007-00001	Digital Volt-Ohmmeter
OTC No. PS90D812-1C	Inside Mirror Removal Tool

SECTION 01-10A Seats and Tracks, Front and Seat Back Latch

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Front Folding Seat Back, F-Series		Front Bucket Seat Back Latch, Bronco.....	01-10A-10
SuperCab.....	01-10A-11	Front Bucket Seats, E-150-250-350, Driver and	
Recliner, Manual.....	01-10A-11	Passenger.....	01-10A-3
DESCRIPTION AND OPERATION		Front Captain's Chairs, F-150-250-350	
Front Seats.....	01-10A-1	SuperCab and Bronco, Passenger Seats and Driver	
Recliner, Manual, E-150-250-350		Seat.....	01-10A-4
Bucket/Captain Chairs.....	01-10A-2	Front Seat Back Adjuster, Recliner,	
Seat Back Latch.....	01-10A-1	E-150-250-350 Bucket/Captain's	
DIAGNOSIS AND TESTING		Chairs.....	01-10A-6
Recliner, Manual, E-150-250-350		Front Seat Back Latch, Bronco and	
Bucket/Captain Chairs.....	01-10A-2	F-150-250-350.....	01-10A-10
Seat Back Latch.....	01-10A-2	Front Seat Tracks, Bench Seat,	
REMOVAL AND INSTALLATION		F-150-250-350, F-Super Duty Chassis Cab and	
Bench Seat Latch, Bronco and F-150-250-350		Bronco.....	01-10A-4
SuperCab.....	01-10A-9	Front Seat Tracks, Bucket Seat, Driver and	
Bench Seat Latch, F-150-250-350, F-Super		Passenger.....	01-10A-5
Duty Chassis Cab.....	01-10A-8	Striker.....	01-10A-11
Front Bench Seats, F-150-250-350, F-Super		SPECIFICATIONS.....	01-10A-12
Duty Chassis Cab and Bronco.....	01-10A-2	VEHICLE APPLICATION.....	01-10A-1

VEHICLE APPLICATION

All E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab and Bronco Vehicles

DESCRIPTION AND OPERATION

Front Seats

The captain's chair on E-Series and Club Wagon mounts on a pedestal attached to the vehicle floor. The bench seat on F-Series and Bronco mounts on two seat tracks attached to the vehicle floor.

The bucket seats on E-Series, F-Series and Bronco mount on two seat tracks. The seat tracks mount on a fixed pedestal (E-150-250-350) or to the vehicle floor (F-150-250-350 and Bronco).

Seat Back Latch

All folding seats (except Bronco passenger seat on vehicles with bucket seats) have a latch designed to hold the seat back in the normal position. The Bronco bucket seat back does not fold forward on the passenger side.

For rear seat passenger entry and exit and to gain access to the storage compartment (F-150-250-350 SuperCab, F-350 Crew Cab and Bronco with full bench seat), a handle on the side of the seat back releases the seat latch.

DESCRIPTION AND OPERATION (Continued)**Recliner, Manual, E-150-250-350
Bucket/Captain Chairs**

With the seat back recliner system, the seat back is reclined rearward for optimum occupant comfort. The reclining seat back is adjusted by a release handle on the outboard side of the seat cushion. To recline the seat back, rotate the handle upward, push the seat back to the desired position and release the handle. Spring action will return the seat back to its full-up position when the handle is lifted and occupant back pressure is removed.

If the recliner assembly is removed for any reason, it must be reinstalled as outlined. Tighten all retaining screws to specification.

DIAGNOSIS AND TESTING**Seat Back Latch**

If the seat back will not latch in position or the latch mechanism will not unlock, it may be necessary to remove the side shield and/or remove the seat back trim cover far enough to inspect the latch mechanism. Then replace any parts to put the latch system in proper working order.

**Recliner, Manual, E-150-250-350
Bucket/Captain Chairs**

If a recliner assembly or component is non-functional or damaged, the entire recliner assembly must be replaced. The recliner assembly is a modular design and the individual components cannot be serviced or replaced independently.

REMOVAL AND INSTALLATION

CAUTION: Use care when handling seat and track assembly. Dropping assembly or sitting on seat when not secured in vehicle could result in damaged components.

**Front Bench Seats, F-150-250-350, F-Super
Duty Chassis Cab and Bronco****Removal**

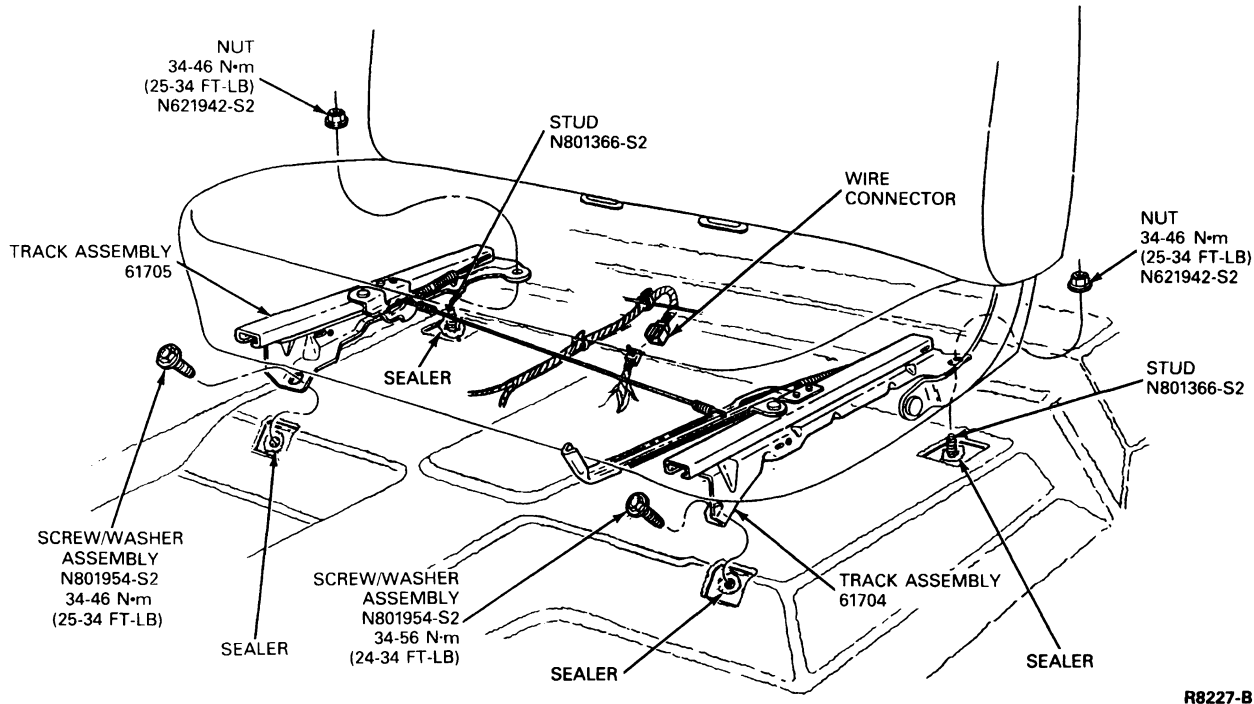
1. Disconnect wiring, if equipped.
2. Remove the seat track-to-floorpan retaining screws and nuts (one of each on each side).
3. Lift the seat and track assembly out of the vehicle.

Installation

1. Apply Caulking Cord D6AZ-19560-A (ESB-M4G32-A) or equivalent around seat track assembly attaching screw and stud locations on floorpan.
2. Position the seat and track assembly in the vehicle and secure it to the floorpan with the retaining screws and nuts. Tighten the screws to 34-46 N·m (25-34 ft-lb).
3. Connect wiring, if equipped.

REMOVAL AND INSTALLATION (Continued)

Front Seat Installation, F-Series



R8227-B

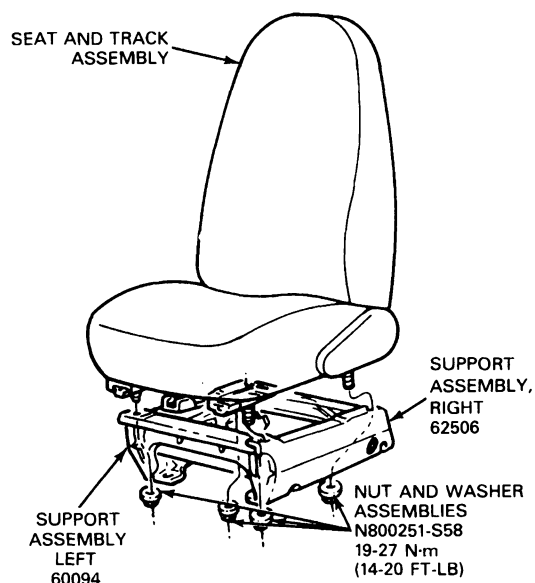
Front Bucket Seats, E-150-250-350, Driver and Passenger

Removal and Installation

1. Remove four seat and track assembly-to-support assembly nut and washer assemblies.
2. Remove seat and track assembly from vehicle.
3. Remove two support-to-floorpan retaining bolts and two nut and washer assemblies. Lift support assembly out of vehicle.

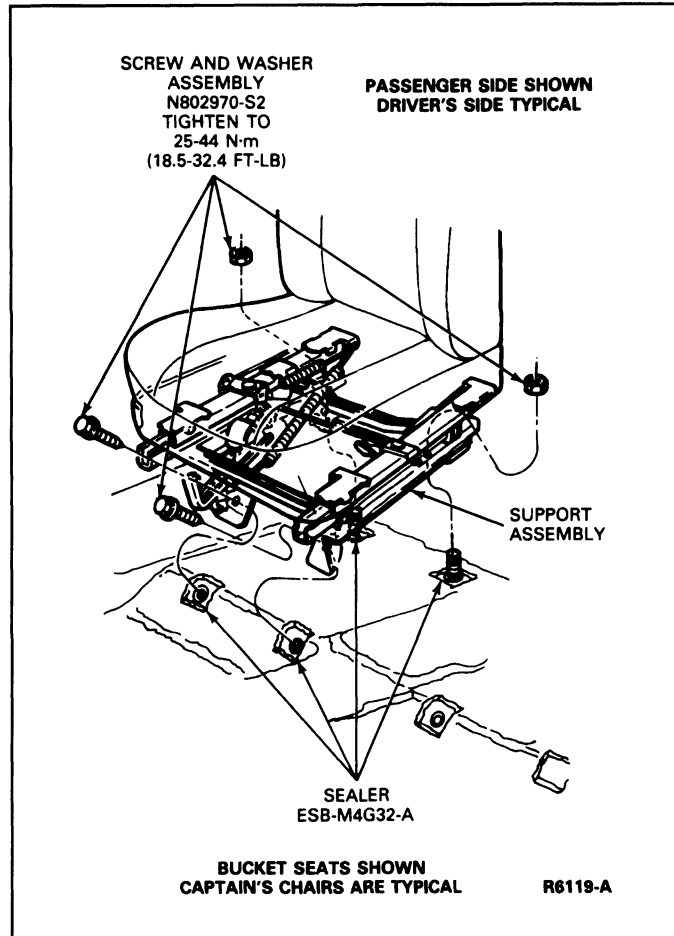
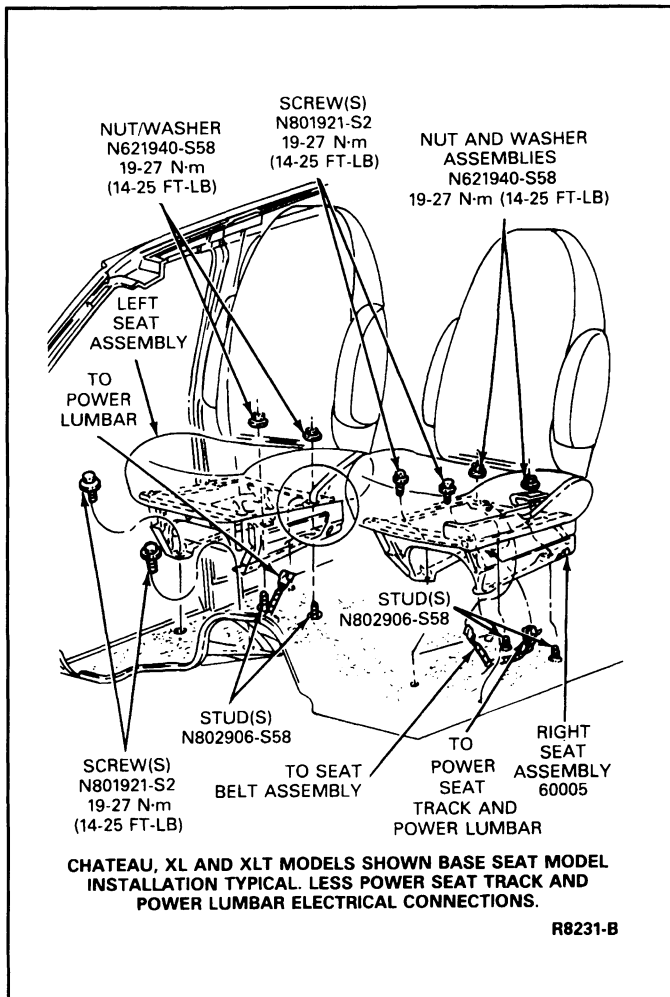
For installation, follow the removal procedure in reverse order. Apply Caulking Cord D6AZ-19560-A (ESB-M4G32-A) or equivalent around support screws, nuts and washers. Tighten seat and seat track nuts 19-27 N·m (14-20 ft-lb). Tighten support assembly-to-floorpan screws and nuts to 19-27 N·m (14-20 ft-lb).

Manual Seat



R8229-B

REMOVAL AND INSTALLATION (Continued)



Front Captain's Chairs, F-150-250-350 SuperCab and Bronco, Passenger Seats and Driver Seat

Removal and Installation

1. Remove support assembly-to-floor bolts.
2. Lift the seat and track assembly from vehicle.
3. Apply Caulking Cord D6AZ-19560-A (ESB-M4G32-A) or equivalent under the seat track assembly.
4. Position seat and track assembly on the floor and secure bolts.
5. Apply sealer around support assembly attaching bolt locations on floorpan. Tighten bolts to 25-44 N·m (19-32 ft-lb).

Front Seat Tracks, Bench Seat, F-150-250-350, F-Super Duty Chassis Cab and Bronco

CAUTION: Use care when handling seat and track assembly. Dropping assembly or sitting on seat when not secured in vehicle may result in damaged components.

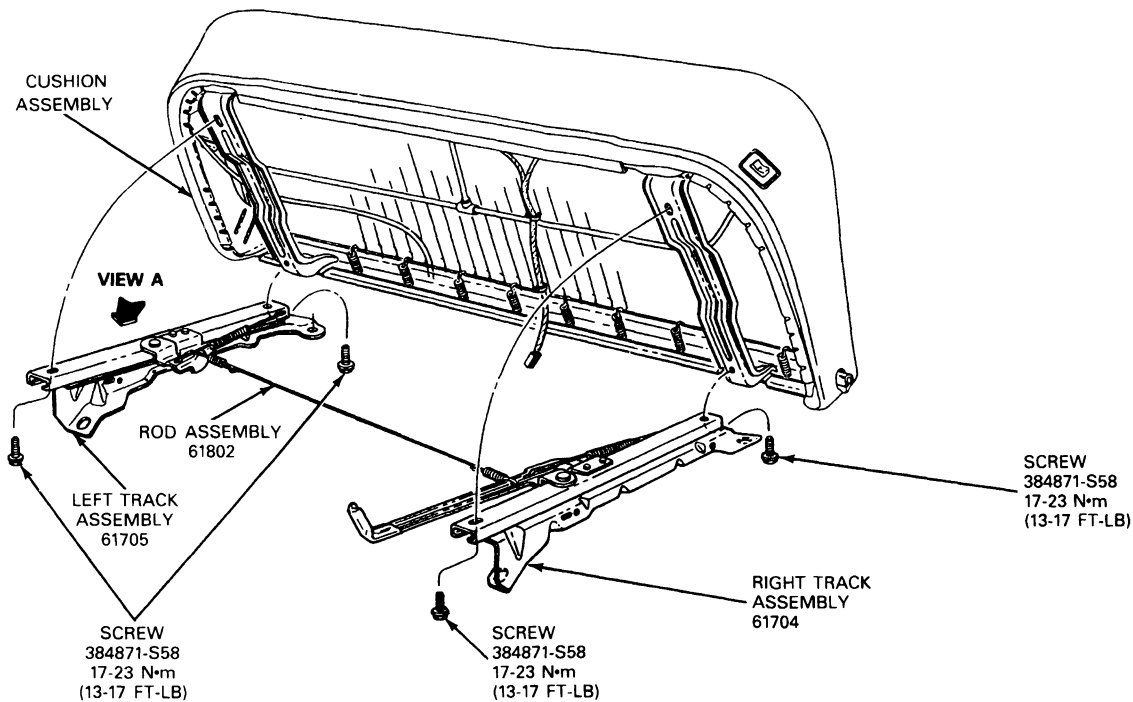
Removal and Installation

1. Remove the bench seat as described in this section.
2. Disconnect the seat track latch tie rod from the latches on the seat tracks.
3. Remove the seat track-to-seat cushion screws and remove the tracks from the cushion.

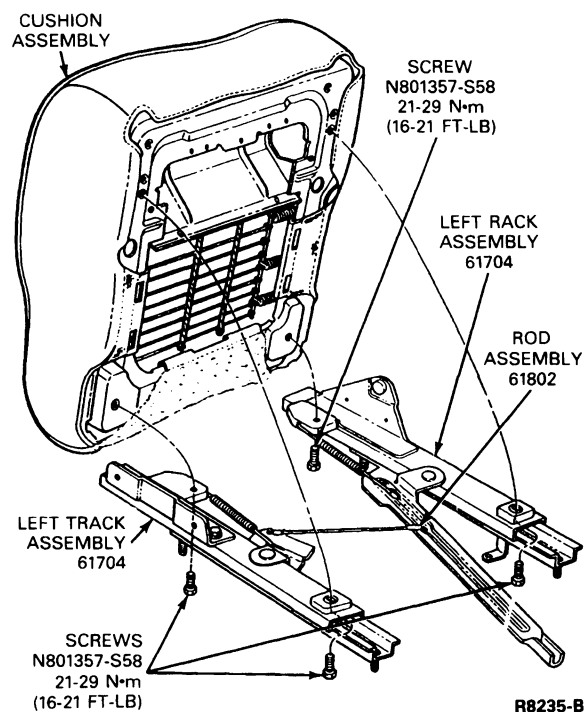
For installation, follow the removal procedure in reverse order. Tighten track-to-cushion screws to 17-23 N·m (13-17 ft-lb).

REMOVAL AND INSTALLATION (Continued)

Front Seat Track to Cushion



R8233-B



R8235-B

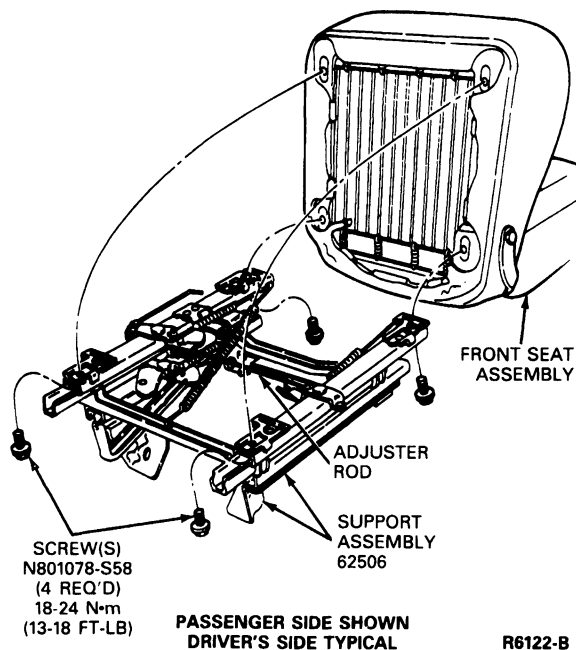
Front Seat Tracks, Bucket Seat, Driver and Passenger

Removal

1. Remove four seat track-to-floor bolts.
2. Lift the seat and track assembly from the vehicle as described in this section.
3. Remove track-to-seat screws, adjuster rod and separate seat from track.

Installation

1. Position the track assembly and adjuster rod to the seat and secure with attaching screws. Tighten screws to 18-24 N·m (13-17 ft-lb).
2. Apply Caulking Cord D6AZ-19560-A (ESB-M4G32-A) or equivalent around the seat track attaching bolt locations on floorpan.
3. Install seat and track assembly into the vehicle as described in this section.

REMOVAL AND INSTALLATION (Continued)**Seat Track to Cushion Assembly****Removal**

1. Remove retaining screws on both seat cushion side covers.
2. Remove both side covers.
3. Remove screws retaining recliner assembly to seat track assembly.
4. Remove seat back screw to seat track assembly.
5. Remove seat back.
6. Pull back a small portion of seat back cover exposing recliner assembly two screws to seat back.
7. Remove screws and recliner assembly.

Installation

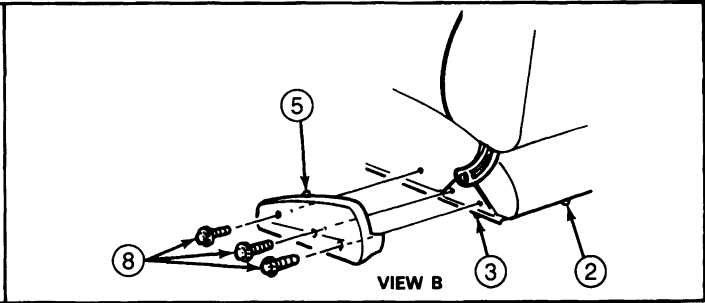
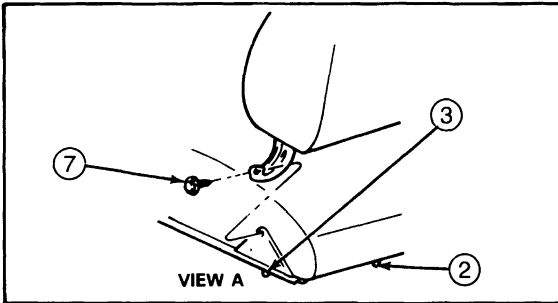
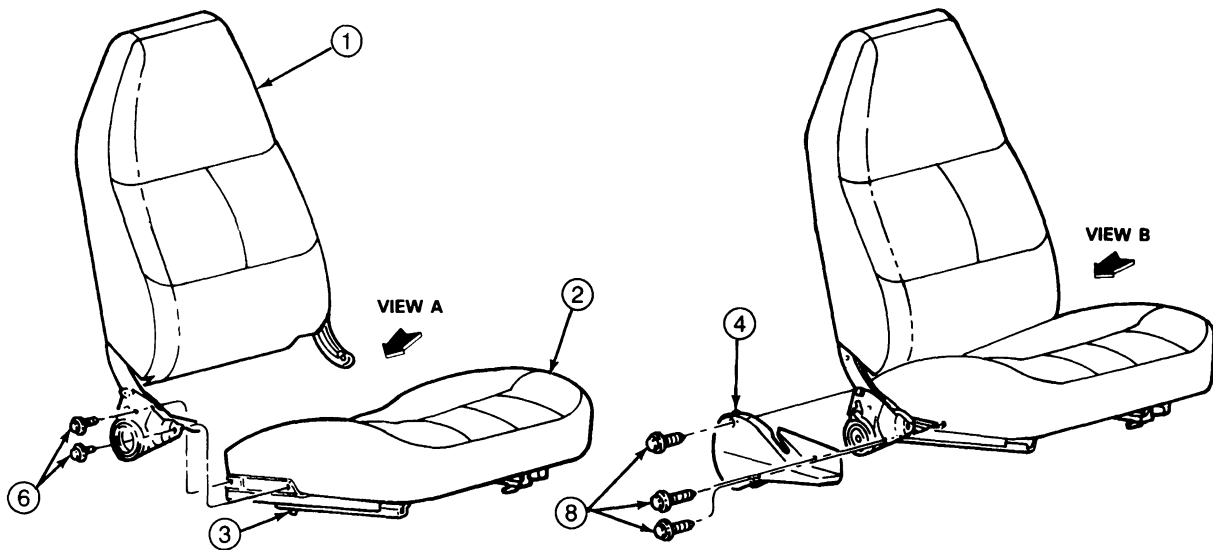
1. Position recliner assembly on seat back frame. Install retaining screw and tighten to 47-63 N·m (35-46 ft-lb).
2. Position seat back to seat track assembly and tighten screw to 21-28 N·m (16-21 ft-lb).
3. Position seat recliner to seat track assembly and tighten screws to 21-28 N·m (16-21 ft-lb).
4. Position side covers and tighten retaining screws to 1.6-2.2 N·m (14-19 in-lb).

Front Seat Back Adjuster, Recliner, E-150-250-350 Bucket / Captain's Chairs

The recliner assembly must be replaced as a unit. Service of the recliner components is not acceptable and should not be attempted.

REMOVAL AND INSTALLATION (Continued)

Recliner Pivot and Adjuster Covers



R8237-A

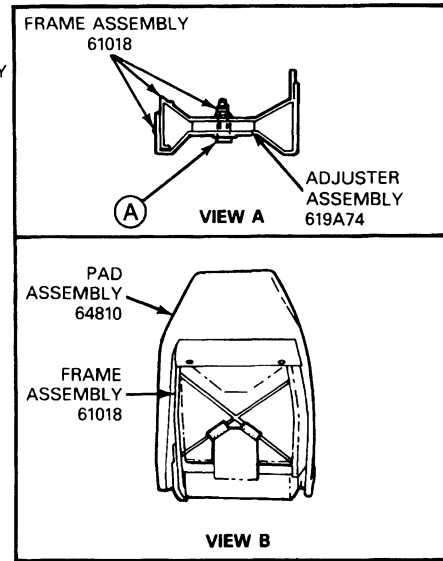
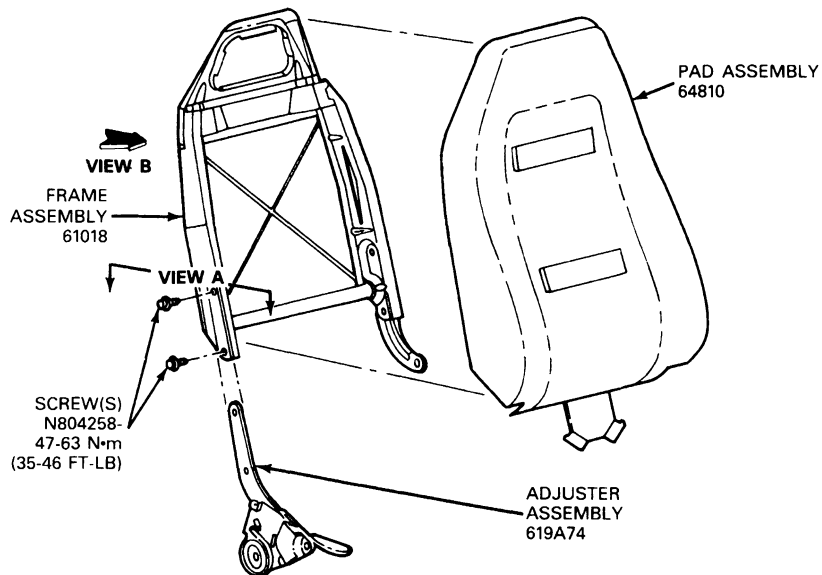
Item	Part Number	Description
1	Ref.	Back Assembly
2	Ref.	Cushion Assembly
3	Ref.	Track Assembly
4	62768	Latch Cover
5	61673	Pivot Cover

(Continued)

Item	Part Number	Description
6	N804258-S58	Screw 51-59 N-m (38-43 Ft-Lb)
7	N800476-S58	Screw 21-29 N-m (16-21 Ft-Lb)
8	56903-S58	Screw 1.6-2.2 N-m (14-19 In-Lb)

REMOVAL AND INSTALLATION (Continued)

Pad Frame and Adjuster Assemblies



R8239-B

Bench Seat Latch, F-150-250-350, F-Super Duty Chassis Cab

Removal

1. Remove attaching screws and trim cover from lower side of seat back (both sides).
2. Remove two latch-to-seat back attaching bolts.

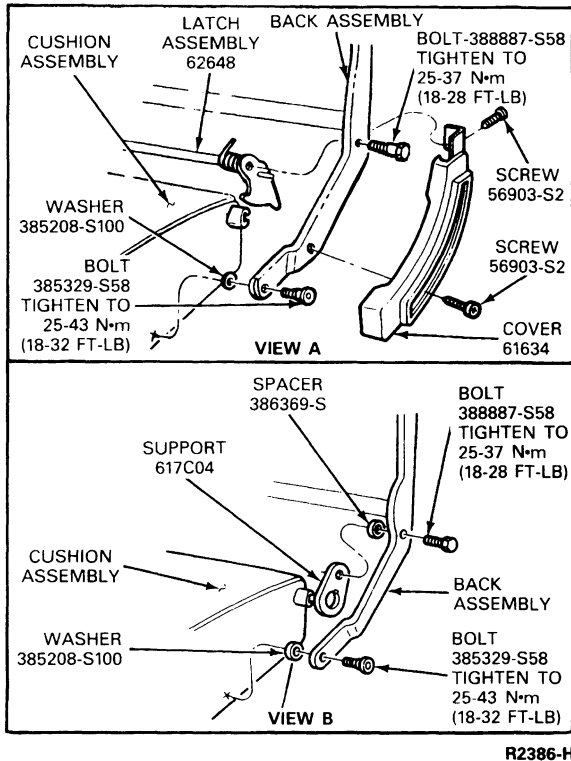
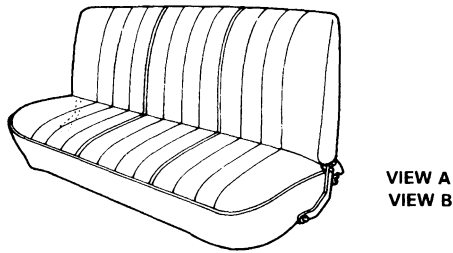
Installation

1. Install two attaching bolts.

NOTE: Springs (one each side) must rest against the bottom of the seat back and hook over the pawls on each end of the latch. Tighten upper bolt to 25-37 N·m (18-28 ft-lb) and the lower bolt to 25-43 N·m (18-32 ft-lb).

REMOVAL AND INSTALLATION (Continued)

2. Install trim cover using cover attaching screw.



2. Remove seat back-to-cushion attaching bolt and washer.
3. Remove back from vehicle.
4. Untrim back to gain access to latch mechanism. Refer to the seat trim part of this section.
5. To remove the rod assembly connecting the unlatching lever to the latch pawl, remove two screws and bundling strap.
6. Unhook rod from lever and pawl.
7. Cut and remove the pawl pivot pin.
8. Disconnect spring from seat back frame.

Installation

1. Insert a new pivot pin through holes in seat back and pawl.
 2. Flatten end of pin to retain in seat frame.
 3. Hook end of spring onto seat frame.
 4. Insert end of latch rod through hole in pawl.
 5. Push latch rod attachment screws through holes in attaching tabs on rod.
 6. Install to seat frame.
 7. Insert ends of rod into proper holes in the lever and pawl.
 8. Install untrimmed seat back frame to cushion and adjust gap between pawl and striker by rotating center portion of the rod assembly.
- NOTE:** The gap between the pawl and striker must be 1.27-1.77mm (0.05-0.07 inch). Remove seat frame from cushion and retrim.
9. Install trimmed seat back to cushion by inserting attaching bolt through hole at end of the arm sticking out of the trimmed back.
 10. Slide washer over the end of the bolt, slide back onto inboard pivot pin and drive attachment bolt. Tighten bolt to 25-43 N·m (18-32 ft-lb). Check gap and adjust if necessary.

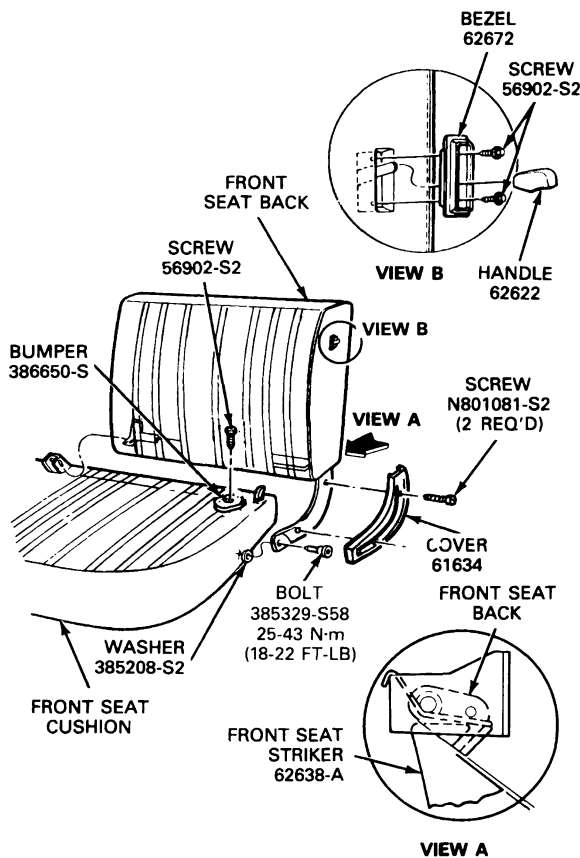
Bench Seat Latch, Bronco and F-150-250-350 SuperCab**Removal**

1. Remove attaching screws and cover from lower side of seat back.

REMOVAL AND INSTALLATION (Continued)

11. Position trim cover and install two screws.

NOTE: The cable assembly is to be adjusted, if required, to produce the 2.5mm (0.10 inch) max. gap between the front seat back latch pawl and the front seat back latch striker.

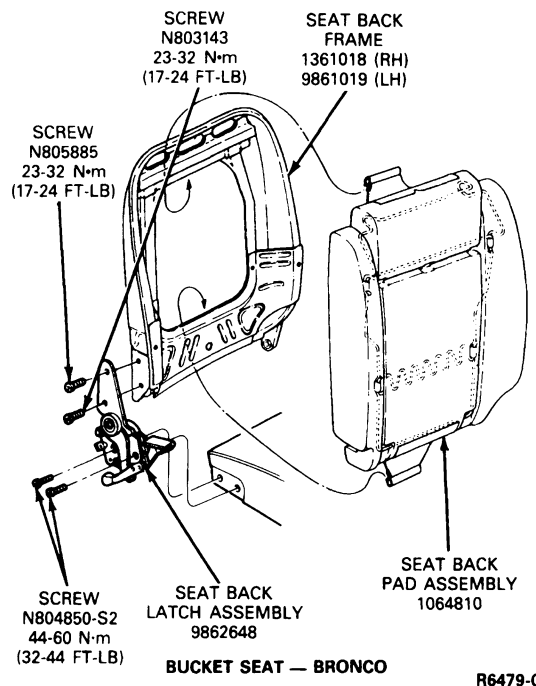


R1903-H

4. Remove latch assembly.

Installation

1. Position latch assembly on lower seat assembly.
2. Install the lower two screws and tighten to 44-60 N·m (32-44 ft-lb).
3. Position latch to upper seat back and install two screws. Tighten to 23-32 N·m (17-24 ft-lb).
4. Install seat back pad assembly.



R6479-C

Front Bucket Seat Back Latch, Bronco**Removal**

1. Remove seat back pad assembly.
2. Remove the upper two screws securing latch to seat back frame.
3. Remove the two lower screws securing latch to lower seat assembly.

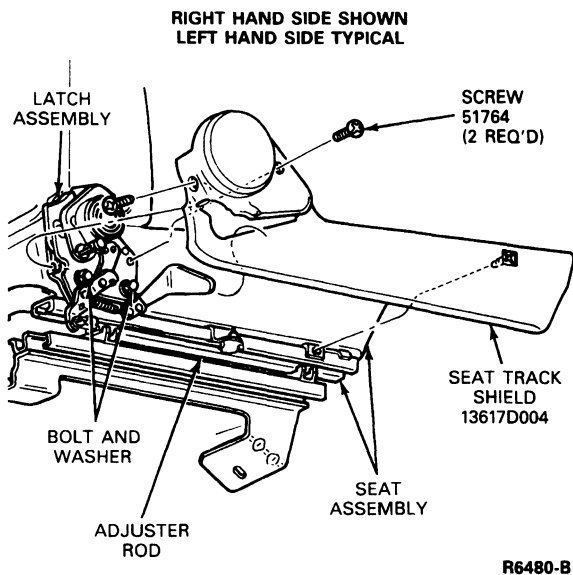
Front Seat Back Latch, Bronco and F-150-250-350**Removal**

1. Remove two screws securing cover to latch assembly. Pull cover free from seat assembly at opposite end.

REMOVAL AND INSTALLATION (Continued)

2. Remove two bolts securing latch assembly to seat and remove latch.

For installation, follow removal procedure in reverse order.

**Striker****Removal**

1. Dump seat back forward.
2. Untrim rear corner of seat cushion.
3. Remove two attaching bolts and striker from seat cushion.

Installation

1. Install two attaching bolts and tighten to 17-27 N·m (9-18 ft-lb).
2. Retrim rear corner of seat cushion.
3. Adjust gap between pawl and striker by reaching up inside trimmed back and rotating latch rod adjustment until gap is 1.27-1.77 mm (0.05-0.07 inch).

ADJUSTMENTS**Recliner, Manual**

The manual recliner system is modular and does not require adjustments. However, proper lubrication of a hesitant seat back recliner assembly is permitted using Multi-Purpose Grease DOAZ-19584-AA or equivalent.

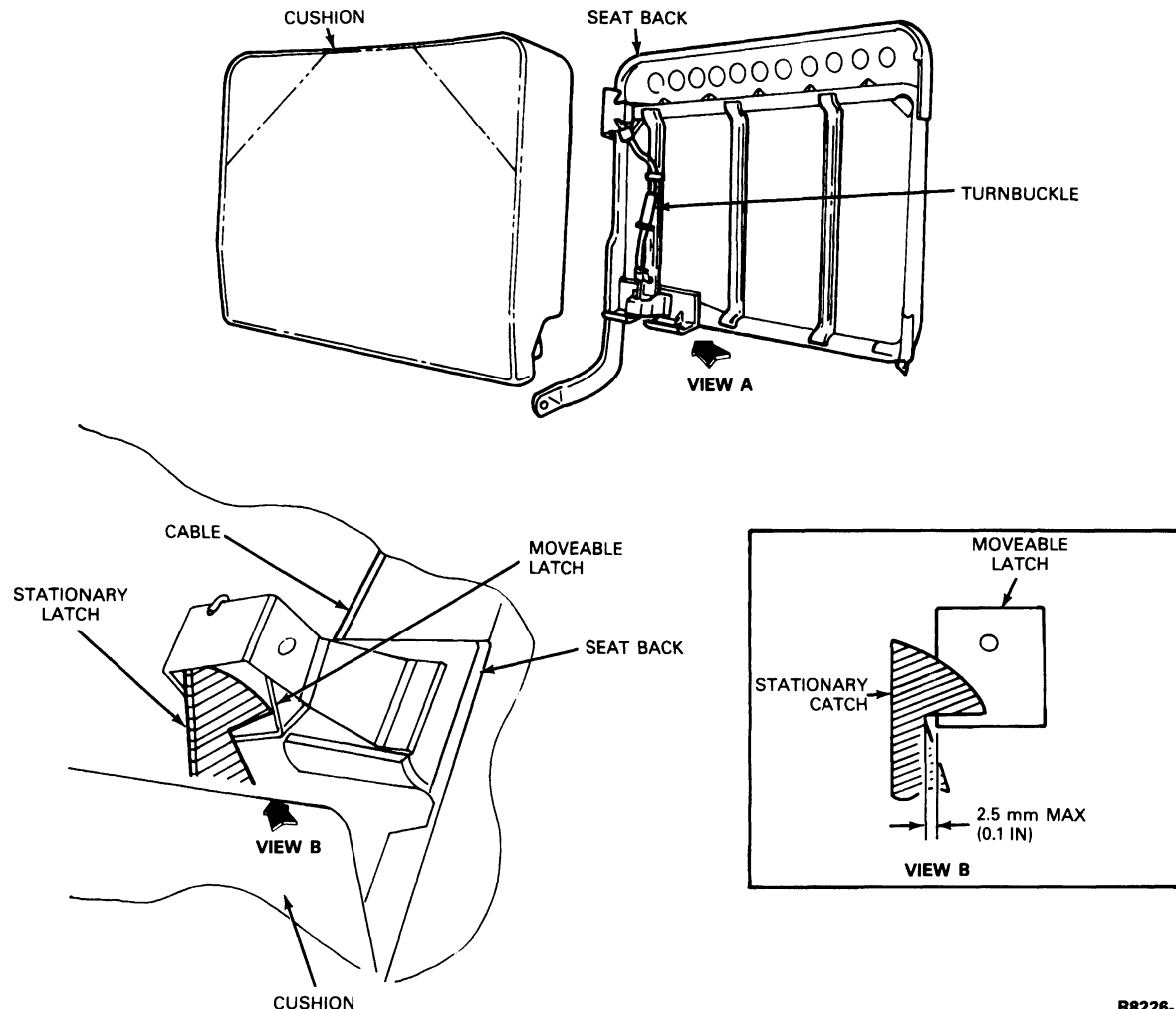
The only authorized service permitted on the recliner mechanism is the following:

1. Tightening of all retaining screws to specification indicated in Removal and Installation.
2. Replacement (in entirety) of a damaged or non-functional recliner assembly.
3. Removal of any foreign material, such as tie straps, pieces of foam and trim.

Front Folding Seat Back, F-Series SuperCab

If the front folding seat back does not return to the locked position, then the locking mechanism is improperly adjusted. The mechanism contains a cable from the handle to the latch that can be shortened or lengthened by turning a turnbuckle in the seat. To adjust perform the following:

1. Unzip the seat back cover and pull cover up as far as possible on the outboard side.
2. Move the pad out of the way to gain access to the turnbuckle shown in the illustration.
3. Turn the turnbuckle by hand, clockwise to shorten or counterclockwise to lengthen.
4. Adjust so that stationary catch and moveable latch are no more than 2.5 mm (0.1 inch) apart as shown.
5. Check for proper operation and reassemble seat.

ADJUSTMENTS (Continued)**Front Folding Seat Back, F-Series SuperCab**

R8226-A

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N-m	Lb-Ft
Track Assembly to Floorpan Nut(s), F-Series	34-46	25-34
Track Assembly Screw(s) / Washer(s), F-Series	34-46	25-34
Manual Seat Seat-to-Track Nut(s) / Washer(s), E-Series	19-27	14-25
Power Seat(s) Screw(s)-to-Floorpan, E-Series	19-27	14-25
Support-to-Floorpan Nut(s), E-Series	19-27	14-25
Captain's Chair Support-to-Floorpan Screw(s) / Washer(s), F-Series	25-44	19-32
Bench Seat Track-to-Cushion Screw(s)	17-23	13-17

(Continued)

TORQUE SPECIFICATIONS (Cont'd)

Description	N-m	Lb-Ft
Bucket Seat(s) Track-to-Cushion Screw(s), E-Series	21-29	16-21
Bucket Seat(s) Track-to-Cushion Screw(s), F-Series	18-24	13-18
Latch Cover Screw(s)	1.6-2.2	14-19
Recliner Assembly Screw(s)	51-59	38-43
Back Assembly to Latch Screw(s)	21-29	16-21
Recliner Assembly to Seat Back Frame Screw(s)	47-63	35-46
Bench Seat Back to Latch Screw(s)	25-37	18-28
Cushion Assembly to Latch Screw(s)	25-43	18-32
Striker Bolts(s)	17-27	9-18

SECTION 01-10B Seats and Anchors, Rear and Seat Back Latch

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Conventional Rear Seats	01-10B-1	Rear Bench Seat, F-350 Crew Cab	01-10B-4
Folding Rear Seats	01-10B-1	Rear Fold-Down Seat, Bronco	01-10B-7
DIAGNOSIS AND TESTING.....	01-10B-2	Rear Quad Buckets, Econoline.....	01-10B-3
REMOVAL AND INSTALLATION		Rear Seat Latch.....	01-10B-10
Forward-Facing Rear Seat, F-150-250-350		Rear Seat Tracks, F-350 Crew Cab.....	01-10B-4
SuperCab.....	01-10B-5	Side-Mounted Folding Rear Seat,	
Front Cushion and Armrest Assembly,		F-150-250-350 SuperCab.....	01-10B-10
Seat/Bed, E-150-250-350	01-10B-7	SPECIFICATIONS.....	01-10B-13
Quick Release Rear Seat, Three and Four		VEHICLE APPLICATION	01-10B-1
Passenger Bench/Bed,			
E-150-250-350	01-10B-2		

VEHICLE APPLICATION

All E-150-250-350, F-150-250-350 SuperCab, Crew Cab and Bronco Vehicles

DESCRIPTION AND OPERATION

Conventional Rear Seats

On E-Series, quick release rear bench and bed seats are held to the floor by the engagement of the rear retainer with the rear striker and the engagement of a latch rod hook with the front striker. The rear quad buckets release by pulling the handle on the right side of the seats and sliding the seat toward the right side of the vehicle. The quick release facilitates removal of the rear seat.

Folding Rear Seats

SuperCab

SuperCab models have optional folding side-mounted rear seats which are designed to fold upward against the side of the cab for storage. A forward-facing folding rear seat which converts to a load floor is optional with F-150 and F-350 SuperCab models. The back of the seat is held in an upright position by a latch mounted on the inside rear of the cab. The bottom of the seat pivots to lie flat against supporting bumpers.

Bronco

The Bronco has an optional fold-down rear seat. A seat back latch on the lower right side of the rear seat is lifted to unlock the seat back. The seat back is folded to the cushion. A cushion latch located at the center rear of the cushion is lifted to unlock the cushion from the floor-mounted striker. The cushion folds forward to provide a flat storage area.

E-150-250-350

E-150-250-350 models have an optional rear seat / bed. A latch is provided to convert the seat to a bed.

Seat Back Latch

All folding seats have a latch designed to hold the seat back in the normal position.

The rear seats can be folded down in order to gain access to the storage compartment (F-Series and Bronco).

DIAGNOSIS AND TESTING

If the seat back will not latch in position or the latch mechanism will not unlock, it may be necessary to remove the side shield and/or remove the seat back trim cover far enough to inspect the latch mechanism. Then, replace any parts to put the latch system in proper working order.

REMOVAL AND INSTALLATION

Quick Release Rear Seat, Three and Four Passenger Bench/Bed, E-150-250-350

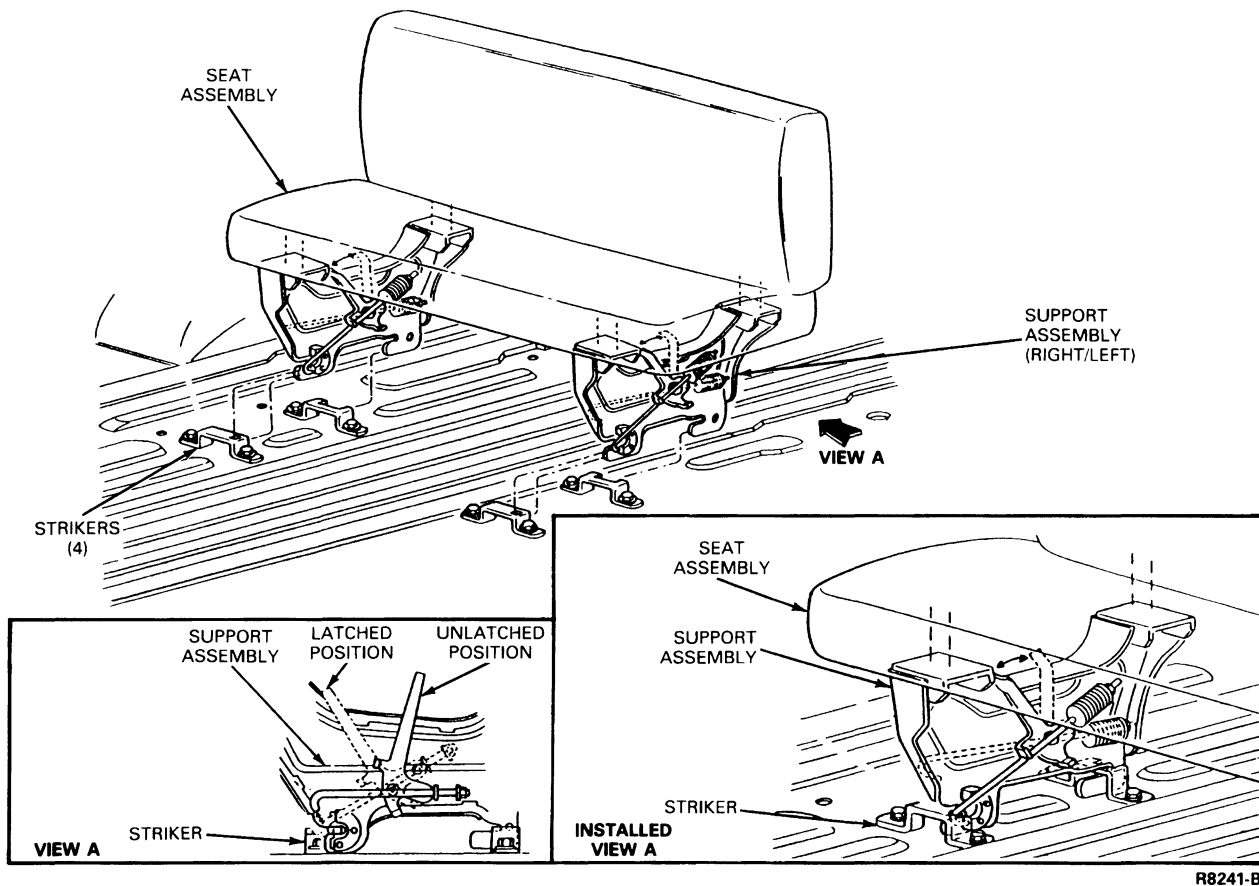
Removal and Installation

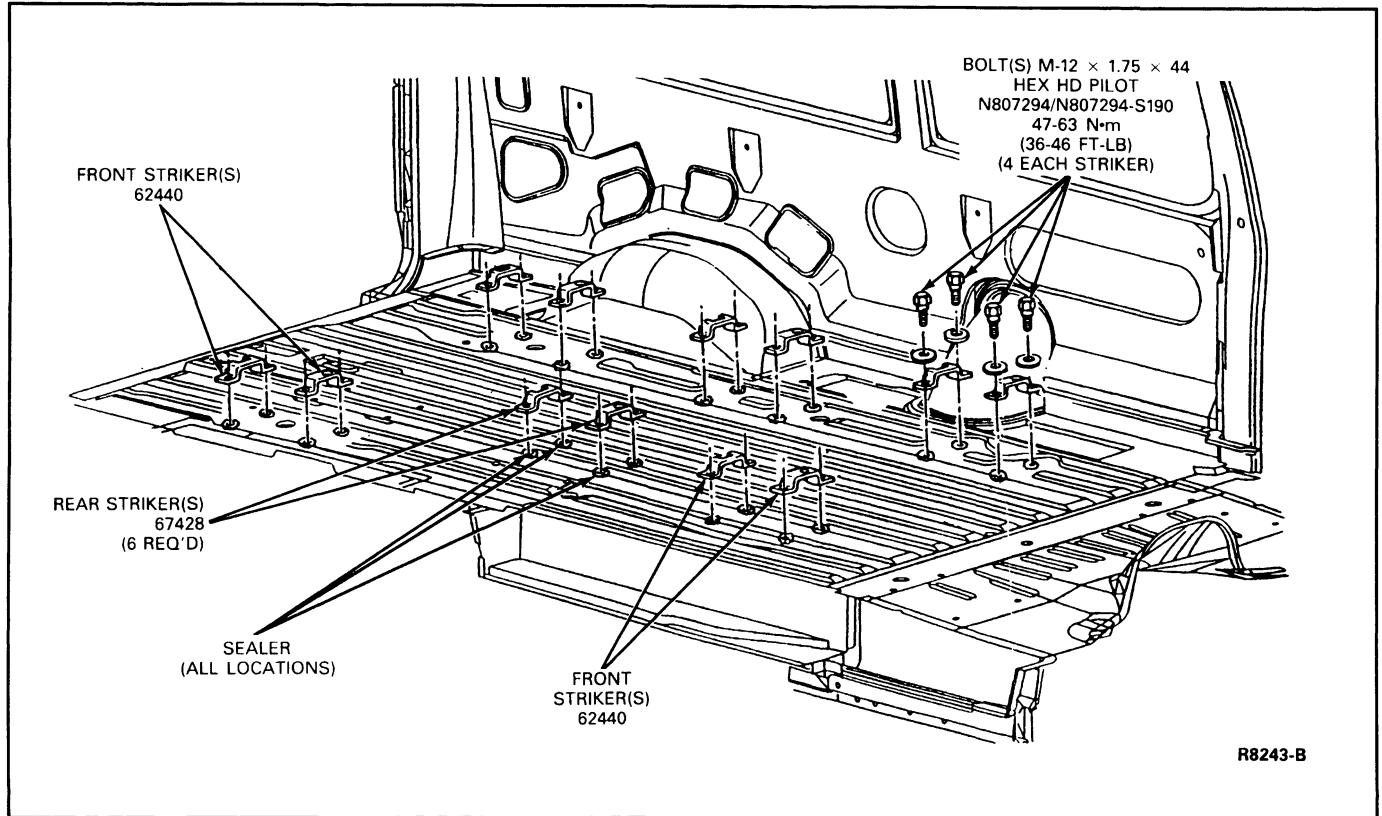
1. Rotate right and left seat latch handles rearward and move seat rearward.
2. Disengage seat from floor strikers.
3. Lift right and left latch rod hook ends out of the floor locking holes.

4. On the bed seat, rotate support assembly rear hook out of the striker before lifting front hook.
5. Remove the seat assembly from vehicle.
6. If removing floor striker, remove attaching bolts and washers.

For installation, follow the removal procedure in reverse order. Apply a bead of Ford Caulking Cord D6AZ-19560-A (ESB-M4G32-A) or equivalent to the floorpan side of washers. Tighten the striker bolts to 59-81 N·m (44-60 ft-lb).

Rear Seat Assembly to Floor

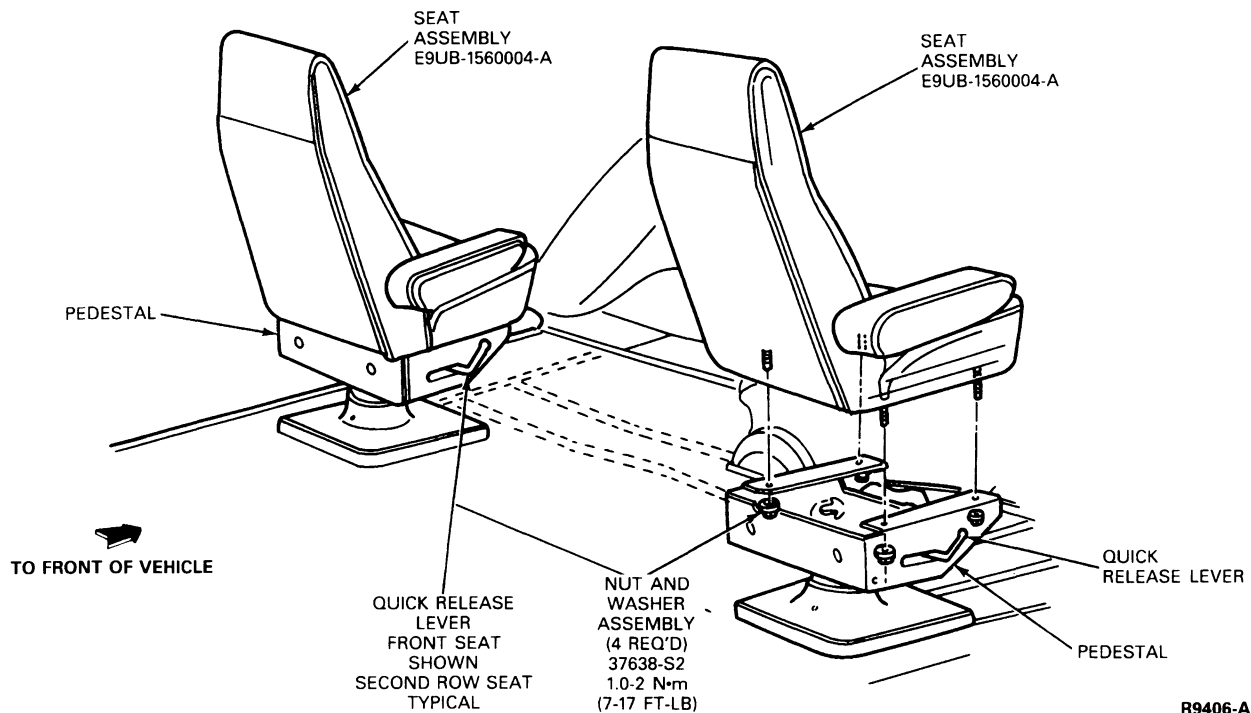


REMOVAL AND INSTALLATION (Continued)**Rear Quad Buckets, Econoline****Removal and Installation**

1. Pull handle, located on right side of pedestal, rearward and slide seat toward right side of vehicle.

2. If removing the seat cushion from pedestal, remove the four attaching nuts and washers.
3. Remove seat cushion.

For installation, follow the removal procedure in the reverse order.

REMOVAL AND INSTALLATION (Continued)**Rear Quad Buckets, Econoline**

WARNING: KEEP STRIKER AREA FREE OF FOREIGN OBJECTS THAT WOULD PREVENT FRONT AND REAR RETAINERS FROM PROPERLY ENGAGING THE STRIKERS. NEVER ATTEMPT TO ADJUST THE SEAT LATCH WHILE THE VEHICLE IS IN MOTION. PRIOR TO OCCUPYING THE SEAT, CHECK TO SEE THAT THE HOOK END OF THE LATCH RODS AND HANDLES ARE LATCHED SECURELY TO THE STRIKERS TO ENSURE PROPER SEAT RETENTION.

Rear Bench Seat, F-350 Crew Cab**Removal and Installation**

1. Remove the seat track-to-floorpan retaining screws (two on each side) and lift the seat and track assembly out of the vehicle.

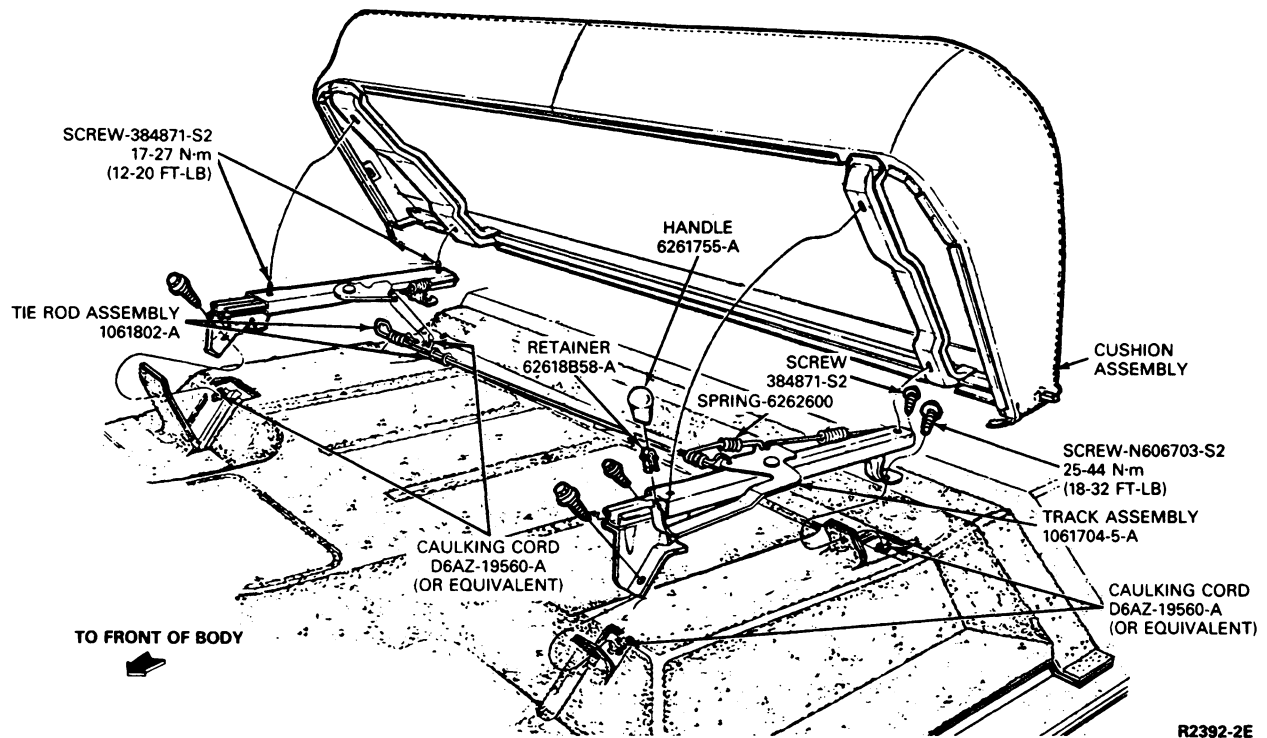
For installation, follow removal procedure in reverse order. Apply Caulking Cord D6AZ-19560-A (ESB-M4G32-A) or equivalent under seat track assembly. Tighten the screws to 25-44 N·m (18-32 ft-lb).

Rear Seat Tracks, F-350 Crew Cab**Removal and Installation**

1. Remove the bench seat as described in this section.
2. Disconnect the small tension spring from the left seat track and the tie rod.
3. Disconnect the seat track latch tie rod from the latches on the seat tracks.
4. Remove the seat track-to-seat cushion screws and remove the tracks from the cushion.

CAUTION: Use care when handling a seat and track assembly. Dropping assembly or sitting on seat when not secured in vehicle may damage seat track components.

For installation, follow removal procedure in reverse order. Lubricate the seat track assemblies using Multi-Purpose Grease D0AZ-19584-AA (ESR-M1C159-A or ESB-M1C93-A) or equivalent. Tighten track-to-cushion screws 17-27 N·m (12-20 ft-lb).

REMOVAL AND INSTALLATION (Continued)**Rear Seat Tracks, F-350 Crew Cab****Forward-Facing Rear Seat, F-150-250-350 SuperCab****Removal and Installation**

1. Release latch and put the rear seat back in the fold-down position.
2. Remove the screw and washer assemblies that fasten the pad to the seat back.
3. Lift up seat back and remove the pad.
4. Remove panel and support assembly-to-floor screws and washers.
5. Pull latch release strap and remove rear seat cushion assembly.
6. If removing release latch, remove four attaching screws and remove the latch.

NOTE: Screws run through panel and support assembly and into latch assembly.

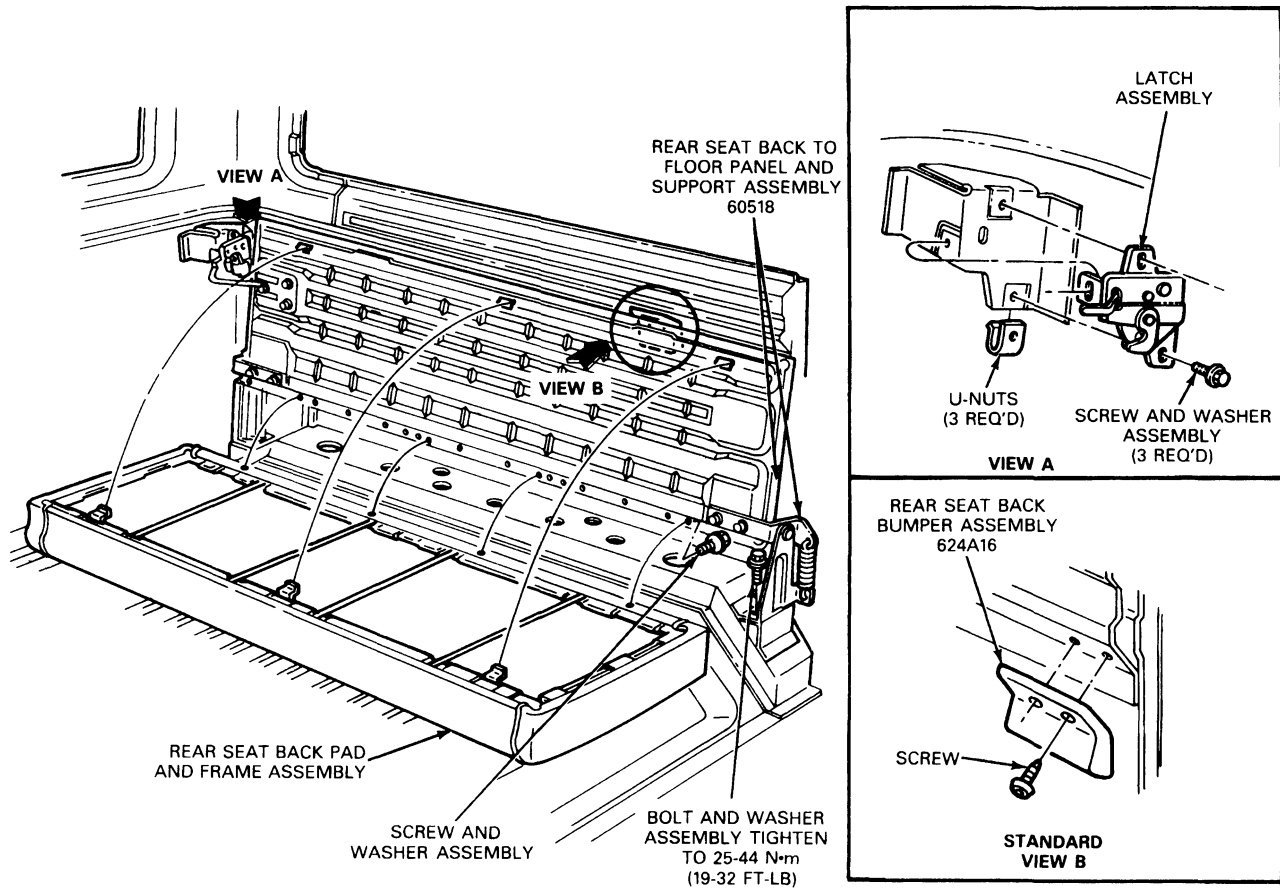
7. Move cushion so bottom panel is toward you.
8. Remove cushion screws to panel and support assembly.
9. Feed latch release strap through cover and cushion.
10. Remove cushion.

For installation, follow the removal procedures in reverse order.

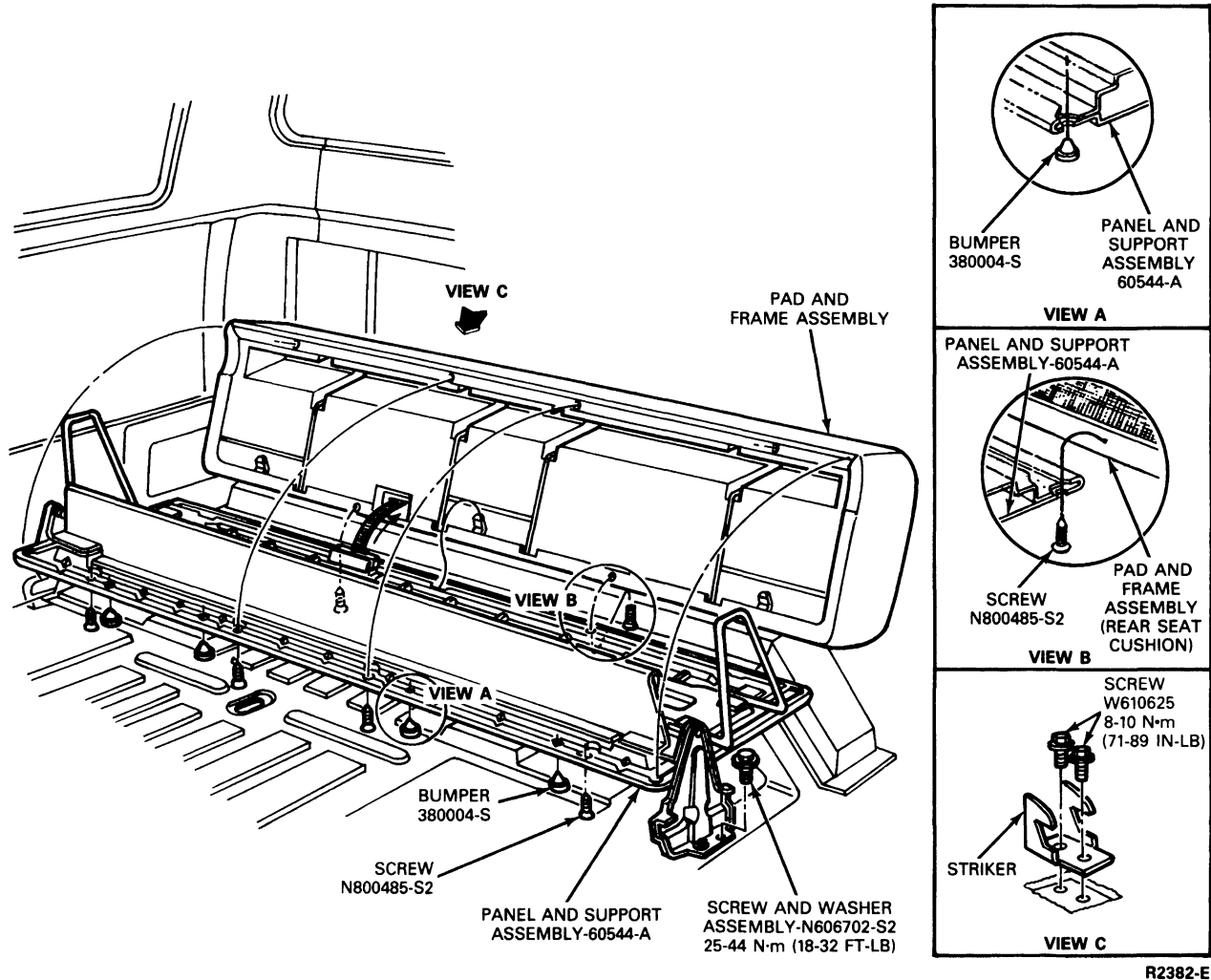
NOTE: Rear seat latching effort is 4-25 pounds static force applied adjacent striker.

REMOVAL AND INSTALLATION (Continued)

Forward-Facing Rear Seat



R2980-C

REMOVAL AND INSTALLATION (Continued)**Rear Seat Cushion Panel and Support Assembly**

R2382-E

**Front Cushion and Armrest Assembly,
Seat/Bed, E-150-250-350****Removal and Installation**

1. Detach rear latch wire from the front latch.
2. Remove four nuts attaching seat cushion to frame assembly.
3. Remove seat cushion from frame assembly.
4. Remove four bolts and nuts attaching the seat back to the frame assembly.
5. Remove seat back from frame assembly.

For installation, follow the removal procedure in reverse order. Tighten seat cushion nuts to 17-27 N·m (12-20 ft-lb). Tighten screws to 11-21 N·m (8-16 ft-lb).

NOTE: Cross-tighten screws for proper seat / bed operation.

Rear Fold-Down Seat, Bronco**Removal and Installation**

1. Unlock the latch and move the seat assembly up.
2. Remove bracket-to-the floor bolts.
3. Remove spring plug buttons. Remove spring bolts.
4. Remove the spring, the washer and the retainer from the bracket.
5. Remove the seat assembly.
6. Remove seat back-to-cushion screws.
7. Remove the seat back.
8. Remove the seat back according to this procedure.
9. Remove the torsion spring.
10. Remove the torsion spring from both brackets.

REMOVAL AND INSTALLATION (Continued)

11. Slide the cushion off the pivot pins in the bracket assemblies.

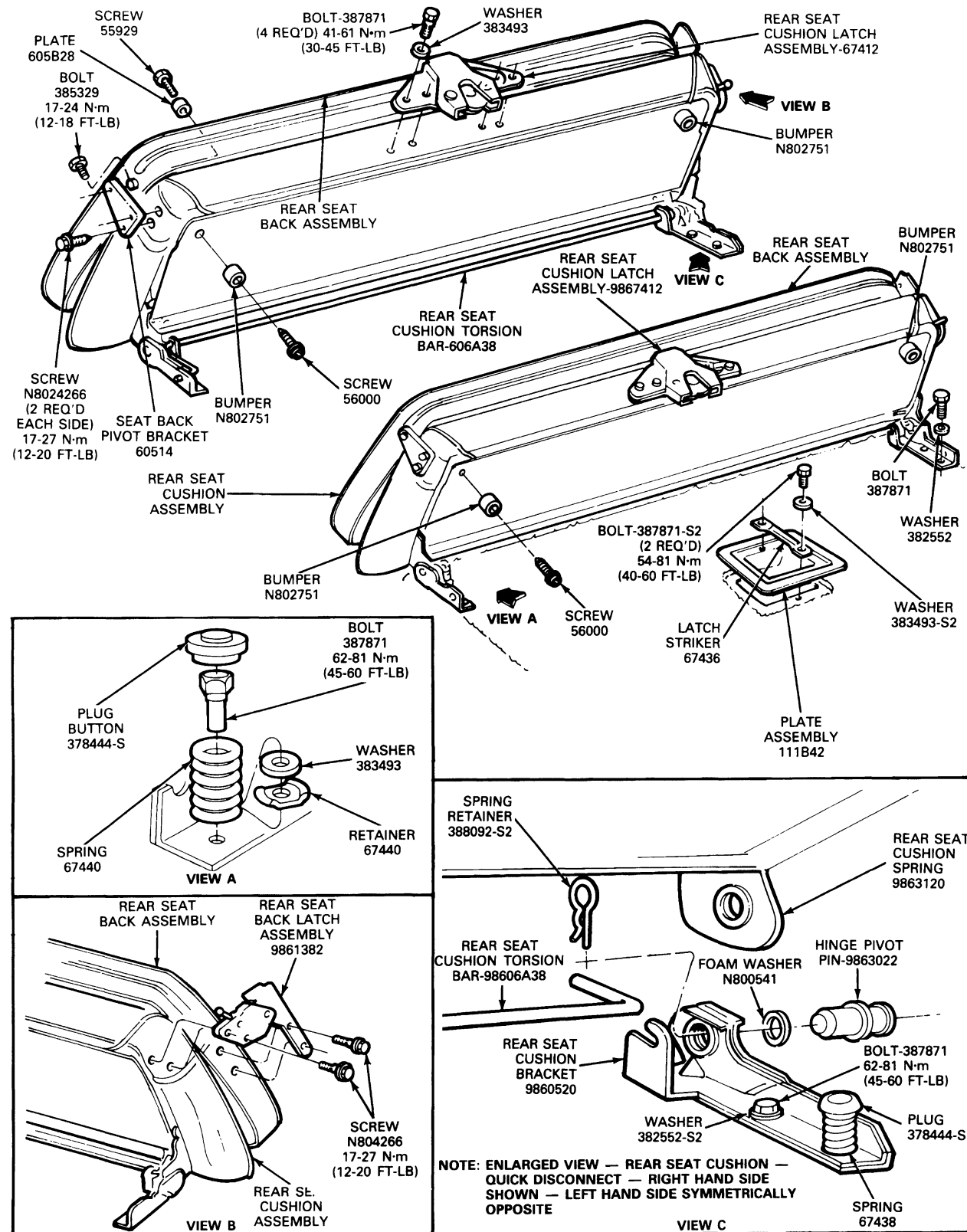
12. Remove the cushion.

For installation, follow the removal procedure in the reverse order. Tighten seat back to cushion screws 17-27 N·m (12-20 ft·lb). Tighten spring bolts to 62-81 N·m (45-60 ft·lb). And, tighten bracket-to-floor to 62-81 N·m (45-60 ft·lb).

13. Check the seat for correct operation.

REMOVAL AND INSTALLATION (Continued)

Rear Fold-Down Seat, Bronco



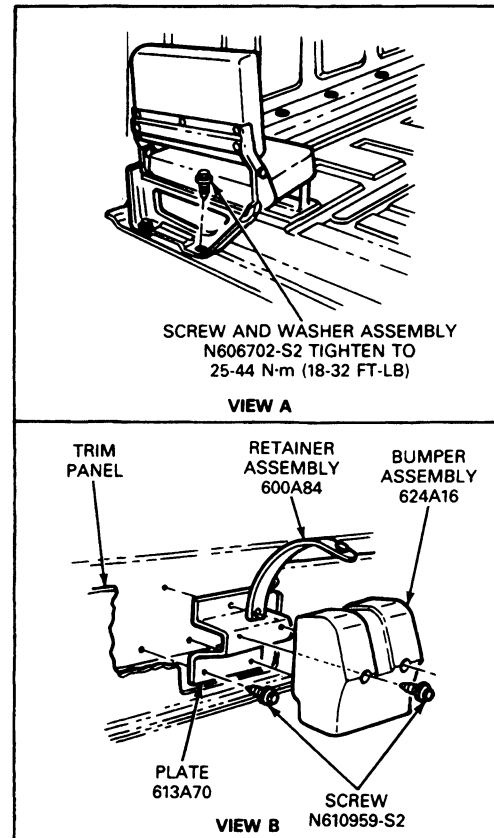
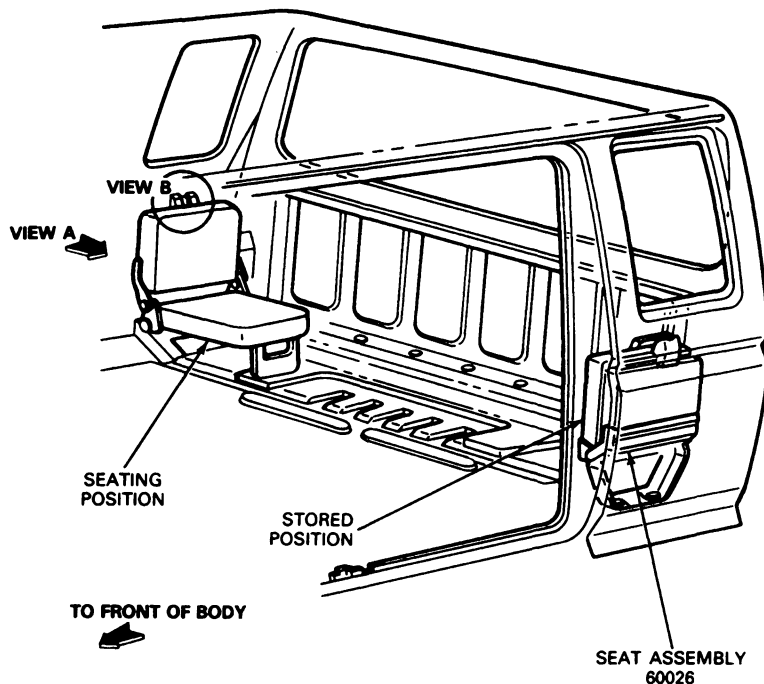
R2143-L

REMOVAL AND INSTALLATION (Continued)**Side-Mounted Folding Rear Seat,
F-150-250-350 SuperCab****Removal and Installation**

1. Remove seat bracket-to-floor screw and washer assemblies.
2. Remove the seat assembly.

3. Remove bumper screws to retainer.
4. Remove the bumper.
5. Remove retainer screws to trim panel.
6. Remove the retainer assembly.

For installation, follow removal procedure in reverse order. Tighten screw and washer assemblies to 25-44 N·m (18-32 ft-lb)

Side-Mounted Folding Rear Seat

R2383-28

Rear Seat Latch**Removal and Installation**

1. Remove latch-to-seat back attaching bolts or screws.

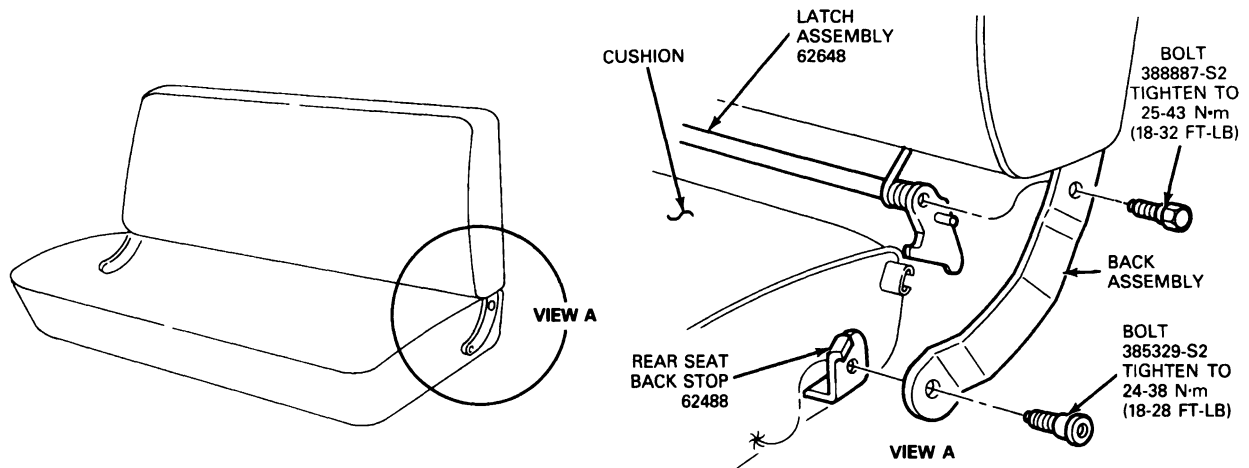
NOTE: On the F-350 Crew Cab, make sure that springs (one each side) rest against the bottom of the seat back and are hooked over the pawls on each end of the latch.

For installation, follow the removal procedure in reverse order. On F-350 Crew Cab, tighten upper latch assembly bolt to 25-43 N·m (18-32 ft-lb) and cushion-to-latch assembly to 24-38 N·m (18-28 ft-lb).

On Bronco, tighten latch bolts to 17-24 N·m (12-20 ft-lb) and screws to 17-27 N·m (12-20 ft-lb).

REMOVAL AND INSTALLATION (Continued)

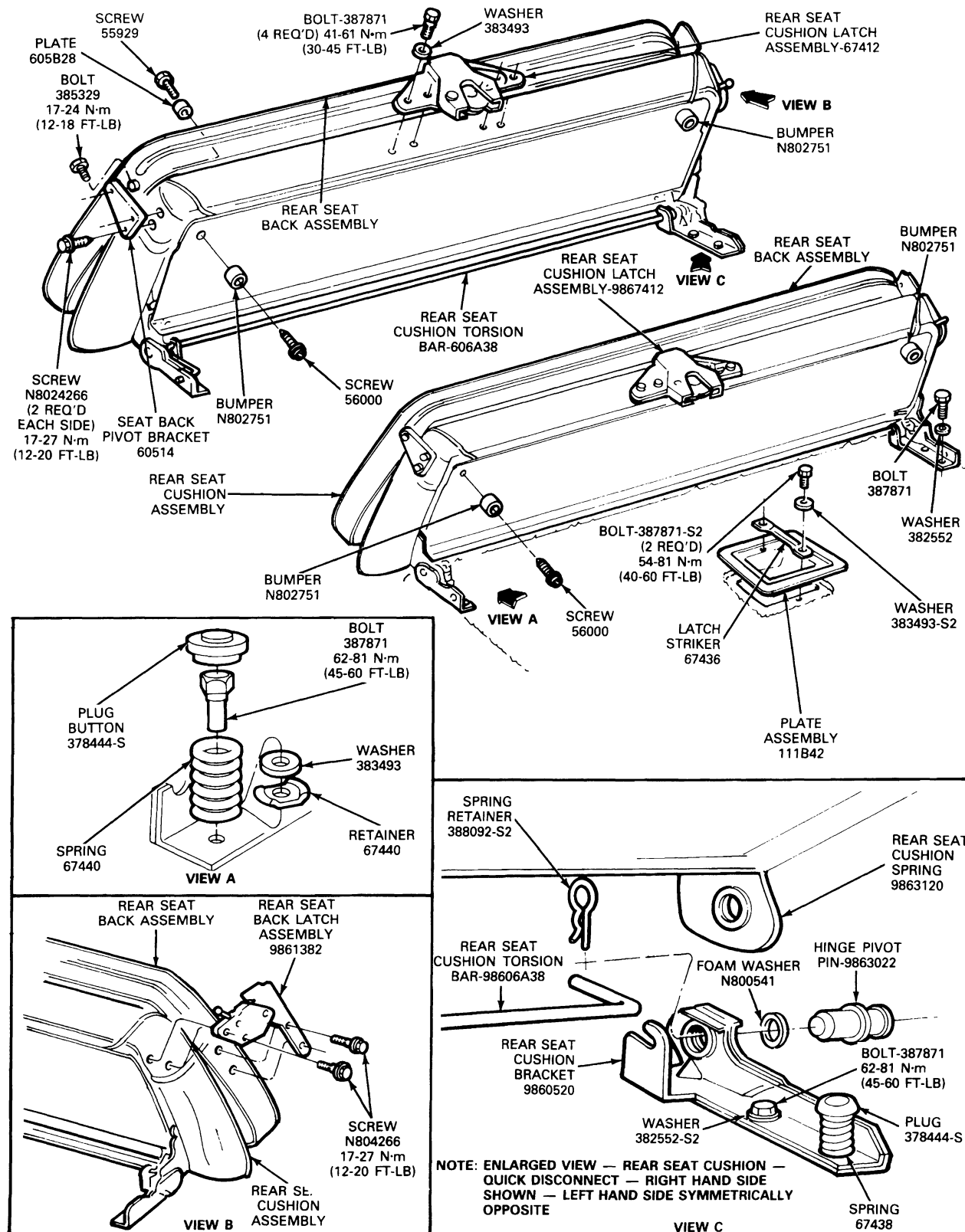
Rear Seat Latch, F-350 Crew Cab



R3771-C

REMOVAL AND INSTALLATION (Continued)

Rear Seat Back Latch, Bronco



R2143-L

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N-m	Lb-Ft
Floor Striker Bolts (E-Series)	59-81	44-60
Bench Seat Screws (F-350 Crew Cab)	25-44	18-32
Track-to-Cushion Screws (F-350 Crew Cab)	17-27	12-20
Rear Seat-to-Floor Panel Bolt and Washer Assembly (F-150-250-350 SuperCab)	25-44	19-32
Pad and Frame Assembly Screw and Washer (F-150-250-350 SuperCab)	25-44	19-32
Seat Cushion Nuts (E-150-250-350)	17-27	12-20
Seat Back-to-Frame Screws (E-150-250-350)	11-21	8-16
Seat Back to Cushion Screws (Bronco)	17-27	12-20

(Continued)

TORQUE SPECIFICATIONS (Cont'd)

Description	N-m	Lb-Ft
Spring Bolts (Bronco)	62-81	45-60
Bracket-to-Floor Bolts and Washers (Bronco)	62-81	45-60
Side Folding Seat Screw and Washer Assemblies (F-150-250-350 SuperCab)	25-44	18-32
Rear Seat Latch-to-Seat Back Bolts (F-350 Crew Cab)	25-43	18-32
Rear Seat Back Stop Bolt (F-350 Crew Cab)	24-38	18-28
Rear Seat Back Latch Screws (Bronco)	17-27	12-20
Rear Seat Cushion Latch Bolts	41-61	30-45

SECTION 01-10C Seat Trim

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION		REMOVAL AND INSTALLATION (Cont'd.)	
Seat Cushion and Back Cover Trim, Bucket		Style and Color Codes	01-10C-1
Seat	01-10C-2	VEHICLE APPLICATION	01-10C-1
Seat Cushion Cover Trim, Bench Seat	01-10C-4		

VEHICLE APPLICATION

All E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco Vehicles

REMOVAL AND INSTALLATION

Style and Color Codes

When replacing seats and /or trim, always make sure the correct type of seat and color is ordered. See the Trim Codes on the Safety Compliance Certification Label on the passenger's side door. For coding information, refer to Section 00-01.

BODY CODES
BRONCO, LIGHT TRUCK,
(F-150 – F-250 – F-350 –
F-SUPER DUTY CHASSIS CAB)
MFD. BY FORD MOTOR CO. IN U.S.A.

DATE:GVWR:
FRONT GAWR:REAR GAWR:

WITH
TIRES
RIMS

WITH
TIRES
RIMS

AT PSI COLDAT PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF
MANUFACTURE SHOWN ABOVE

VIN:
TYPE:

1D7A

EXTERIOR PAINT COLORS

WBTYPE GVWBODYTRANSAXLETAPE SPRING
133F252LG4F342B2D29

DSO

LJ4

SEAT TRIM
AND STYLE

TRIM
COLOR

F-SERIES ONLY
CAB/BACK OF CAB

CR6114-B

REMOVAL AND INSTALLATION (Continued)

NOTE: Repairs to seat cushions or seat backs are performed outside the vehicle and are usually for replacement of torn, worn or burned seat covers. In a few instances, the pads may be damaged and require replacement.

BODY CODES
E-150 — E-250 — E-350


MFD. BY FORD MOTOR CO. IN U.S.A.

DATE:		GVWR: LB/ KG	
FRONT GAWR: LB		REAR GAWR: LB	
KG	WITH TIRES RIMS	KG	WITH TIRES RIMS
AT PSI COLD		AT PSI COLD	

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF
MANUFACTURE SHOWN ABOVE

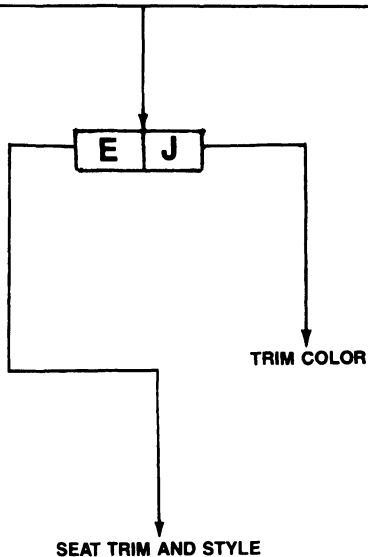
VIN: _____

TYPE: _____



1G 9N

EXTERIOR PAINT COLORS						DSO	
WB	TYPE	GVW	BODY	TRANS	AXLE	TAPE	SPRING
138	E112	EY	T	16	2	2C2D	



CR6113-A

When installing a new seat or back cover assembly, refer to the following figures for the locations of listing wires, hog rings, anti-squeak pads, and seat pad stack-up.

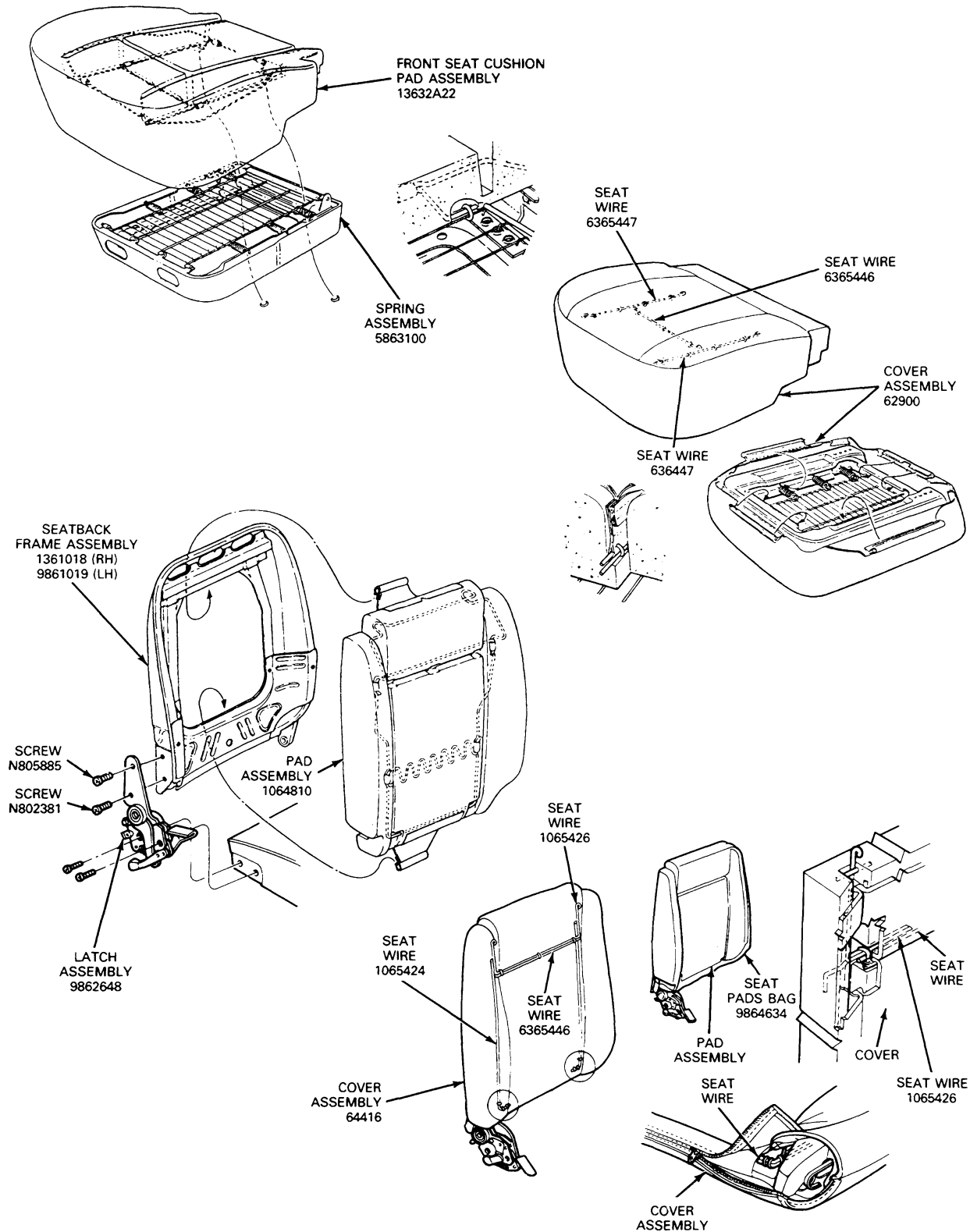
Seat Cushion and Back Cover Trim, Bucket Seat

Removal and Installation

1. Remove the seat belt retainer loop screw, if so equipped. Remove the seat and track assembly if replacing cushion cover. Refer to Section 01-09.
2. Remove the seat tracks from the seat.
3. Remove the seat back assembly and the seat cushion stops.
4. Remove the hog rings and /or "J" retainers, retaining the seat cushion cover to the frame. Remove cover.

REMOVAL AND INSTALLATION (Continued)

Front Seat Cushion, Seat Back and Cover Installation, F-Series, Typical View



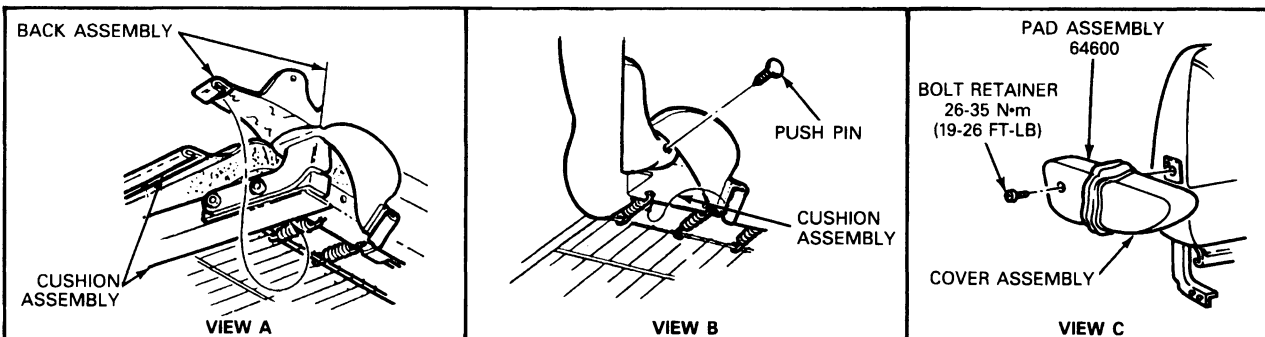
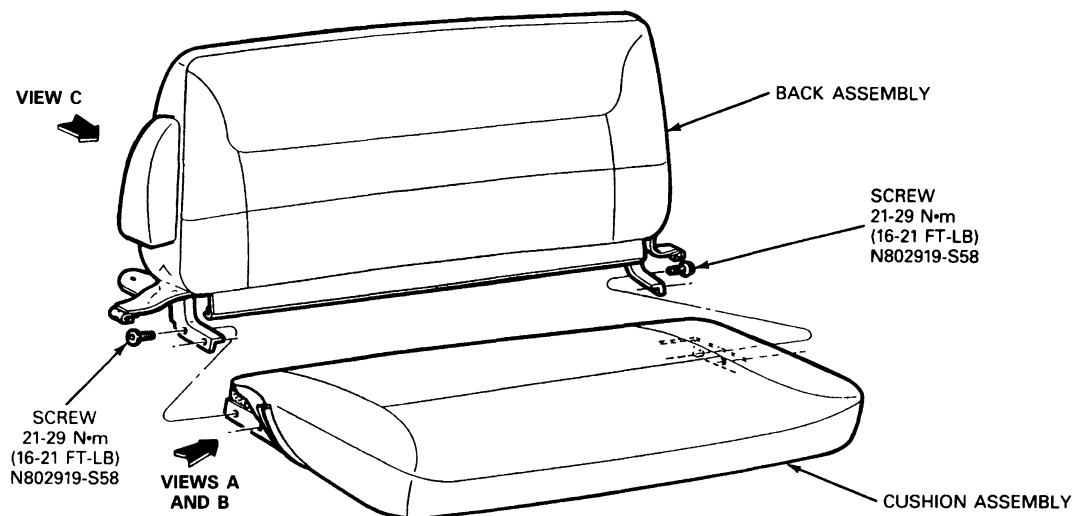
R6484-2A

REMOVAL AND INSTALLATION (Continued)

5. Remove the hog rings and / or "J" retainers, retaining the seat back cover to the frame. Remove cover.

6. Transfer the bolster wires to cover listings.

For installation, follow removal procedures in reverse order. Tighten seat assembly screw to vehicle 21-29 N·m (16-21 ft-lb).

Rear Seat Back to Cushion, E-150-250-350

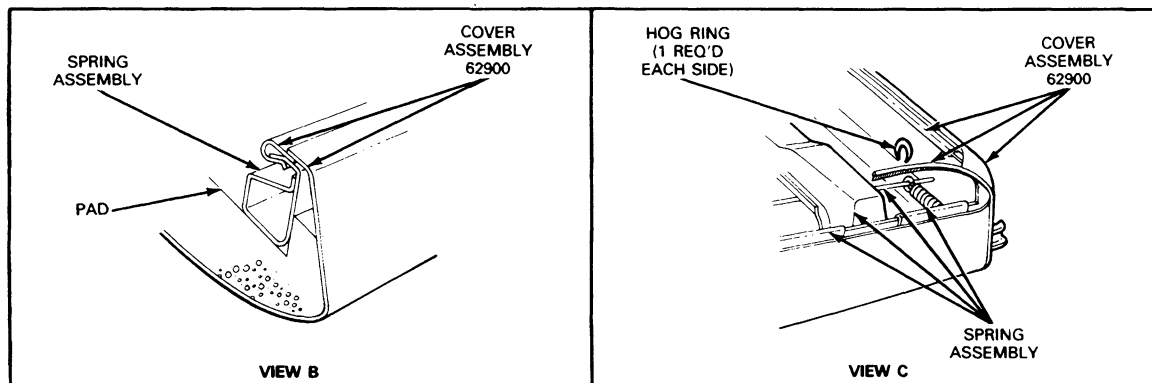
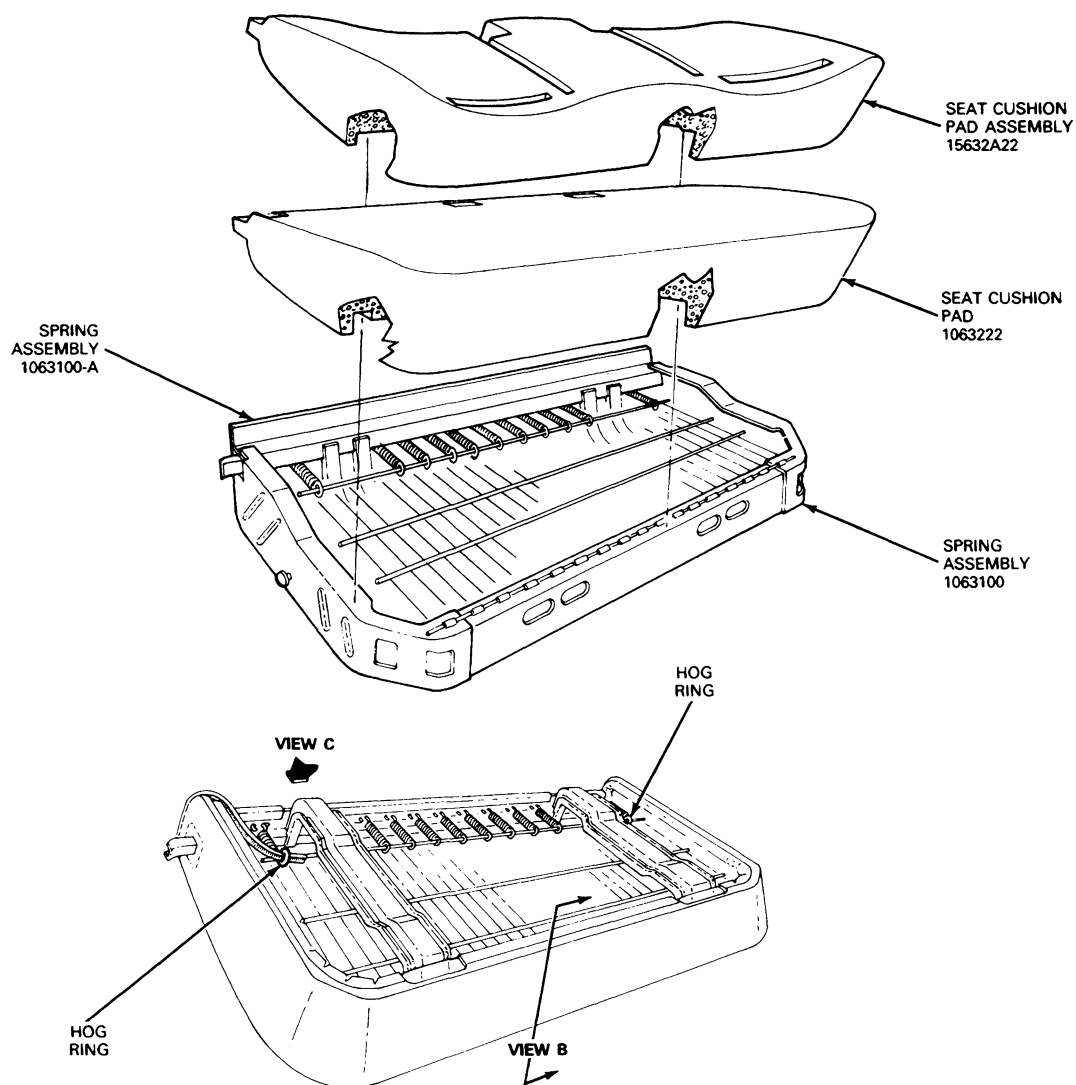
R8269-B

Seat Cushion Cover Trim, Bench Seat**Removal and Installation**

1. Remove the seat and track assembly from the vehicle. Refer to the correct part in this section.
2. Remove the seat back assembly from the seat cushion.
3. Cut the hog rings retaining the cushion cover to the frame assembly. Remove cover.
4. If the padding is being replaced, cut the hog rings attaching the padding to the spring assembly and remove the padding.
5. Position the new pad to the seat back assembly. Fasten pad in place with hog rings.
6. Transfer the listing wires from the old cover to the listings in the new cover.
7. Position the cover over the spring assembly. Fasten cover with hog rings.
8. Install the seat back to the seat cushion.
9. Install the seat and track assembly into the vehicle. Tighten attaching screws and washers to specifications. Refer to Section 01-09.

REMOVAL AND INSTALLATION (Continued)

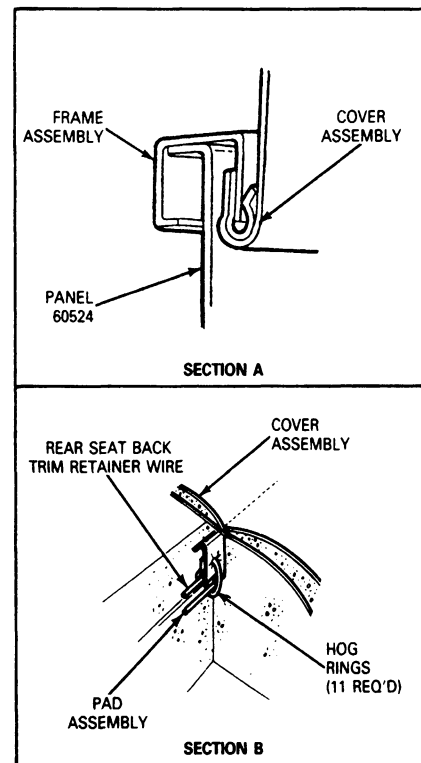
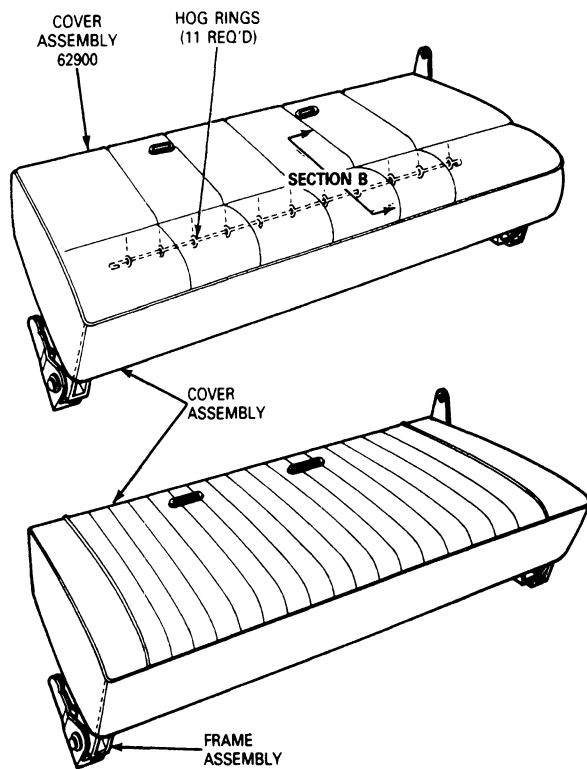
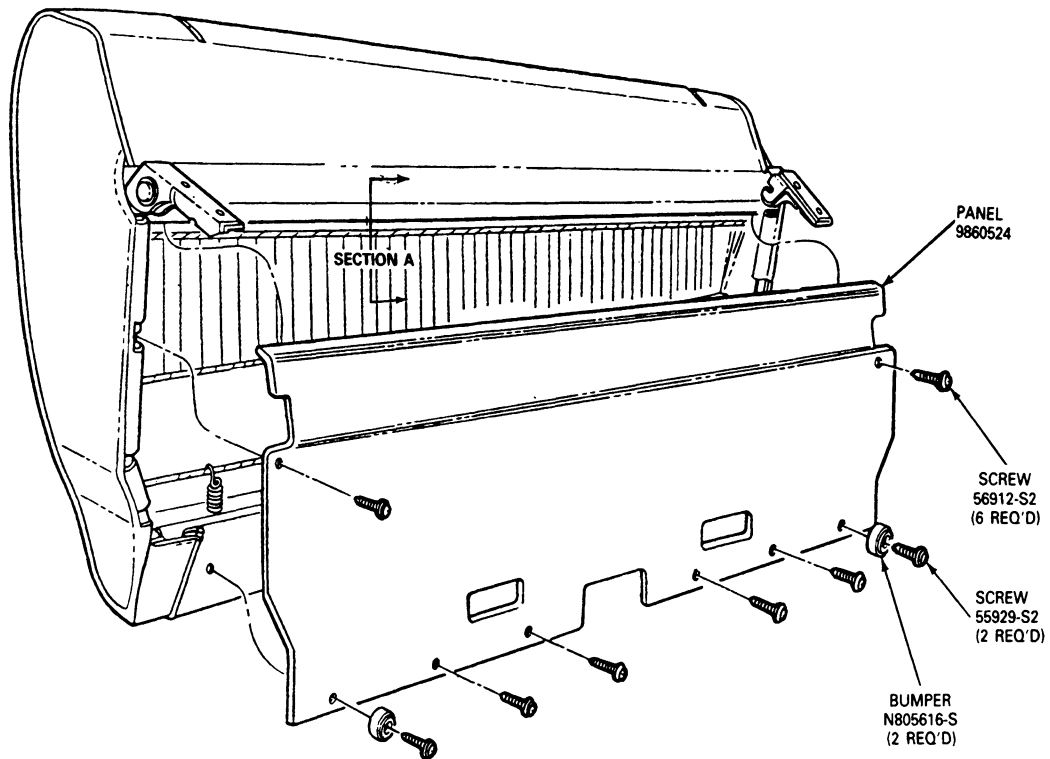
Front Seat Cushion Cover Installation, F-Series, Typical View



R2537-2C

REMOVAL AND INSTALLATION (Continued)

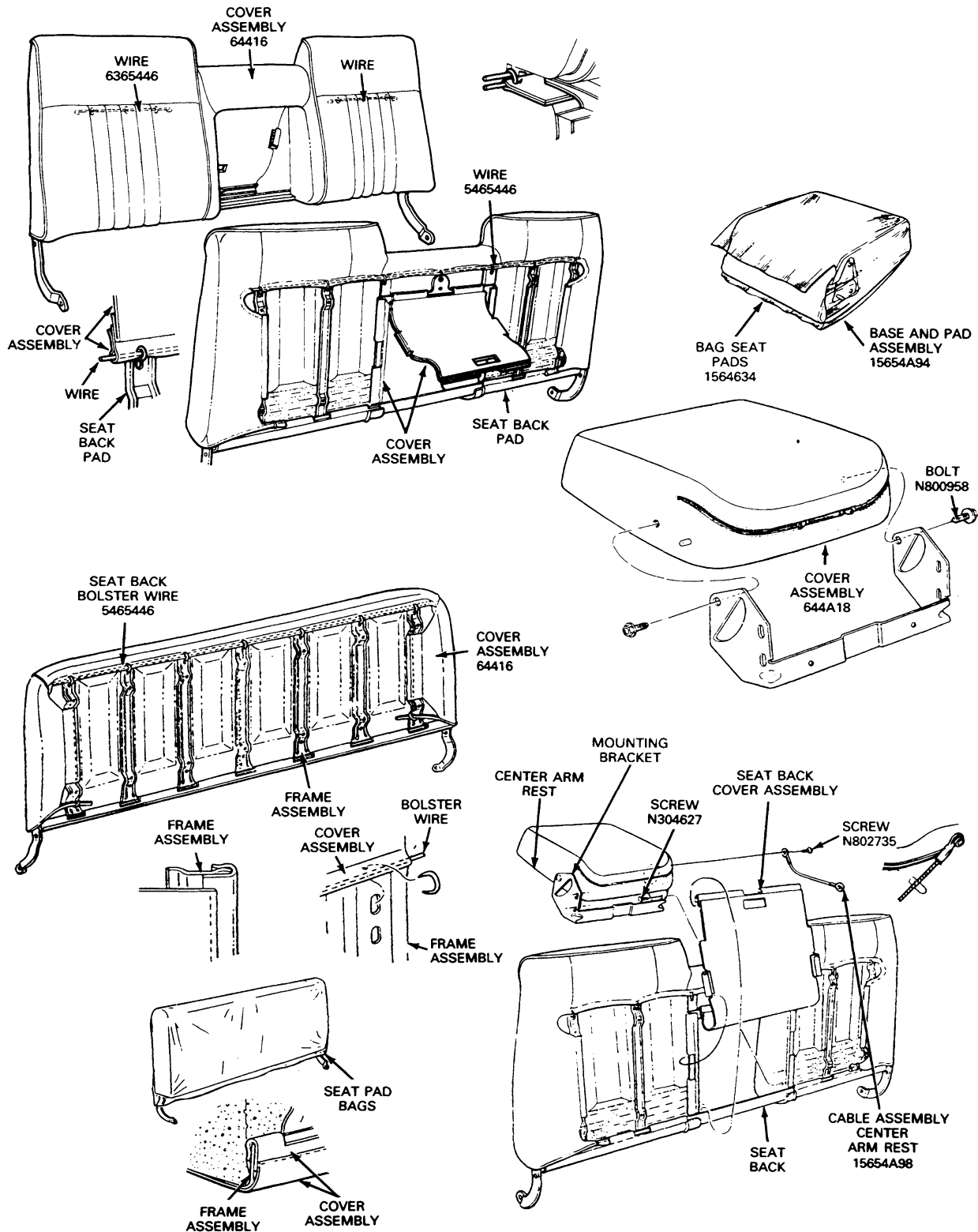
Rear Folding Seat, F-Series, Typical View



R2391-2C

REMOVAL AND INSTALLATION (Continued)

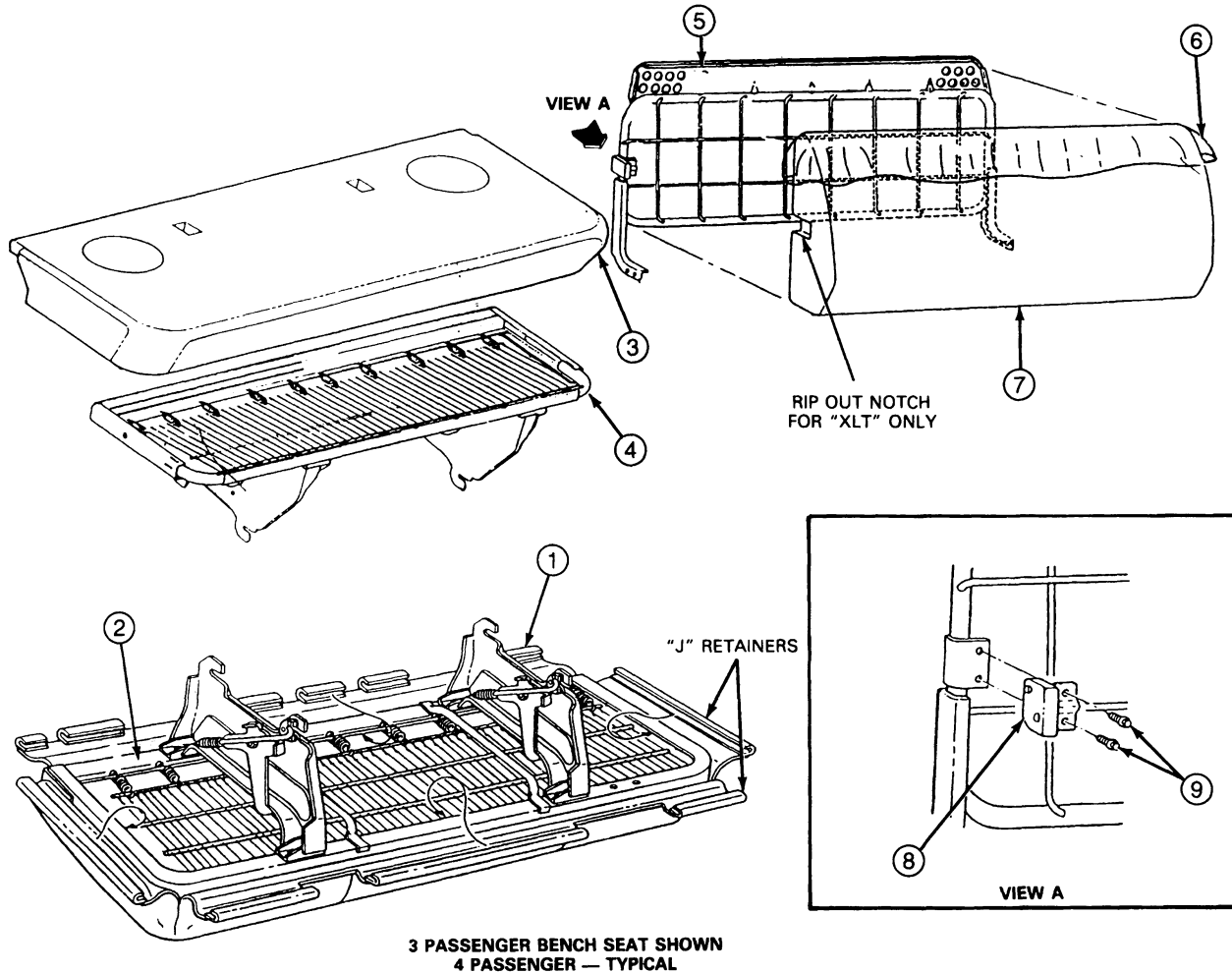
Seat Back Cover Installation with Center Armrest, F-150-250-350, F-Super Duty Chassis Cab



R6486-2A

REMOVAL AND INSTALLATION (Continued)

Rear Seat Cushions and Pad, E-150-250-350



R8273-A

Item	Part Number	Description
1	63804	Cover Assembly
2	Ref.	Frame Assembly
3	63840	Pad Assembly
4	63160	Frame Assembly

(Continued)

Item	Part Number	Description
5	613A38	Frame Assembly
6	64822	Slide
7	66800	Pad Assembly
8	67336	Bracket Assembly
9	N802919	Screw 21-29 N-m (16-21 Ft-Lb).

SECTION 01-11 Glass, Frames and Mechanisms

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Power Window Motor, F-Series and Bronco	01-11-10	SPECIFICATIONS	01-11-35
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Rear Quarter Glass, Econoline	01-11-15		

VEHICLE APPLICATION

E-150-250-350, F-Super Duty Chassis Cab and
Bronco Vehicles

DIAGNOSIS AND TESTING

Power Window Switch

Multiple Switch, Econoline (Left Side)

Testing of the power window multiple switch should be performed with the switch removed from the vehicle. The switch can be removed from the vehicle following the procedures outlined in this section. Use a self-powered test lamp or a Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent.

1. Clip one test lead probe on Pin 6 which is grounded.
2. With both switches in the neutral position, Pins 1 through 4 should have continuity to Pin 6.
3. Push both window switches upward. Both Pins 1 and 3 should have no continuity to Pin 6.
4. Push both window switches downward. Both Pins 2 and 4 should have no continuity to Pin 6.
5. Remove the test lead from Pin 6 and connect to Pin 5 (hot feed pin). With both switches in the neutral position, Pin 5 should have continuity only with itself.
6. Push both window switches upward. Both Pins 1 and 3 should have continuity to Pin 5.
7. Push both window switches downward. Both Pins 2 and 4 should have continuity to Pin 5.

DIAGNOSIS AND TESTING (Continued)

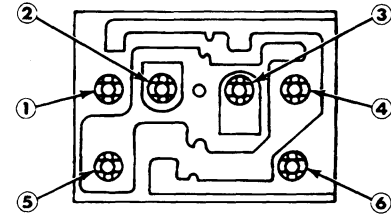
8. If any one switch does not test as stated, replace the complete switch assembly.

CONNECT ONE SIDE OF AN OHMMETER SELF-POWERED OR TEST LAMP TO TERMINAL NO. 5 (BATTERY TERMINAL) AND THE OTHER SIDE TO THE TERMINALS SHOWN BELOW.

WINDOW SWITCH POSITION	CONTINUITY BETWEEN TERMINALS
NEUTRAL	NO. 5
RIGHT FRONT — UP	NO. 3
RIGHT FRONT — DOWN	NO. 4
LEFT FRONT — UP	NO. 1
LEFT FRONT — DOWN	NO. 2

CONNECT ONE SIDE OF AN OHMMETER SELF-POWERED OR TEST LAMP TO TERMINAL NO. 6 (GROUND TERMINAL) AND THE OTHER SIDE TO THE TERMINALS SHOWN BELOW.

WINDOW SWITCH POSITION	CONTINUITY BETWEEN TERMINALS
NEUTRAL	NOS. 1, 2, 3, 4
RIGHT FRONT — UP	NOS. 1, 2 AND 4
RIGHT FRONT — DOWN	NOS. 1, 2 AND 3
LEFT FRONT — UP	NOS. 2, 3 AND 4
LEFT FRONT — DOWN	NOS. 1, 3 AND 4



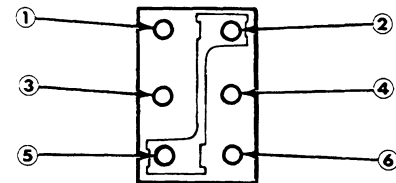
1. LEFT FRONT "UP" TERMINAL
2. LEFT FRONT "DOWN" TERMINAL
3. RIGHT FRONT "UP" TERMINAL
4. RIGHT FRONT "DOWN" TERMINAL
5. HOT FEED WHEN IGNITION SWITCH IS "ON"
6. GROUND TERMINAL

N5031-2F

Single Switch, Econoline (Right Side)

NOTE: The switch should be removed from the vehicle following the procedures outlined in this section.

1. Use a self-powered test lamp or an ohmmeter, to test the power window switch.
2. With the switch in the neutral position, there should be continuity between terminals 1 and 3, 2 and 5, and 4 and 6.
3. With the toggle switch pushed downward, there should be continuity between terminals 2, 4 and 5, and 1 and 3. Terminal 6 should be disconnected from any other terminal.
4. With the toggle switch pushed upward, there should be continuity between terminals 2, 3 and 5, and 4 and 6. Terminal 1 should be disconnected from any other terminal.
5. If the switch does not test as stated, replace switch.

**SINGLE POWER WINDOW SWITCH TEST**

- ① POWER FEED, OR GROUND FROM DRIVERS SWITCH (ALLOWS OPERATION OF INDIVIDUAL WINDOWS FROM LEFT FRONT DOOR)
- ② HOT FEED FOR SINGLE SWITCH (BUS BAR TO PIN NO. 5)
- ③ MOTOR TERMINAL — UP
- ④ MOTOR TERMINAL — DOWN
- ⑤ HOT FEED
- ⑥ POWER FEED, OR GROUND FROM DRIVERS SWITCH (ALLOWS OPERATION OF INDIVIDUAL WINDOWS FROM LEFT FRONT DOOR)

N5032-1C

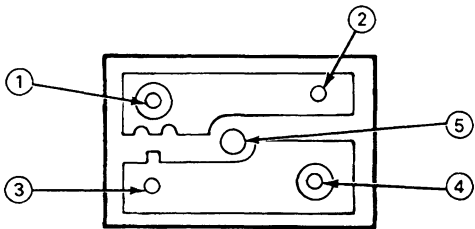
Door Window Switch, F-Series and Bronco

NOTE: Remove switch from the vehicle as described in this section. The raised portion of the switch knob should face right exposing the five terminals.

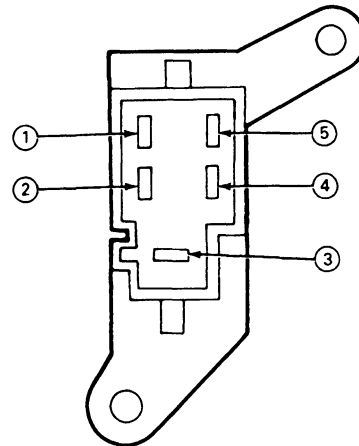
1. Use a self-powered test lamp or an ohmmeter to test the power window switch.
2. With the switch in the neutral position, there should be continuity between terminals 1 and 2, and terminals 3 and 4. Terminal 5 should be disconnected from all other terminals.

DIAGNOSIS AND TESTING (Continued)

3. When the raised portion of the switch rocker knob is pushed, closing windows, there should be continuity between terminals 1 and 5, and terminals 3 and 4. Terminal 2 should be disconnected from all other terminals.
4. When the depressed portion of the switch rocker knob is pushed, opening the windows, there should be continuity between terminals 1 and 2, and terminals 4 and 5. Terminal 3 should be disconnected from all other terminals.
5. If the switch assembly does not test as stated, replace switch.



N6079-1B



N6080-1A

Tailgate Switch, Instrument Panel-Mounted

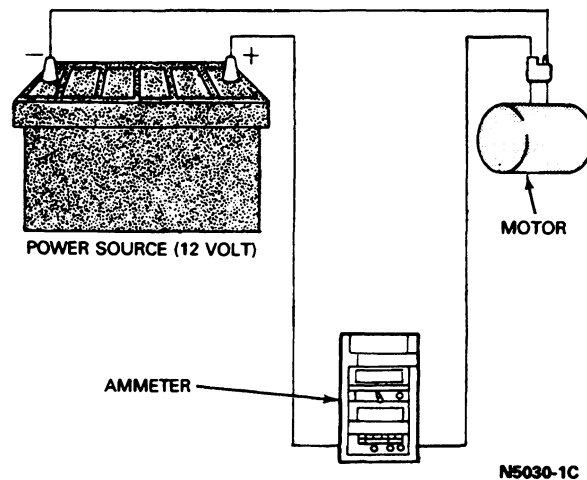
NOTE: Remove switch from the vehicle, as described in this section.

1. Use a self-powered test lamp, or an ohmmeter to test the power tailgate switch.
2. With the switch in the neutral position, there should be continuity between terminals 1 and 2, and terminals 3 and 4. Terminal 5 should be disconnected from all other terminals.
3. When the switch rocker knob is pushed up to close the tailgate window, there should be continuity between terminals 1 and 2, and terminals 4 and 5. Terminal 3 should be disconnected from all other terminals.
4. When the switch rocker knob is pushed down to open the tailgate window, there should be continuity between terminals 2 and 5, and terminals 3 and 4. Terminal 1 should be disconnected from all other terminals.
5. If the switch does not test as stated, replace the switch.

Power Window Motor, Door and Tailgate

To test power window motor current draw, remove the door trim panel or tailgate trim panel. Refer to Sections 01-05A and 01-05B.

1. Disconnect the motor lead.
 2. Disconnect the regulator mechanism from the motor.
 3. Supply power to motor lead connector with an ammeter in series.
 4. Operate the motor and observe the current draw.
- NOTE:** The current draw for the no-load test should not exceed four amps and should not fluctuate. Reversal of the motor wire connections will reverse the direction of motor rotation.
5. Replace the motor if the current draw exceeds four amps.

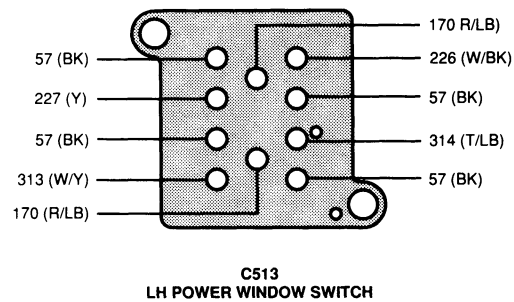
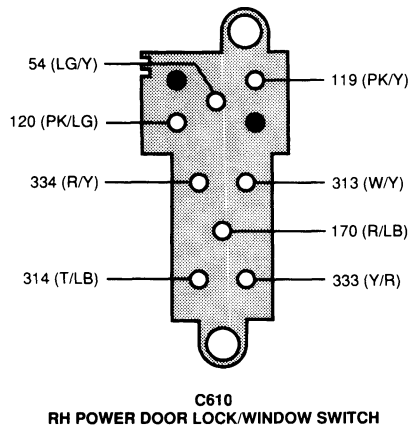
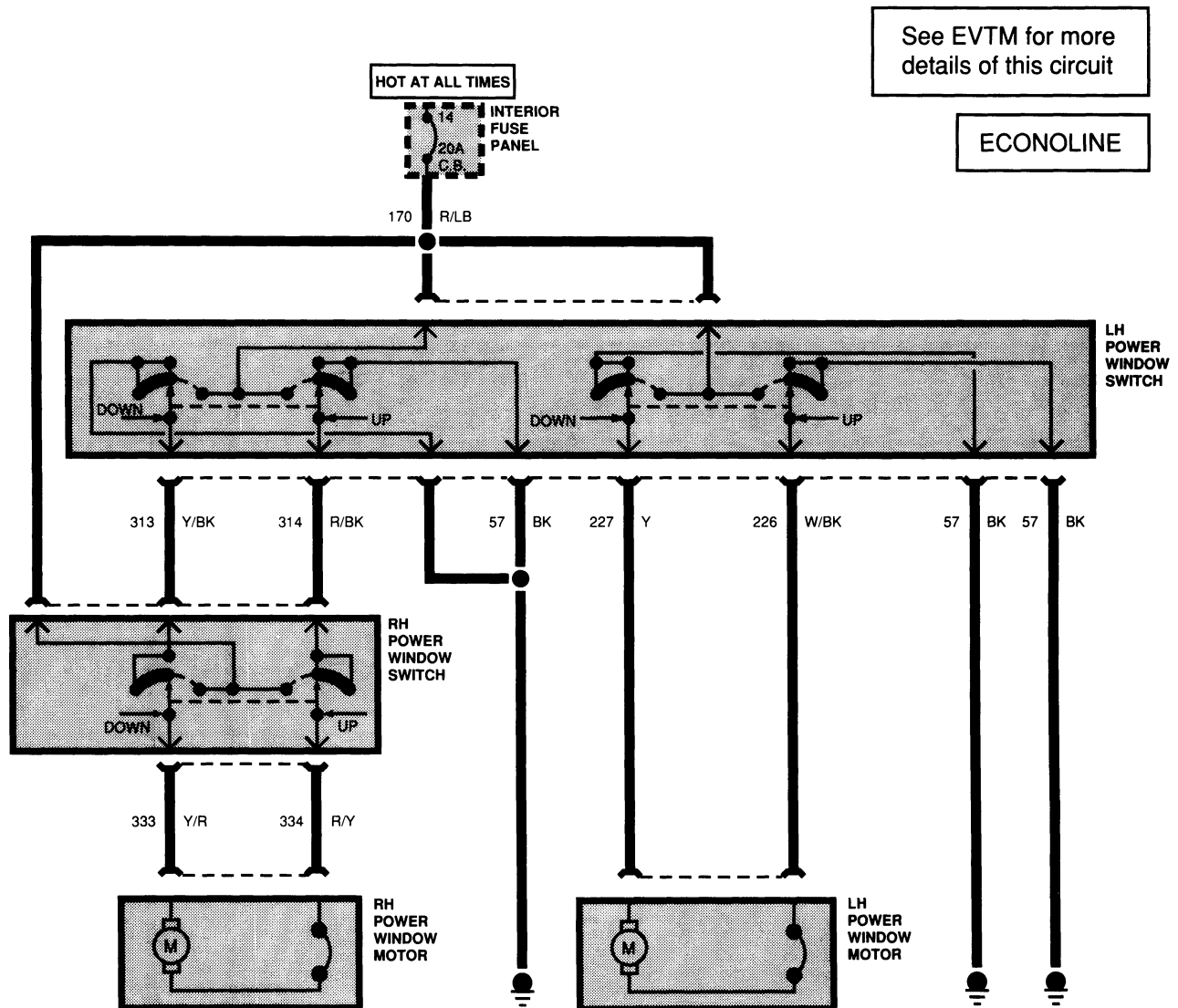


N5030-1C

6. If the switch assembly does not test as stated, replace the switch.

DIAGNOSIS AND TESTING (Continued)

Power Windows, Electrical Schematic, E-150-250-350



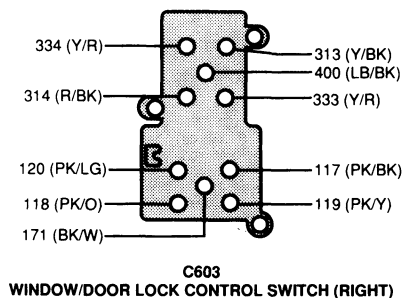
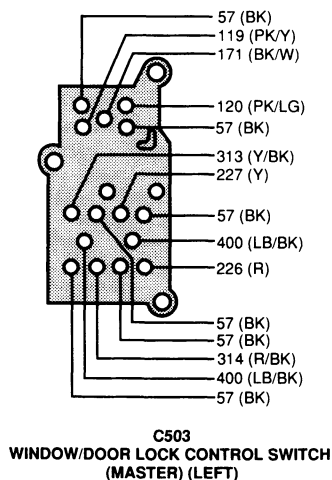
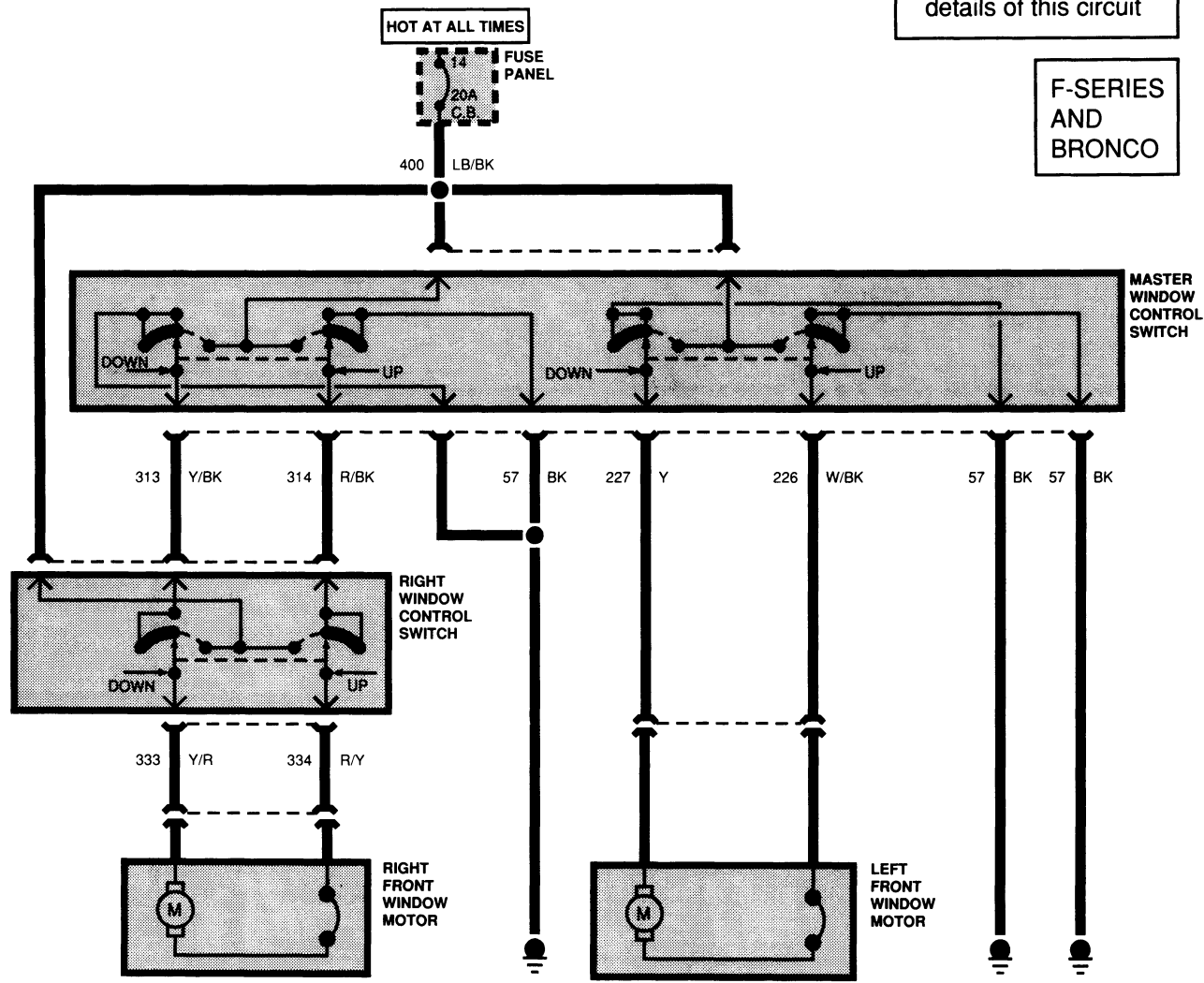
N10285-A

DIAGNOSIS AND TESTING (Continued)

Power Windows, Electrical Schematic, F-Series and Bronco

See EVTM for more
details of this circuit

F-SERIES
AND
BRONCO

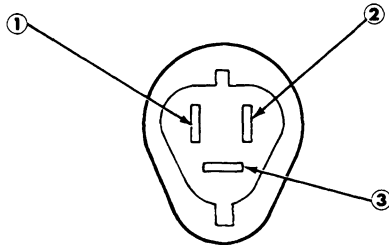


N10286-A

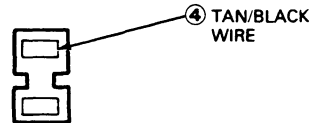
DIAGNOSIS AND TESTING (Continued)**Window Switch, Tailgate-Mounted**

Testing of the tailgate-mounted window switch can be performed with the switch installed in the vehicle. Use a self-powered test lamp or an ohmmeter.

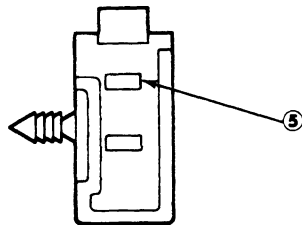
1. With the switch in the neutral position, there should be continuity between terminals 1, 2 and 3.
2. With the window up there should be continuity between terminals 1 and 5, and 2 and 4.
3. With window down there should be continuity between terminals 2 and 5, and 3 and 4.
4. If the switch does not test as stated, replace switch.



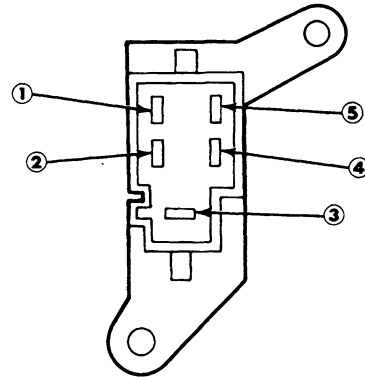
**TAILGATE MOUNTED
SWITCH CONNECTOR**



**TAILGATE LIMIT
SWITCH CONNECTOR**



TAILGATE MOTOR CONNECTOR

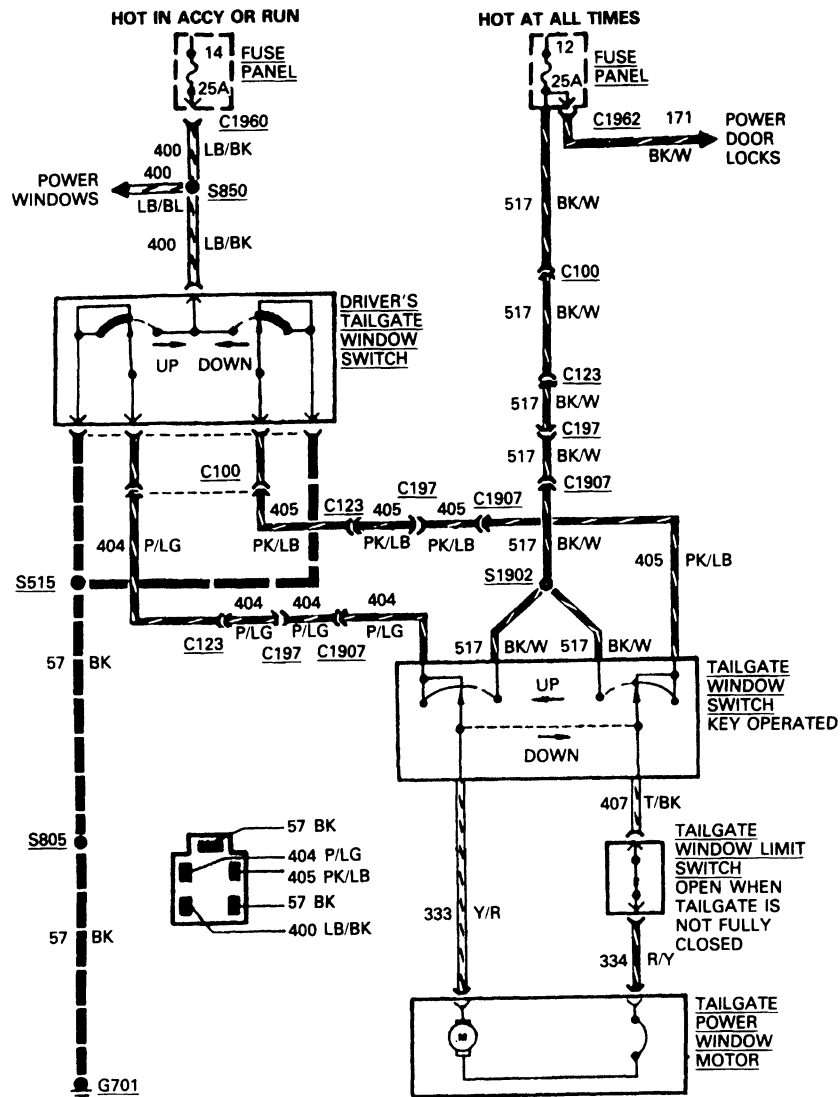


**TAILGATE WINDOW SWITCH
TERMINAL POSITION (I/P SWITCH)**

N6032-2B

DIAGNOSIS AND TESTING (Continued)

Tailgate Power Window Electrical Schematic



REMOVAL AND INSTALLATION

Power Window Switch, Econoline

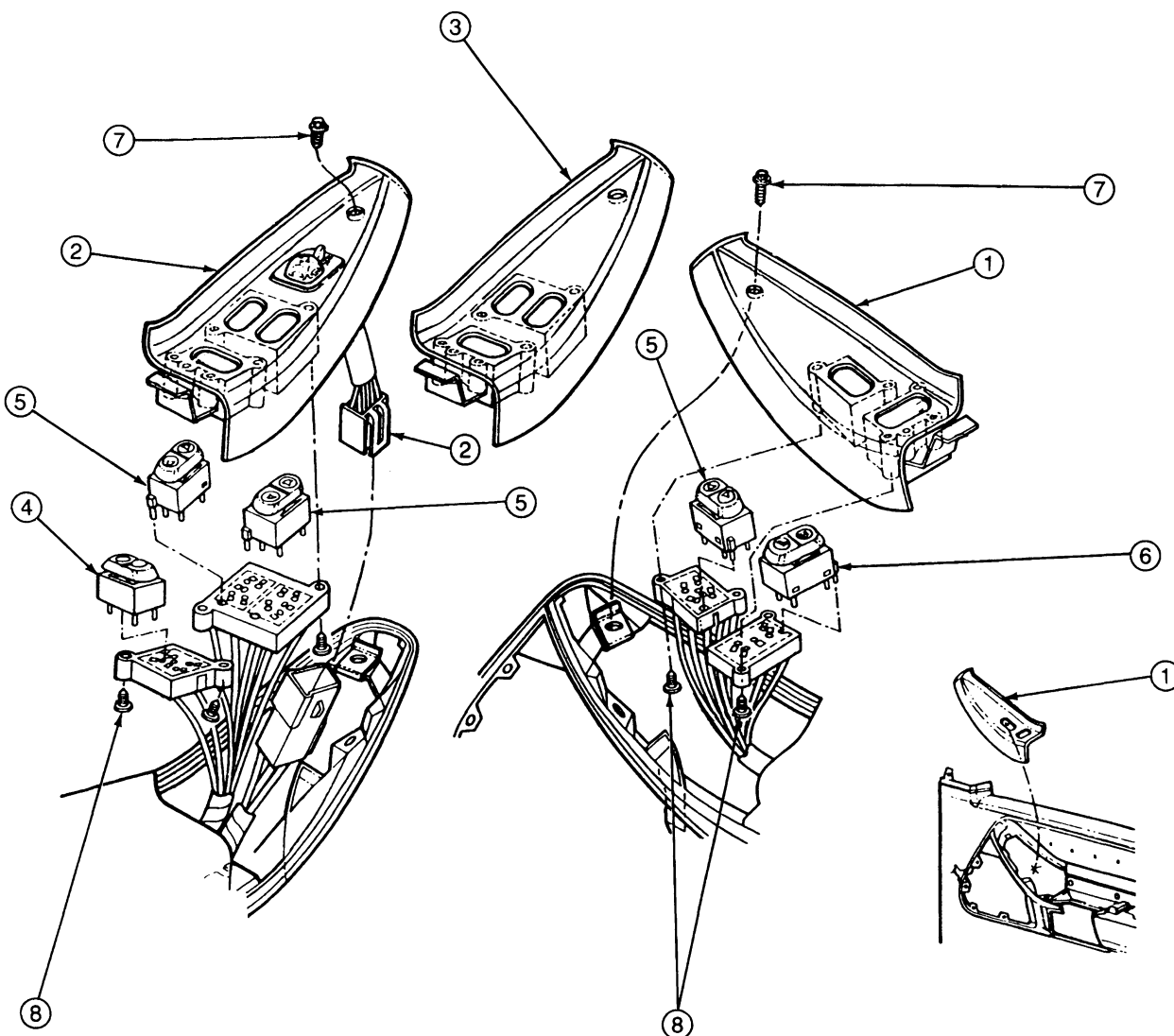
Removal and Installation

1. Remove switch housing retaining screw.
2. Lift housing to gain access to switch retaining screws. Remove screws and window regulator switch.

3. Disconnect switch from electrical connector.
For installation follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Front Door Switches, Econoline



N9917-A

Item	Part Number	Description
1	14A563	Window Regulator Front Door Switch, RH
2	14B133	Window Regulator Front Door Switch with Power Mirrors
3	14A564	Window Regulator Front Door Switch Without Power Mirrors

(Continued)

Item	Part Number	Description
4	14963	Door Lock Switch, LH
5	14529	Window Regulator Control Switch
6	14017	Door Lock Switch, RH
7	N610127-S58	Screw
8	56904-S58	Screw

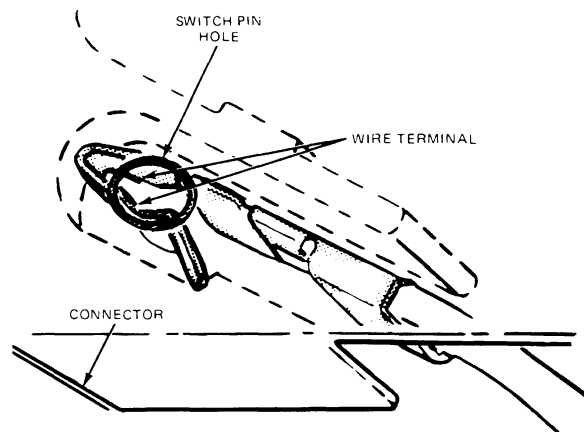
REMOVAL AND INSTALLATION (Continued)**Window Motor and/or Drive, Econoline****Removal**

1. Remove door trim panel and watershield. Refer to Section 01-05B.
2. Disconnect battery ground cable. Disconnect motor wires at multiple connector.
3. Remove three 1/4-inch rivets attaching the motor bracket to inner panel. Use drift to knock out the center pins from each rivet. Using a 1/4-inch diameter drill, drill out the remainder of the rivet. Use care not to enlarge sheet metal holes in the door inner panel.
4. Working through access hole, remove motor bracket from inner panel and rotate to gain access to three motor retaining screws.
5. Remove motor retaining screws and separate motor from bracket and cable drum housing.
6. Remove rotor.

Installation

1. Position motor and drive to cable drum housing and motor mounting bracket. Install three motor screws. Tighten to 5.5-7.0 N·m (4.0-5.2 ft-lb).
2. Install rivets retaining motor mounting bracket to inner panel using a 1/4-20 x 1/2-inch bolt and 1/4-20 nut and washer assemblies or equivalent metric fasteners.
3. Connect power window motor wiring and battery ground cable.
4. Check window operation, install watershield, door trim panel, and armrest. Refer to Section 01-05B.

2. Remove three connector attaching screws from switch housing.
3. The switch is held in place by the electrical contact pins. To remove switch, carefully pry switch from connector with a small screwdriver.



N5035-1A

For installation, follow removal procedures in reverse order.

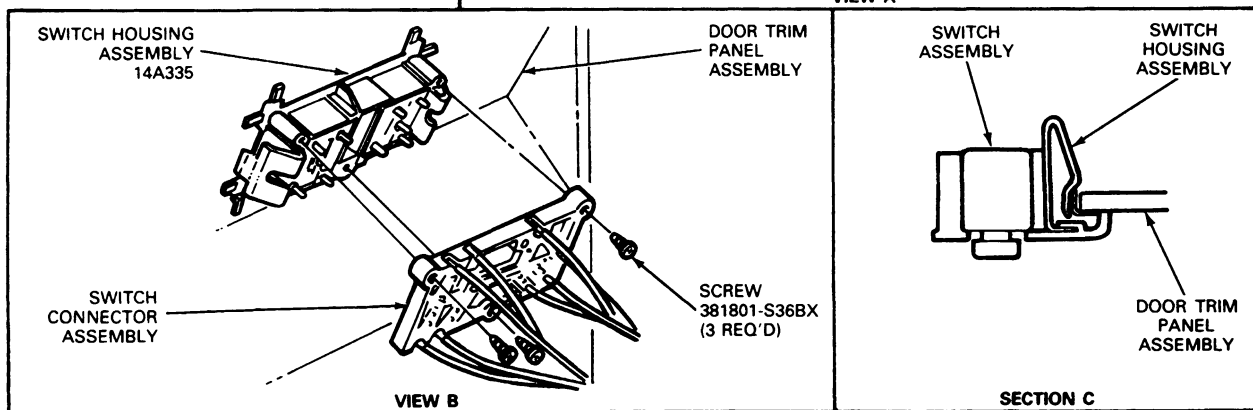
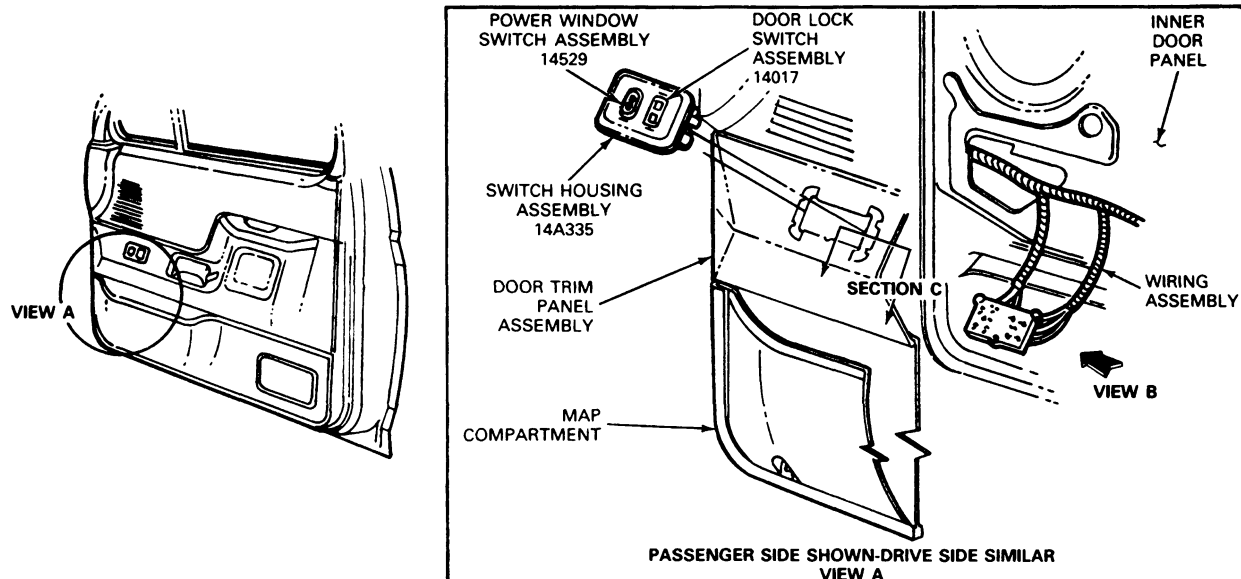
NOTE: The switch is keyed to the connector and can only be installed one way.

Power Window Switch, F-Series and Bronco**Removal and Installation**

1. Insert a small, thin-bladed screwdriver into spring tab slots, located at front and rear of switch housing, and apply pressure to make the switch housing assembly pop out.

REMOVAL AND INSTALLATION (Continued)

Power Window Switch, F-Series and Bronco



R4674-2A

Power Window Motor, F-Series and Bronco

Removal

1. Disconnect the battery ground cable.
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles to relearn the strategy.
2. Remove the door trim panel and watershield.
3. Disconnect power window motor wire from wire harness connector.
NOTE: Check inside the door to make sure electrical wires are not in line with holes to be drilled in the door inner panel.
4. Using a 12.7mm (1/2-inch) diameter drill bit, drill two holes in the door inner panel at the drill dimples located opposite the two unexposed motor drive retainer screws.

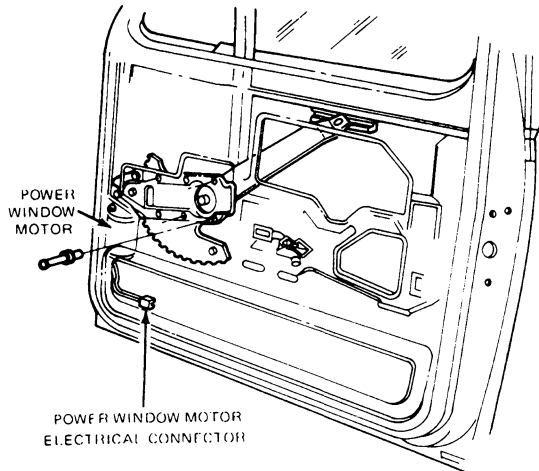
5. Remove the three motor mount retainer screws using two drilled holes and existing larger hole access to screw heads.
6. Push the motor toward the outside sheet metal to disengage the motor and drive from the regulator gear.
7. After the motor and drive are disengaged, prop the window in full UP position.
8. Remove the motor and drive from inside the door.

Installation

1. Install a new motor and drive assembly and engage the motor to the regulator. Tighten motor retaining screws to 5.6-9.6 N-m (50-85 in-lb).
2. Install two pieces of Pressure-Sensitive Waterproof Tape D6AZ-19627-A or equivalent body tape (25.4mm [1 inch] square) over drilled holes.
3. Connect power window motor wiring. Connect battery ground cable.

REMOVAL AND INSTALLATION (Continued)

4. Remove glass prop and check window operation.
5. Make sure door drain holes are open.
6. Install trim panel.
7. Connect battery ground cable.

**Tailgate Window Regulator Switch, Instrument Panel-Mounted, Bronco**

NOTE: The tailgate switch is located in the lower left finish panel on the instrument panel.

Removal and Installation

1. Remove the headlamp switch knob and the windshield wiper switch knob by releasing knob retaining clips and pulling the knobs from switch shafts.
2. Using a thin-bladed screwdriver or a small putty knife, carefully pry off the lower left finish panel by starting at the upper left corner of the finish panel and working counterclockwise around the perimeter of the finish panel.

NOTE: The finish panel is held in place by four retaining clips on the instrument panel holding four plastic fingers on the finish panel and care should be taken not to break the four plastic fingers when prying the finish panel off.

3. Remove the two switch retaining screws. Remove the switch from the finish panel.
4. Separate the switch assembly from the wiring harness by pulling wiring harness and switch apart.

For installation, follow removal procedures in reverse order.

Tailgate Mounted Window Regulator Switch, Bronco**Removal and Installation**

1. Remove interior access cover panel. Refer to Section 01-05A.
2. Raise glass. If glass cannot be raised, remove glass as outlined in this section.
3. Disconnect wiring harness.
4. Detach switch from lock cylinder by removing clip and remove from tailgate.

For installation, follow removal procedures in reverse order.

Tailgate Window Regulator Motor, Bronco**Removal and Installation**

1. Remove window regulator. Refer to window regulator removal in this section.
2. Raise glass to full up position. If glass cannot be raised, remove glass as outlined in this section.
3. Disconnect motor wiring harness.

WARNING: COUNTERBALANCE SPRING IS UNDER TENSION! TO PREVENT INJURY FROM SUDDEN MOVEMENT OF REGULATOR COMPONENTS, CLAMP/LOCK GEAR SECTORS TO ALLOW SAFE MOTOR REMOVAL.

4. Detach and remove electrical motor from tailgate.

For installation, follow removal procedures in reverse order.

Window, Manual Regulator, Econoline**Removal**

1. Remove door armrest, trim panel and watershield. Refer to Section 01-05B.
2. Remove door glass as outlined in this section.
3. Disconnect power motor wiring connector.
4. Remove three 1/4-inch rivets retaining motor bracket to inner panel and two 1/4-inch rivets retaining lower bracket of regulator to inner panel.
5. Use drift to knock out center pins for each rivet. Using a 1/4-inch diameter drill, drill out remainder of rivet.

NOTE: Use care not to enlarge sheet metal holes in the door inner panel.

6. Remove two upper regulator retaining nuts.
7. Remove regulator.

Installation

1. Install regulator into access hole in inner panel.

REMOVAL AND INSTALLATION (Continued)

2. Position regulator using upper regulator studs and tabs on motor mounting bracket.
3. Install rivets retaining regulator to door inner panel (1/4-20 x 1/2-inch bolt and 1/4-20 nut and washer assemblies or equivalent metric fasteners may be used as alternates).
4. Install two upper regulator retaining nuts.
5. Install door glass as outlined in this section.
6. Adjust glass as outlined in this section.
7. Install watershield and door trim panel. Refer to Section 01-05B.

Window Regulator, F-Series, Bronco**Removal**

1. Remove door trim panel and access cover, if so equipped.
2. Support glass in the full up position.
3. Remove center pin from regulator attaching rivets with drift punch. Then, drill head from each rivet using a 6.35mm (1/4-inch) drill and remove rivet. Be careful not to damage sheet metal holes during drilling.
4. Disengage regulator arm from glass bracket and remove regulator.

Tailgate Window Regulator, Manual Bronco**Removal and Installation**

1. Lower tailgate and remove interior access cover panel (ten screws). If tailgate will not lower because glass will not go full down, manually depress safety lockout rod located in bottom center of tailgate.
2. Raise glass using jumper to motor or manually close left tailgate latch. If the glass will not go up, glass must be removed as outlined in this section.
3. Remove regulator attaching screw and washer assemblies.
4. Remove regulator.

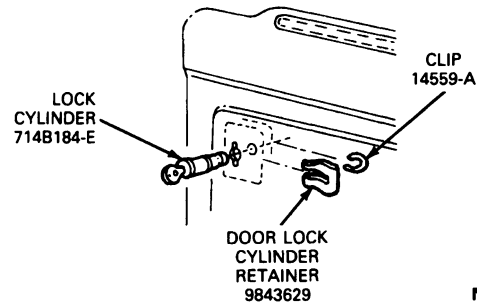
For installation, follow removal procedures in reverse order. Tighten screw/washer to 9-14 N·m (6-11 ft-lb).

Tailgate Lock Cylinder, Bronco**Removal**

1. Remove interior access cover panel.
2. Raise glass. If glass cannot be raised, remove glass as outlined in this section.
3. Remove lock cylinder retainer.
4. Disengage lock cylinder from switch and remove from tailgate.

Installation

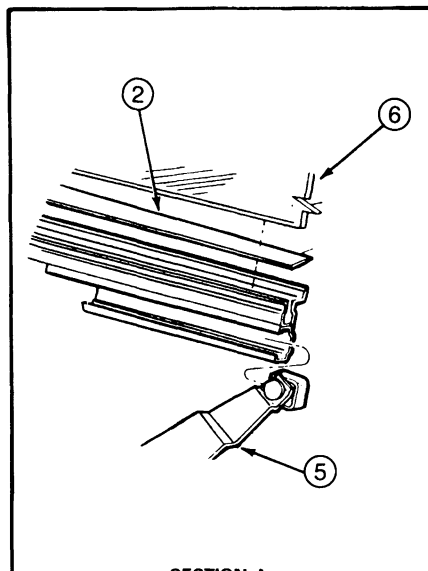
1. Position lock cylinder to tailgate and engage in switch.
2. Secure lock cylinder with retainer.
3. Check operation of lock cylinder and switch.
4. Install interior access cover panel.

**Installation**

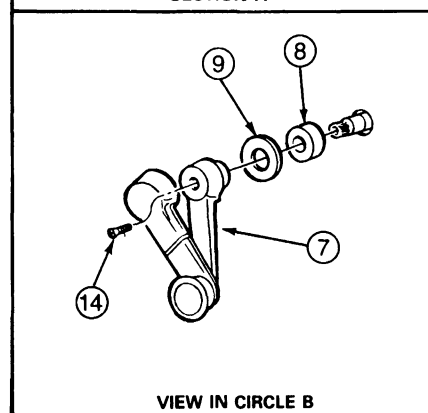
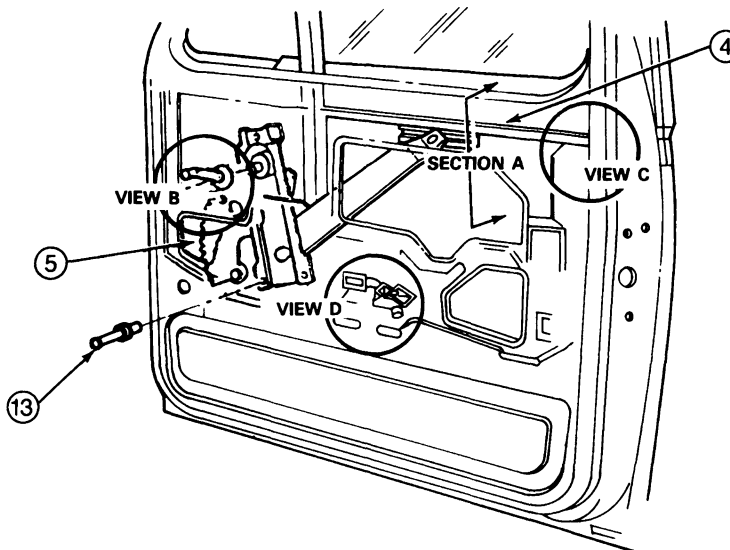
1. Position regulator in door and insert arm into glass bracket channel.
2. Position regulator to inner panel and install rivets using Rotunda Hydraulic Rivet Gun 107-00600 or equivalent to attach regulator to inner panel. A 1/4 inch-20 x 1/2 inch screw and washer assembly and a 1/4 inch-20 nut and washer assembly may be used in place of the rivets if rivets are not available (equivalent metric retainers may also be used).
3. Check operation of window mechanism and install door trim panel.

REMOVAL AND INSTALLATION (Continued)

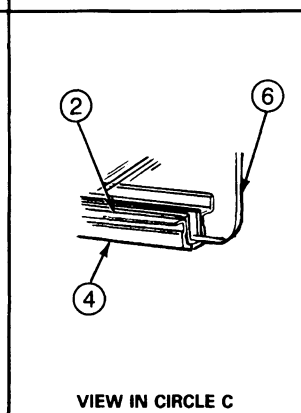
Window, Manual Regulator, Typical



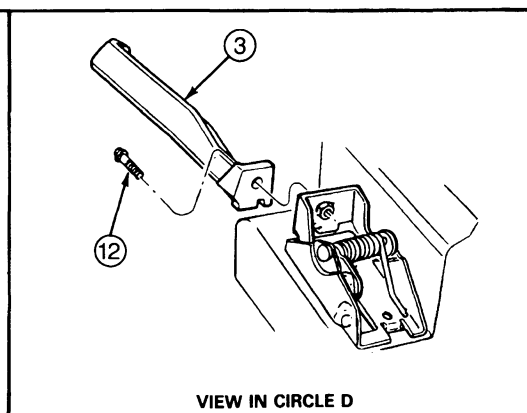
SECTION A



VIEW IN CIRCLE B



VIEW IN CIRCLE C



VIEW IN CIRCLE D

N4542-G

Item	Part Number	Description
2	ESB-M3G44-A Or Equivalent	Tape
3	22614	Door Handle
4	21458	Channel Assembly
5	23200	Regulator
6	21410	Door Glass
7	23342	Handle Assembly

(Continued)

Item	Part Number	Description
8	23327	Spacer
9	23370	Plate
12	N80127 1-S100	Screw and Washer Assembly 9-14 N-m (6.6-10.3 Ft-Lb)
13	385189-S100	Rivet
14	390334-S7	Screw 3.7-5.4 N-m (33-47 In-Lb)

WARNING: ALWAYS WEAR SAFETY GLASSES AND GLOVES WHEN HANDLING GLASS TO AVOID PERSONAL INJURY.

Front Door Glass, Econoline

Removal

1. Remove door trim panel and watershield. Refer to Section 01-05B.
2. Remove rear glass run retainer as outlined in this section.
3. Remove inside belt weatherstrip.

REMOVAL AND INSTALLATION (Continued)

4. Remove outside belt weatherstrip.
5. Lower glass to gain access to the two glass bracket retaining rivets.
6. Remove center pins from rivets using a drift. Using a 1/4-inch diameter drill, drill out the remainder of the rivets.

CAUTION: Do not attempt to pry out the rivets as damage to the glass could result. Prior to removing rivet center pins, it is recommended that a suitable block support be placed between door outer panel and glass bracket to stabilize glass during rivet removal.

7. Remove glass.

Installation

1. Insert glass into door between outer belt weatherstrip and inner panel.
2. Position glass into door frame and lower window to align with regulator bracket.
3. Install two 1/4-inch rivets using Blind Oval Head Fastener 385189S100 or equivalent (use of 1/4-20 x 1 inch bolts is optional). Equivalent metric fasteners may also be used.
4. Install rear glass run retainer as outlined in this section.
5. Adjust door glass as outlined in this section.
6. Install outside, then inside belt weatherstrips.
7. Install watershield, door trim and armrest. Refer to Section 01-05B.

2. Remove screw and washer attaching rear glass run retainer to door inner panel. Remove retainer.
3. To install, reverse Steps 1 and 2. Adjust door glass as outlined in this section.

Door Glass Run Channel, Econoline**Removal**

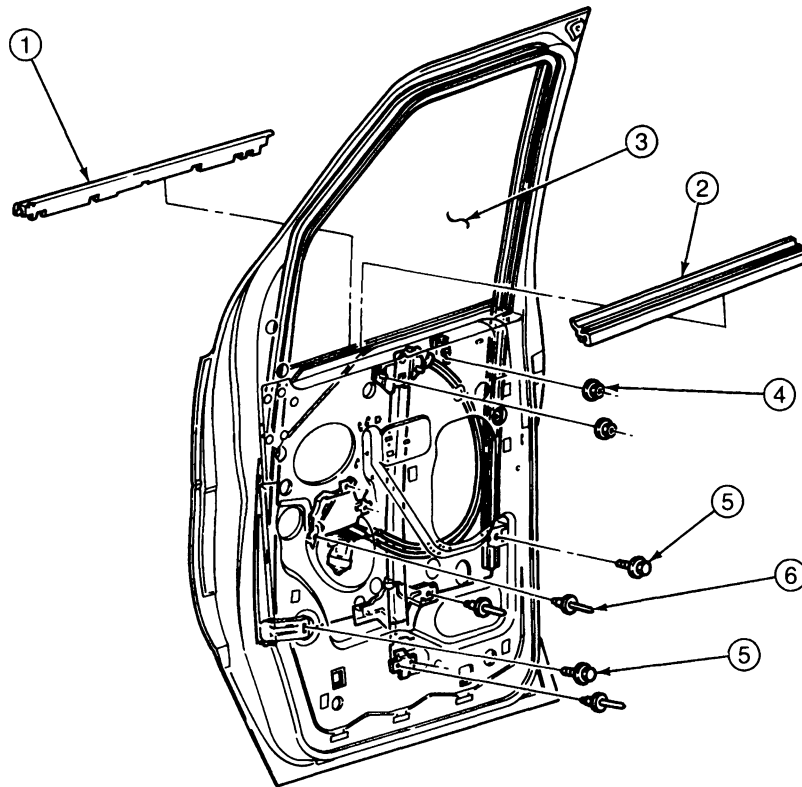
1. Remove door trim panel and watershield. Refer to Section 01-05B.
2. Remove inner and outer belt weatherstrip.
3. Remove door glass as outlined in this section.
4. Remove run retaining bolt.
5. Remove door glass run channel.

Installation

1. Install run channel assembly into door frame.
2. Push run channel onto door flange starting at upper B-pillar corner.
3. Continue down B-pillar and then across top of door frame and down A-pillar.
4. Install glass run retaining screw and washer assembly.
5. Install door glass as outlined in this section.
6. Install inner belt weatherstrip.
7. Adjust door glass as outlined.
8. Install watershield and trim panel. Refer to Section 01-05B

Door Glass Run Retainer, Econoline**Removal and Installation**

1. Raise glass to the full up position.

REMOVAL AND INSTALLATION (Continued)**Door Glass, Econoline**

N9906-A

Item	Part Number	Description
1	21452-3	Outside Belt
2	21439-5	Inside Belt
3	21478	Window Glass

(Continued)

Item	Part Number	Description
4	N621906-S36	Nut and Washer Assembly 7-11 N·m (6-8 Ft·Lb)
5	N800508-S36	Screw and Washer Assembly 7-11 N·m (6-8 Ft·Lb)
6	385189-S100	Rivet

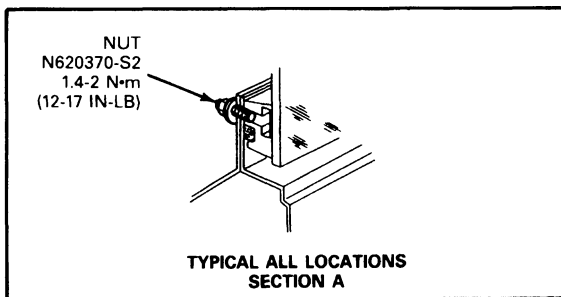
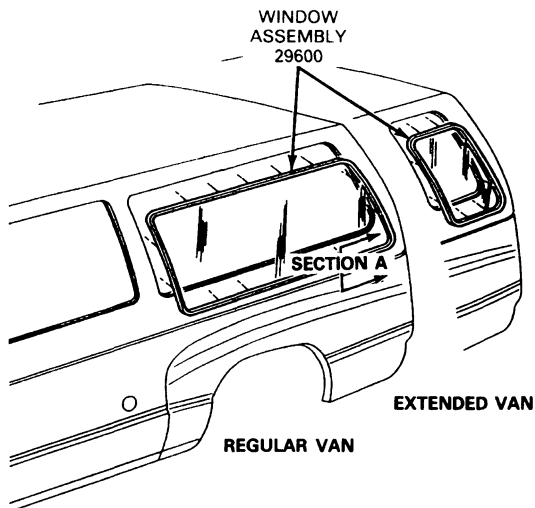
Rear Quarter Glass, Econoline**Removal and Installation**

NOTE: Tape exterior of glass to vehicle, to prevent glass from falling out of vehicle during removal.

1. Remove center control panel. Refer to Section 01-05B.
2. Remove swing hinge as outlined in this section.
3. Remove seat belt retainers. Refer to Section 01-20B.
4. Loosen center trim panel; do not remove.
5. Remove rear trim panel. Refer to Section 01-05B.
6. Remove lower trim panel. Refer to Section 01-05B.

7. Remove air conditioning hardware. Refer to 12-03A.
8. Remove the headliner plastic retainers and loosen moulding to access rear glass retainers.
9. Remove fourteen glass retaining nuts. Note location of retainer for installation.
10. Using a razor cut the form core butyl and remove glass.
11. Remove all foam butyl from glass, if reinstalling, and pinchweld using a razor blade.

For installation, follow the removal procedure in reverse order. Align glass using alignment hole at lower rear pinchweld.

REMOVAL AND INSTALLATION (Continued)**Rear Quarter Glass Windows, Econoline**

N9912-B

Side Flip-Out Glass and Back Door Glass, Econoline**Removal and Installation**

NOTE: When removing the side flip-out glass, use an assistant to lift glass from vehicle.

NOTE: If removing back door glass, tape glass to exterior of vehicle prior to beginning removal procedure.

1. Using a small screwdriver, remove pins from window hinges.
2. Remove screws from top of glass, using a Torx® T27.

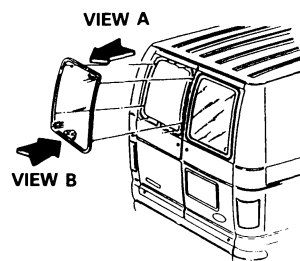
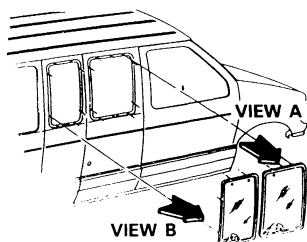
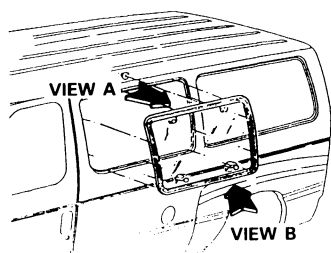
NOTE: It is important to install glass hardware in same order as originally installed to prevent improper fit and wind noise.

3. From exterior of vehicle, have an assistant lift glass from vehicle.
4. On side glass, if removing moulding from vehicle glass opening, remove interior trim to access mounting system.

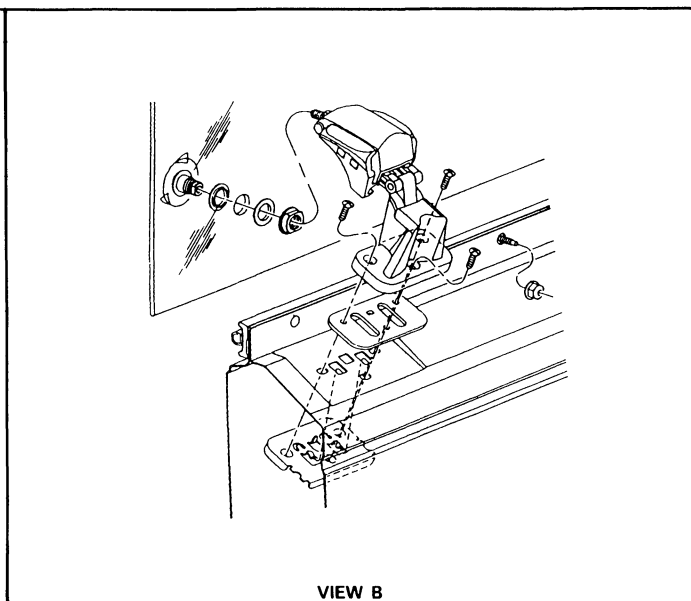
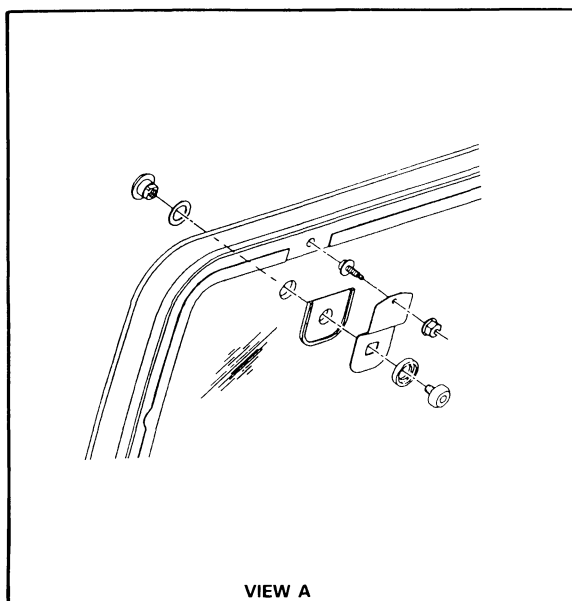
For installation, follow removal procedures in reverse order. Check glass for proper operation.

REMOVAL AND INSTALLATION (Continued)

Movable Glass, Econoline



MAIN VIEW



N9915-B

Front Door Glass, F-Series and Bronco

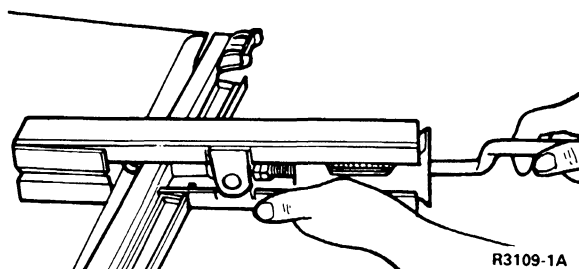
Removal

1. Remove the door trim panel and watershield. Refer to Section 01-05A.
2. Remove screw from the front division bar.
3. Remove two vent window assembly attaching screws from the front edge of the door.
4. Lower the door glass and pull the glass run out of the run retainer near the vent window division bar enough to allow removal of the vent window assembly.
5. Tilt the vent window and division bar assembly toward the rear of door and remove vent window from door.
6. Rotate front edge of glass downward and lift the glass from door.
7. Remove the glass from the glass channel using Glass and Channel Removal Tool 2900.

Installation

1. Install the glass channel using Glass and Channel Removal Tool 2900 or equivalent.

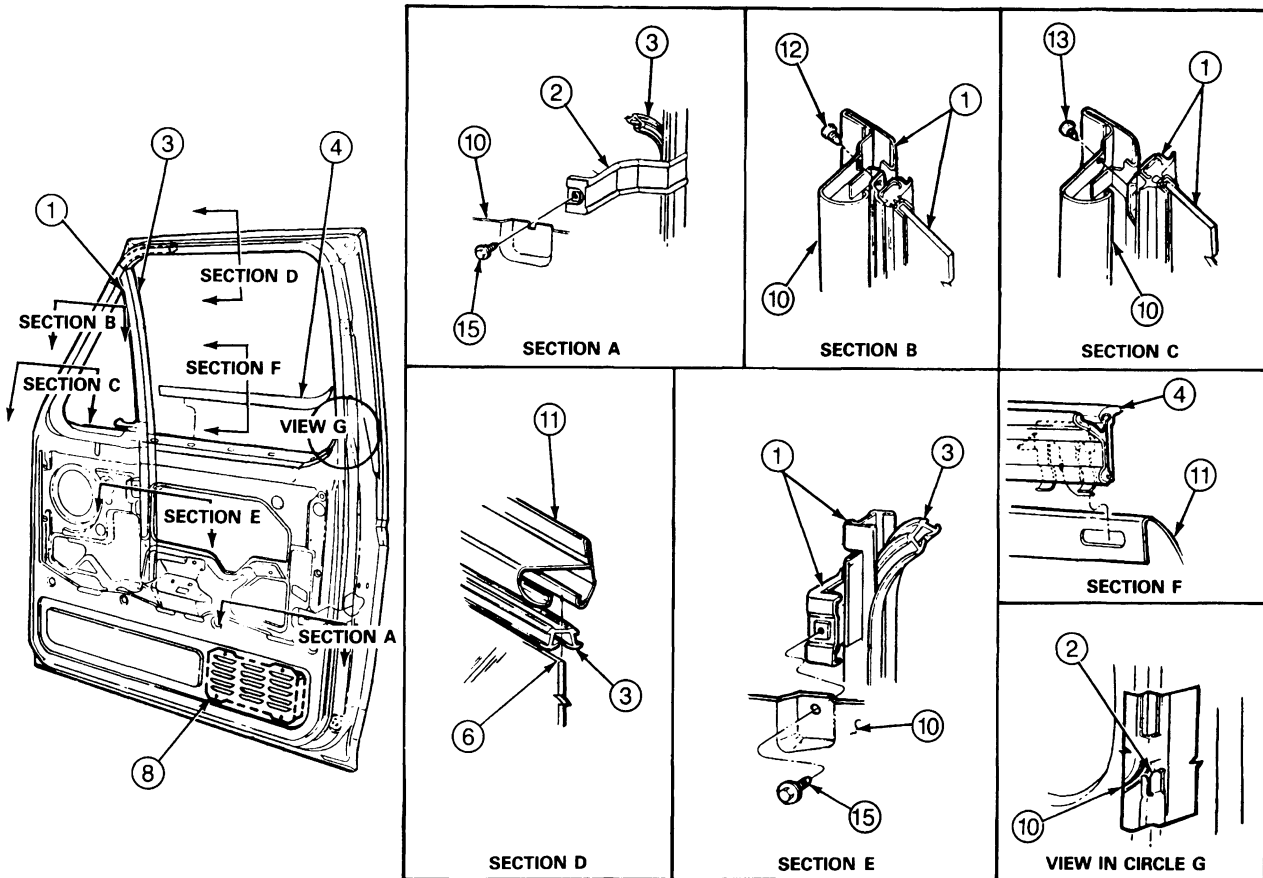
GLASS AND CHANNEL REMOVAL TOOL (NO. 2900)
OR EQUIVALENT AVAILABLE FROM SOMMER AND
MALA GLASS MACHINE COMPANY, 5501 W.
OGDEN AVENUE, CHICAGO, ILLINOIS 60650



2. Position the glass and channel assembly into the door, inserting the regulator arm roller into the slot of the glass channel.

REMOVAL AND INSTALLATION (Continued)

3. Position the vent window and division bar into the door and insert the front edge of the glass into the division bar (front) run.
4. Install the two vent window attaching screws at the forward edge of the door.
5. Insert the glass run into the run retainer near the division bar.
6. Install the screw at the front run retainer. Adjust as outlined in this section.
7. Check window operation.
8. Install the watershield and door trim panel as described in this section.

Front Door Glass, F-Series and Bronco

N4541-D

Item	Part Number	Description
1	21402	Vent Window
2	21532	Retainer Assembly
3	21596	Run Assembly
4	21452	Weather Strip Assembly
6	21410	Glass — Door Window

(Continued)

Item	Part Number	Description
8	20892	Door Vent Valve Assembly
10	—	Door Inner Panel
11	—	Door Outer Panel
13	55927-S55	Screw
15	800510-S100	Screw and Washer Assembly

Back Window, Fixed Glass, F-Series

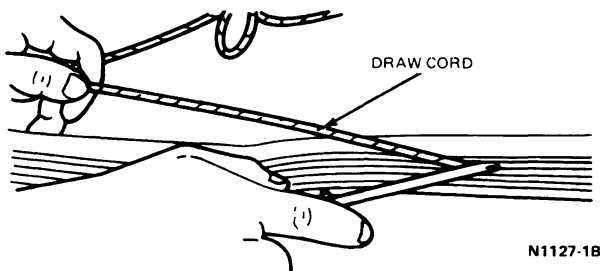
An assistant outside the vehicle is necessary when removing or replacing the glass.

Removal

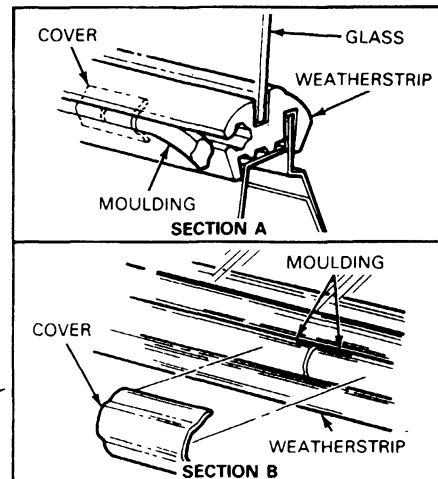
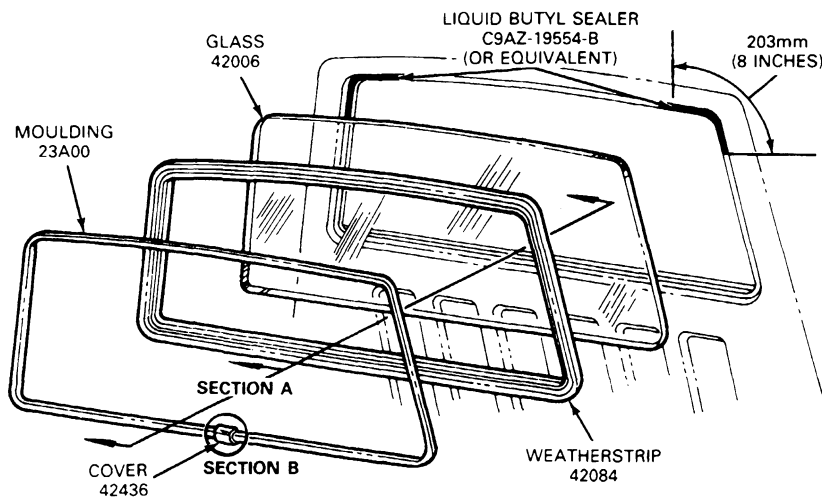
1. From vehicle interior, pull down on weatherstrip and push glass and weatherstrip from window. Use assistant to grasp glass from exterior to remove.
2. Remove the weatherstrip from the glass.

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Clean the old seal from the body recess and from the glass assembly.
NOTE: All traces of old sealing material must be removed.
2. Inspect for sheet metal deficiencies. Check the sealing surface of flange for chipped or missing pane. Repair as necessary.
3. Install outside moulding, if equipped. Position the weatherstrip to the back window glass.
4. Install a draw cord all around the weatherstrip in the flange crevice, allowing the cord to overlap at the bottom center of the glass. Coat the weatherstrip mounting surface with Rubber Lubricant D9AZ-19583-A (ESA-M1B6-A) or equivalent.



5. Apply Liquid Butyl Sealer C9AZ-19554-B (ESB-M4G 162-A) or equivalent to the back window opening areas.
6. Position the glass and weatherstrip to the window opening. With an assistant applying hand pressure from outside the cab, pull (from inside) the weatherstrip lip over the window opening flange with the draw cord.
7. Pull the weatherstrip over the lower flange, pulling one end of the cord at a time. Then, pull the weatherstrip over the side flanges and upper flange.
8. Clean the glass and the area around the window to remove all excess sealer.
9. Test for water leaks. If leaks are present, lift or pull down weatherstrip lip at leak location. Apply Liquid Butyl Sealer C9AZ-19554-B (ESB-M4G 162-A) or equivalent. Remove excess sealer.

Back Window, Fixed Glass, F-Series**Movable Back Window, F-Series****Removal**

1. From vehicle interior, pull down the weatherstrip lip along the window opening.
2. Push the back window frame and weatherstrip out of the window opening from inside the cab.
3. Remove the weatherstrip from the window frame.
4. Place the movable windows in the open position.

5. From the top of the window frame, remove the screw retaining each division bar. Also, remove the two screws retaining the anchor plate in the window track and remove the plate.
6. Spread the window frame and work the movable glass out of its track. Remove from frame.
7. If the stationary glass is to be replaced, remove the division bar lower retaining screw and remove the division bar.

REMOVAL AND INSTALLATION (Continued)

8. Spread the window frame enough to remove stationary glass from frame.

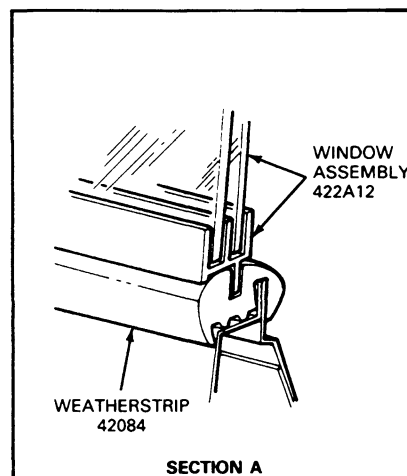
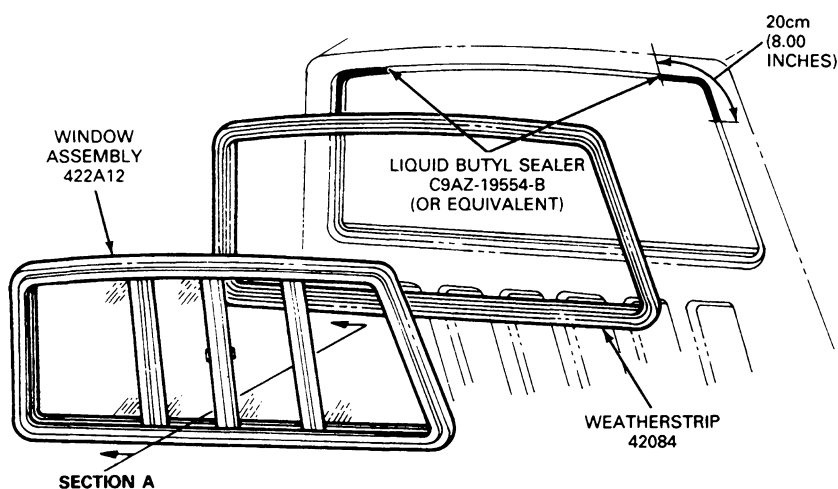
Installation

1. If the stationary glass is to be replaced, apply Silicone Lubricant COAZ-19553-AA (ESR-M13P4-A) or equivalent to the window weatherstrip and track. Spread the frame slightly and slide the glass into frame.

NOTE: Do not allow the weatherstrip to bunch.

2. Position the division bar in the frame and install the lower retaining screw.
3. Spread the frame slightly and install the movable glass in its track.
4. Install the division bar upper retaining screws.
5. Position the weatherstrip to the window frame.

6. Install a draw cord all around the weatherstrip in the flange crevice, allowing the cord to overlap at the bottom center of the glass.
7. Apply 203mm (8 inches) of Liquid Butyl Sealer C9AZ-19554-B (ESB-M4G162-A) or equivalent between the two secondary sealing fins centered on each upper corner.
8. Position the glass and weatherstrip to the window opening.
9. With an assistant applying hand pressure from outside the cab, pull the weatherstrip lip over the window opening flange with a draw cord.
10. Pull the weatherstrip over the lower flange, pulling one end of the cord at a time.
11. Pull the seal over the side flanges and upper flange.

Back Window Glass Installation

N4546-2D

Door Glass, F-Series Crew Cab**Removal**

1. Remove the door latch trim cup, armrest and window regulator handle. Remove door trim panel. Refer to Section 01-05A.
2. Remove one screw at top of door and one screw on door inner panel retaining division bar to door.
3. With movable window in the down position, remove division bar by pulling it toward rear of vehicle and lifting up, while twisting bar so bracket clears window glass opening and weatherstrip slides off.
4. Raise movable window half way up, slide regulator out of window glass channel. Remove window from window opening.
5. Pull fixed window and weatherstrip towards rear of vehicle as an assembly and remove.

Installation

1. Install weatherstrip to fixed window.

2. Position fixed window and weatherstrip as an assembly into the window opening, align in channels, and slide toward front of vehicle until it is firmly seated.
3. Install the movable window into the window opening and while supporting window in half open position, slide window regulator into window glass channel.
4. Install division bar into the window opening.
5. Install movable window weatherstrip into division bar and onto top of movable window.
6. Align movable window into division bar run. Install one screw at top of door and one bolt to front of door to retain division bar. Tighten to specifications.
7. Cycle window and check for looseness or binding.
8. Adjust channel as necessary by loosening rear window run retaining bolt and moving rear window run forward or rearward.

REMOVAL AND INSTALLATION (Continued)

- | | |
|--|---|
| <ul style="list-style-type: none">9. Tighten rear window run screw securely as specified.10. Install door trim panel. Refer to Section 01-05A.11. Install the armrest with two bolts and the door latch trim cup with one screw. | <ul style="list-style-type: none">12. Install the window regulator handle with one screw. |
|--|---|

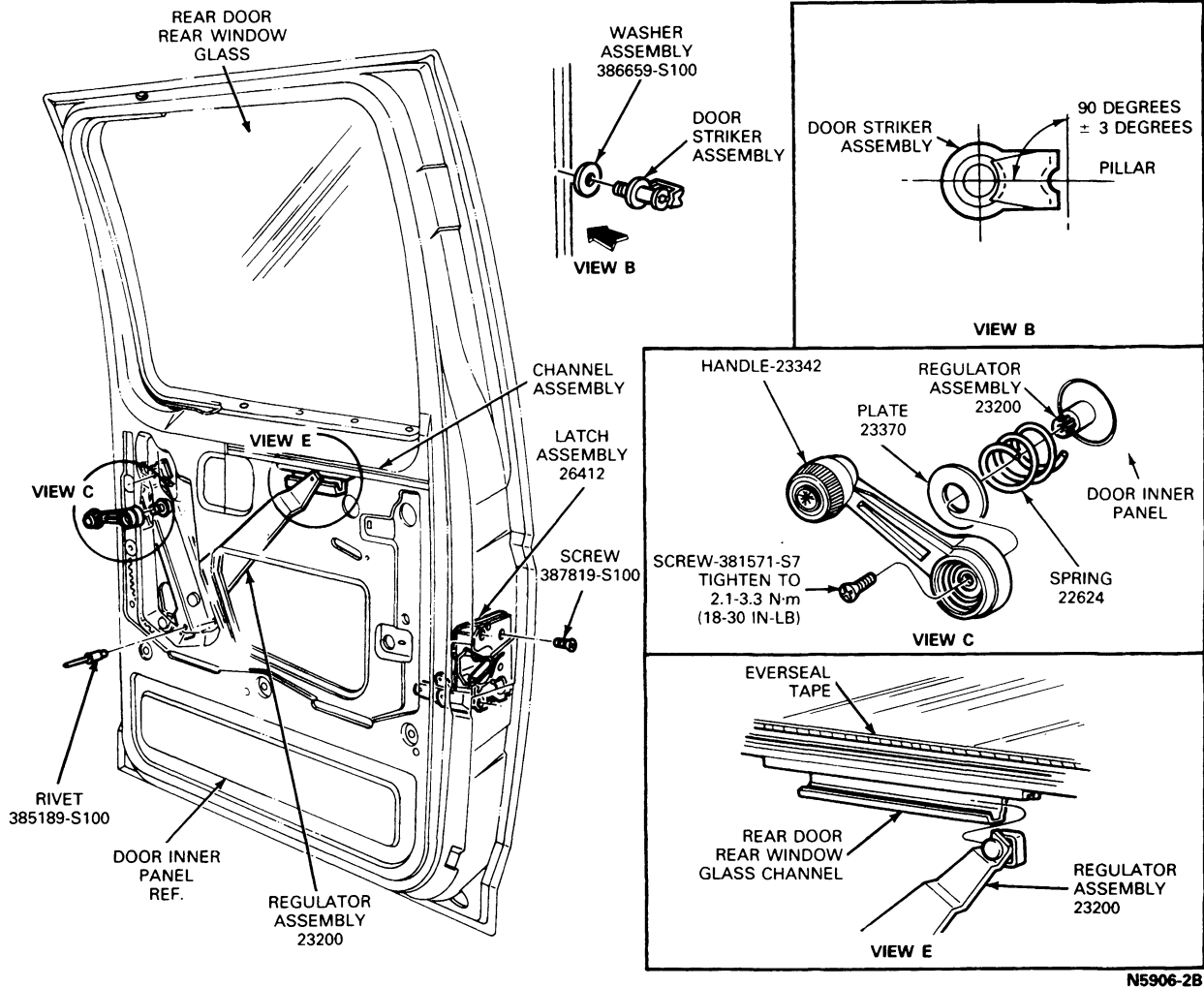
REMOVAL AND INSTALLATION (Continued)

Crew Cab Rear Door Window, Weatherstrips and Retainers



REMOVAL AND INSTALLATION (Continued)

Crew Cab Rear Door Window Mechanisms



Side Window, F-Series SuperCab

Removal

1. Remove interior trim around window.
2. Remove six window retaining nuts from the inside of the vehicle.
3. Remove the glass assembly by pushing with enough pressure to separate the butyl seal.
4. Clean the old seal from the body recess and from the window module. All traces of the old sealing material must be removed.
5. Inspect for sheet metal deficiencies. Check the sealing surface of the flange for chipped or missing paint. Repair as necessary.

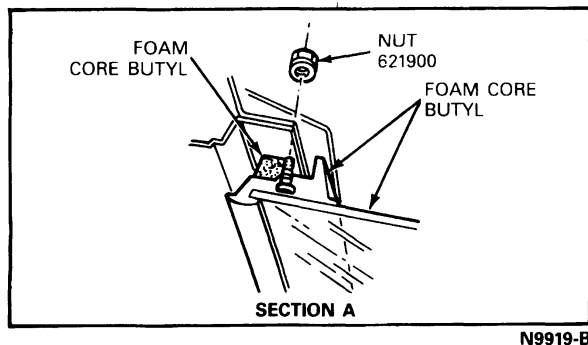
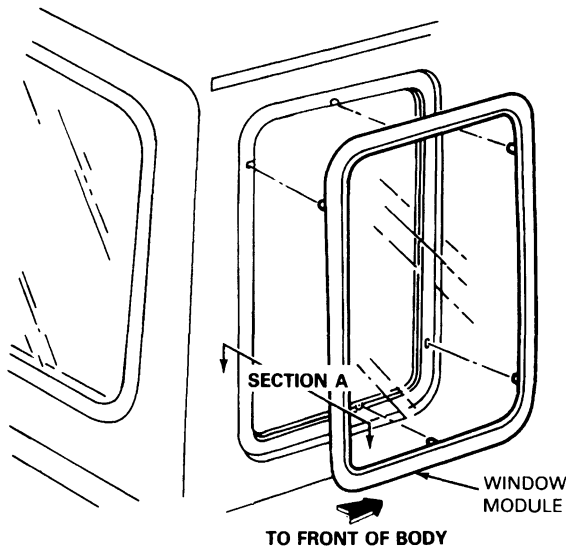
Installation

NOTE: Sheet metal flange and window module must be clean and free of defects.

1. Apply Foam Core Butyl Service Tape to the back side of the window module on the sealing surface, if not already present, and remove protective backing paper equivalent around the outer perimeter of the body recess.
2. Press window assembly into place. Use enough pressure to seat the glass firmly in the sealing material, but avoid damaging or distorting window module. Install six retaining screws and tighten to 2.1-2.9 N·m (19-25 in-lb).
3. Install interior trim around window.

REMOVAL AND INSTALLATION (Continued)

4. Test for leaks. If present repeat above steps.



N9919-B

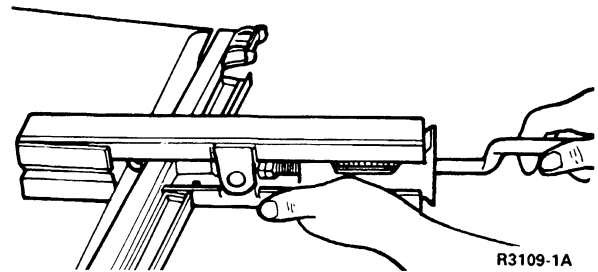
Vent Window Glass**Removal**

1. Open the vent window.
2. Push the glass from the glass frame using Glass and Channel Removal Tool 2900 or equivalent.
3. Clean the glass frame of tape and sealer.

Installation

1. Apply sealer to the glass frame.
2. Install the glass and new tape in the glass frame using Glass and Channel Removal Tool 2900 or equivalent.
3. Trim the excess edges of the tape around the glass frame and clean the glass and surrounding area.

GLASS AND CHANNEL REMOVAL TOOL (NO. 2900)
OR EQUIVALENT AVAILABLE FROM SOMMER AND
MALA GLASS MACHINE COMPANY, 5501 W.
OGDEN AVENUE, CHICAGO, ILLINOIS 60650

**Vent Window Assembly and Weatherstrip, F-Series and Bronco****Removal**

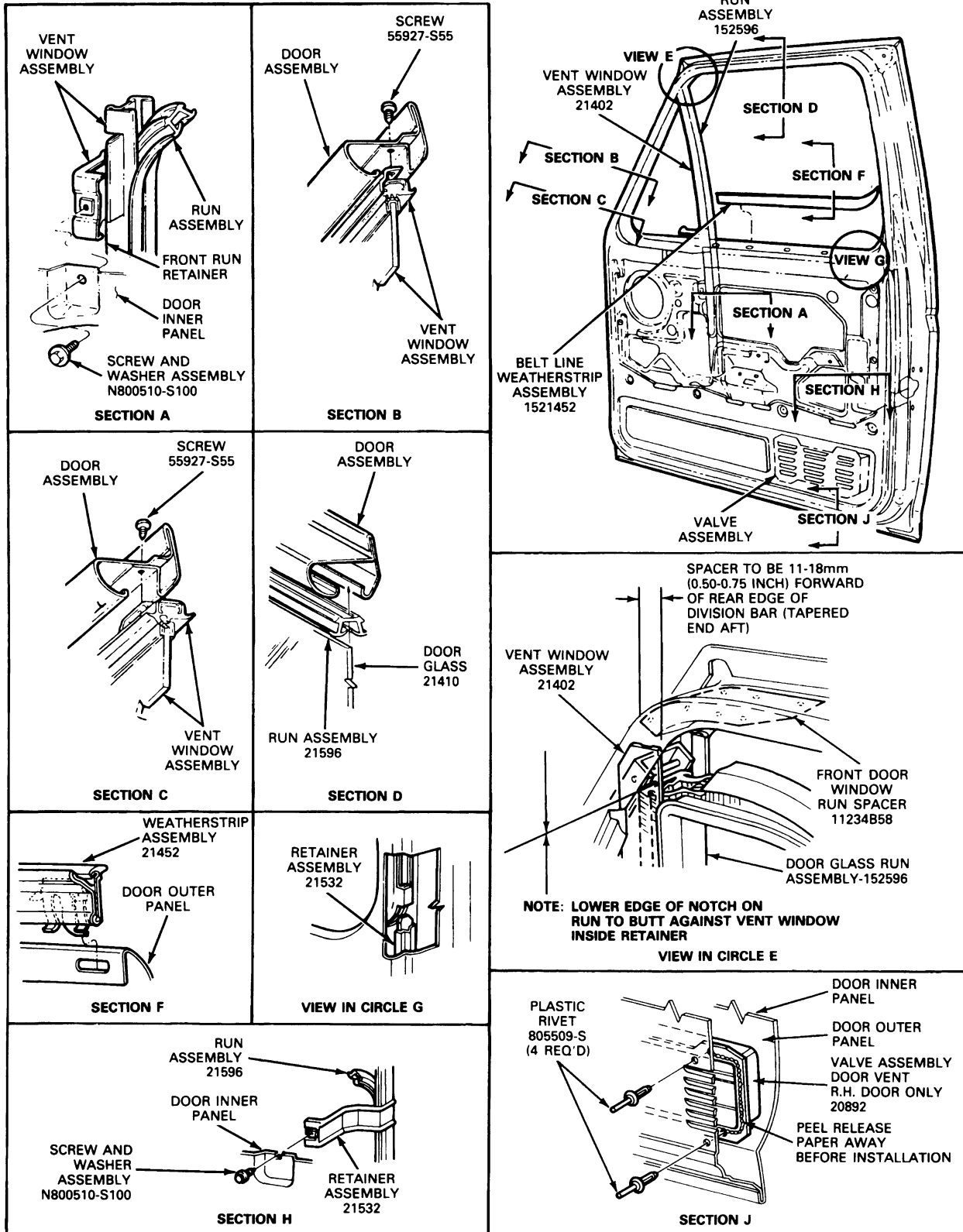
1. Remove the door trim panel retaining screws and remove the door trim panel.
2. Remove the screw retaining the division bar to door inner panel.
3. Remove the two screws attaching the vent assembly to the leading edge of the door.
4. Lower the door glass to full down position.
5. Pull the glass run part way out of the door run retainer in the division bar area.
6. Tilt the vent window and division bar assembly toward the rear of the door and remove the vent window assembly from the door.
7. Remove two vent upper pivot-to-vent frame screws.
8. Remove the retaining nut and tension spring from the vent window lower pivot.
9. Separate the vent glass retainer and the pivot stops from the vent frame and weatherstrip assembly.

Installation

1. Position the vent glass retainer assembly with the pivot stops into the vent window frame and weatherstrip assembly.
2. Install the two upper pivot-to-frame retaining screws.
3. Install the pivot tension spring and retaining nut. Adjust spring tension for proper operation.
4. Position the run assembly in the vent window assembly.
5. Position the vent window and division bar assembly into the door and to the glass edge. Make sure front door window spacer is in place.
6. Install the vent window frame to leading edge of door window frame with two retaining screws.
7. Install the division bar screw (adjust the run for proper door window operation).
8. Install the door trim panel and retaining screws.

REMOVAL AND INSTALLATION (Continued)

Vent Window Assembly, F-Series and Bronco



N4543-G

REMOVAL AND INSTALLATION (Continued)**Rear Side Window Glass, Bronco**

An assistant outside the vehicle is necessary when removing or replacing the glass.

Removal

1. From inside vehicle start at one corner and work across the top of the glass, pulling the weatherstrip down and pushing the glass and weatherstrip outward until assistant can grasp glass and lift it from the glass opening.
2. Remove the weatherstrip from the glass.

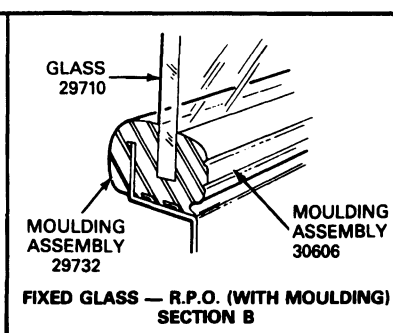
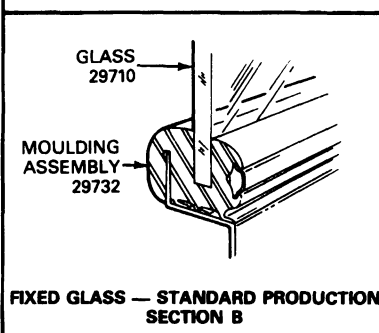
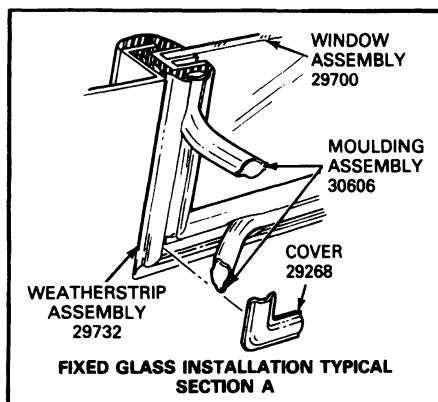
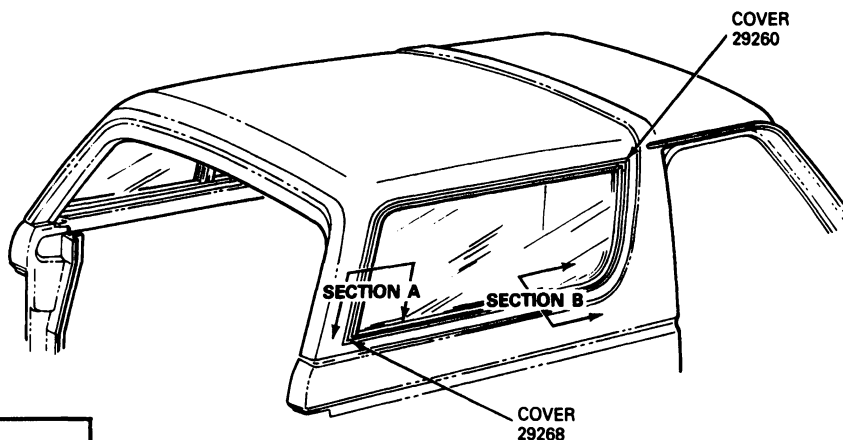
Installation

1. Clean the weatherstrip with cleaning solvent to remove all old sealer and cement.
2. Clean the glass opening flange. Check the flange for wavy areas, and repair as necessary.
3. Install the outside moulding, if so equipped. Position the weatherstrip to the window glass.

4. Install a draw cord all around the weatherstrip in the flange crevice. Let the draw cord overlap at the bottom center approximately 457mm (18 inches) and tape the ends of the draw cord to the inside of the glass. Apply Rubber Lubricant D9AZ-19583-A (ESA-M1B6-A) or equivalent to the weatherstrip lip.
5. Have an assistant position the window assembly in the window opening and apply hand pressure on the glass from the outside.
6. From inside, draw the lip of the weatherstrip over the window opening lower flange with a draw cord. Alternate from side to side, moving approximately 305mm (12 inches) at a time, until the window is in place.
7. Water test the installation for leaks, and seal with additional Liquid Butyl Sealer C9AZ-19554-B (ESB-M4G162-A) or equivalent, if necessary.
8. Remove excess sealer.

Rear Side Window Glass, Bronco

SLIDING SIDE WINDOW SHOWN
FIXED SIDE WINDOW TYPICAL



N5901-C

Tailgate Glass, Bronco**Removal**

1. Open tailgate.

2. Remove inside cover access panel and retaining screws.
3. Remove inside cover panel support and retaining screws.

REMOVAL AND INSTALLATION (Continued)

4. Remove inside cover watershield.
5. Manually close both tailgate latches to raise the glass.
6. Remove four nuts retaining glass and bracket assembly to regulator.
7. If tailgate has heated glass option, disconnect two terminals (driver's side).
8. Grind off four rivets, two on each bracket assembly to glass. Punch out four rivets and remove four retainers and spacers.
9. Pull out tailgate upper corner seal assembly, one on each side.
10. Snap out tailgate inside belt weatherstrip assembly with tool.
11. Slide back window glass out from tailgate assembly.

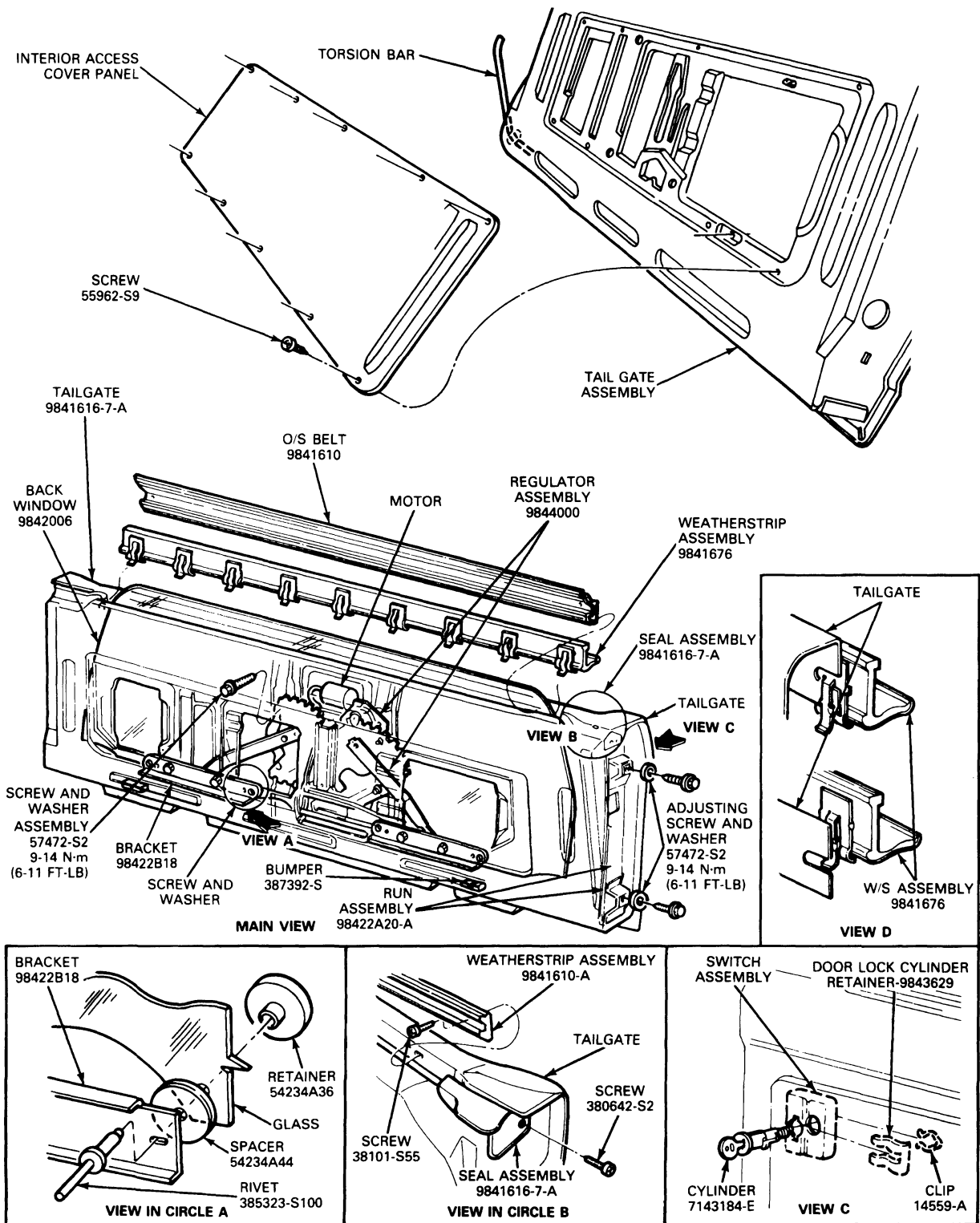
Installation

1. Slide glass midway into tailgate assembly.

2. Connect heated glass wires, if so equipped.
3. Install glass bracket C-channels onto the regulator arm slide guides.
4. Position tailgate glass over glass bracket C-channel studs and install four spacers, retainers and rivets.
5. Lower glass to connect heated glass wiring terminals.
6. Close tailgate and cycle glass to ensure smooth operation.
7. Install watershield.
8. Install inside cover panel support (one screw).
9. Install ten inside cover access panel screws.
10. Close door and cycle tailgate to ensure proper function.

REMOVAL AND INSTALLATION (Continued)

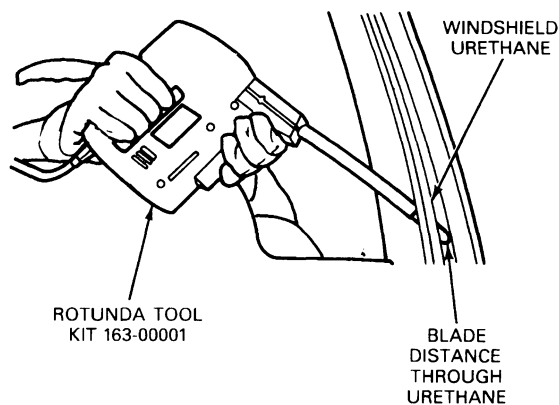
Tailgate Glass, Bronco



R2134-H

REMOVAL AND INSTALLATION (Continued)**Windshield, Econoline****Removal and Installation**

1. Remove windshield wipers. Refer to Section 01-16A.
2. Remove twelve two-piece cowl attaching screws.
3. Open hood, remove two-piece cowl starting with the driver side.
4. Close hood.
5. Remove the two lower glass stops and discard.
6. Remove rearview mirror, using Mirror Removal Tool T91T-17700-A.
7. Open front doors and loosen door seal moulding. Do not remove.
8. Remove A-pillar trim moulding.
9. Spray equalizer cutting lubricant ECL-784 around windshield urethane cutting area.
10. Cut urethane with utility knife.
NOTE: Start tool running prior to pushing blade into urethane.
11. Insert Equalizer Cutting Knife, Rotunda Tool Kit 163-00001 or equivalent into urethane at lower center of windshield and continue toward driver side.



N10737-A

NOTE: On bonded encapsulated parts, turn blade over so flat side is against pinchweld. If blade is not turned over it may cut / damage plastic encapsulation.

NOTE: Replace the two glass stops to prevent glass from falling out while cutting remaining urethane.

12. Remove windshield.
13. Using a razor remove any remaining urethane from pinchweld.
14. If reinstalling clean all remaining urethane from glass.
15. Apply Black Primer #2 around windshield edge and wipe off any excess.

16. Apply Black Pinchweld Primer Essex 400 urethane to pinchweld.
17. Apply urethane and position windshield onto vehicle.

NOTE: Refer to urethane manufacturer's directions for exact cure time.

For installation, follow removal procedures in reverse order.

Windshield Glass, F-Series and Bronco**Removal**

1. Remove the windshield wiper arms and blades.
2. Remove all mouldings, glass stops and retainers.
3. Remove windshield rearview mirror.
 - a. Loosen mirror mounting bracket setscrew.
 - b. Pull mirror assembly upward to remove from windshield retainer.
4. Spray equalizer cutting lubricant ECL-784 around windshield urethane cutting area.
5. Cut urethane around windshield with utility knife.
6. Insert Equalizer Cutting Knife, Rotunda Tool Kit 163-00001 or equivalent, into urethane at lower center of windshield and continue toward driver side.
NOTE: On bonded encapsulated parts, turn blade over so flat side is against pinchweld. If blade is not turned over it may cut / damage plastic encapsulation.
7. Remove the windshield.
8. Remove any excess urethane, using care not to smear the urethane on component parts, instrument panel and vinyl roof.

NOTE: If the urethane has cured all the way through, it will not be necessary to remove the urethane which remains on the sheet metal.

9. Check flange sealing area for faulty sheet metal or foreign objects which may have caused, or may cause, glass breakage. Repair sheet metal if necessary.

Installation

NOTE: If existing (fully cured) urethane remains on the windshield opening flange, the new urethane should be applied on top of the existing urethane. However, at no point should the existing urethane material exceed 2.54mm (0.10 inch) above the flange sheet metal. If necessary, reduce the height of the existing urethane at various points using a razor blade or Stanley® knife.

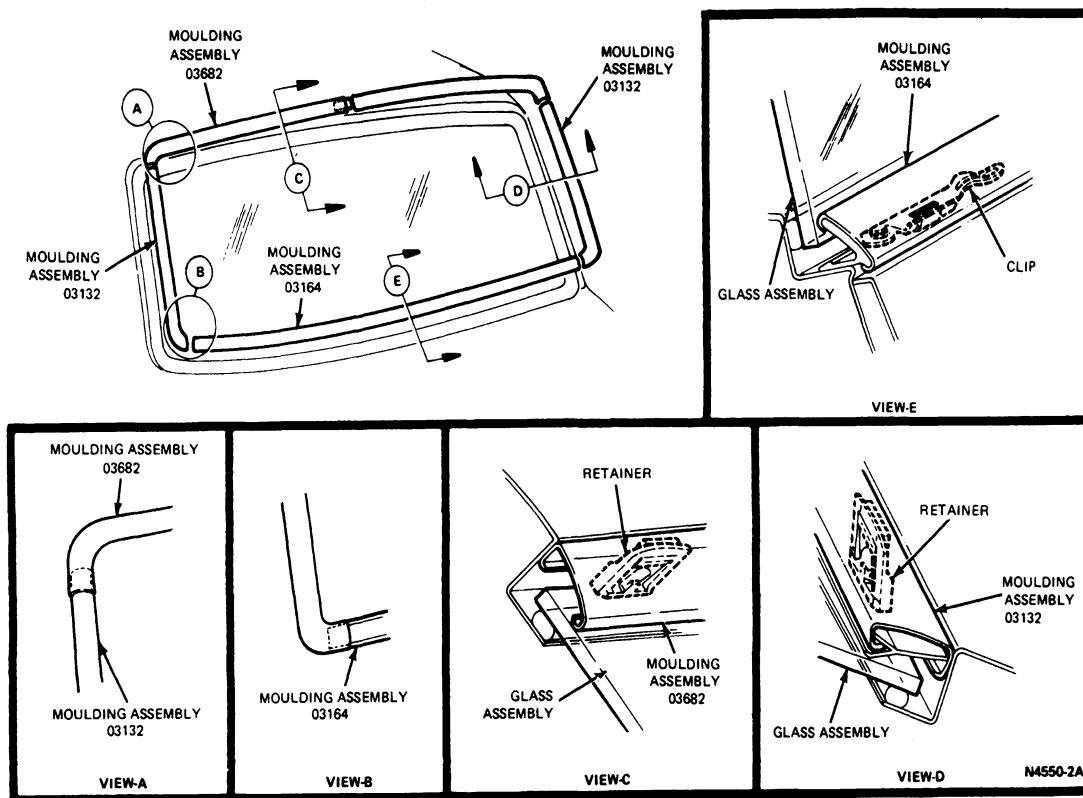
NOTE: Repair sheet metal flange if damaged.

1. If painted sheet metal has been exposed anywhere along the flange, use a clean brush and apply Urethane Metal Primer WSB-M2G234-C or equivalent to windshield opening flange.

NOTE: A minimum of 30 minutes is required for primer surface to dry.

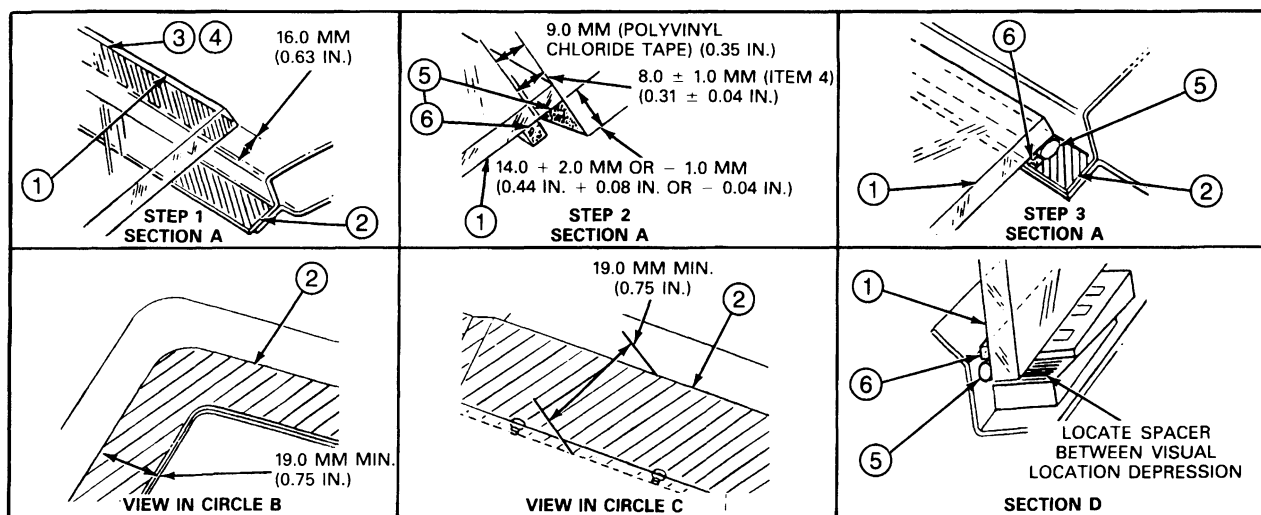
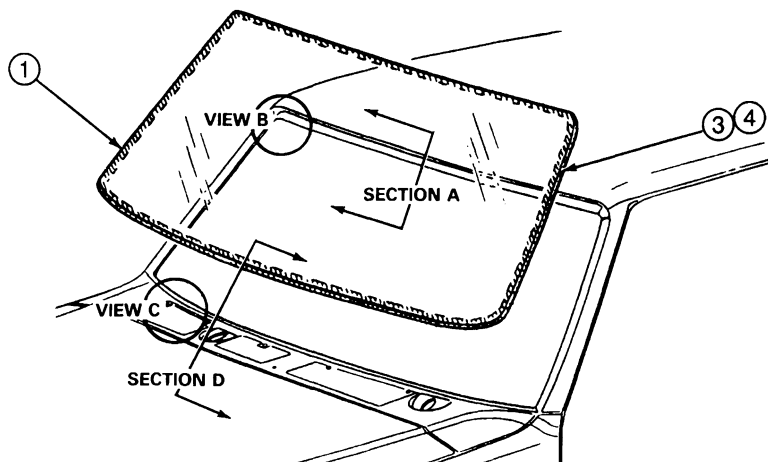
REMOVAL AND INSTALLATION (Continued)

2. Install foam dam (with self-adhesive backing) around window opening at end of metal flange, and at uppermost side of seal plane along cowl.
3. Clean the windshield.
4. Properly align windshield window glass into body.
5. Place windshield window glass into opening. Center it top, bottom and side-to-side. Adjust lower glass spacers to achieve this.
6. Using masking tape or crayon, make alignment marks at points on four side of both glass and window opening.
7. Remove windshield window glass and place on a low stable work surface, inside up.
8. Using a lint-free cloth, wipe the outer 12.70mm (1/2-inch) of the inside windshield periphery with Urethane Glass Wipe WSB-M5B280-C2 or equivalent.
NOTE: Wipe off primer immediately after application because it flash dries.
9. Thoroughly shake and stir Urethane Glass Primer WSB-M2G3 14-B or equivalent to ensure uniform pigment mixing.
10. Using a clean brush, apply primer to the outer 12.7mm (1/2 inch) of the windshield periphery. Allow at least five minutes drying time.
11. Apply an even bead of Urethane Sealer WSB-M2G3 16-B or equivalent around entire windshield edge using an air pressure cartridge gun. Air in pressure should be approximately 276 kPa (40 psi). The bead should be triangular in shape, 14mm (0.55 inch) high, and 8mm (0.31 inch) at base.
12. Taking care to align the marks on the glass to the body, install the windshield assembly onto the vehicle. This must be done within 10 minutes of applying the urethane.
13. Install the retainers and mouldings.
WARNING: ALLOW ALL GLASS PARTS INSTALLED WITH URETHANE AMPLE TIME TO CURE.
14. Install windshield wiper arms and blades, and rearview mirror.
15. Install windshield moulding.
NOTE: Use only urethane to afterseal all air and water leaks.

Windshield Glass Removal and Installation, Alternate Method, F-Series and Bronco

REMOVAL AND INSTALLATION (Continued)

Windshield Glass Removal and Installation, F-Series and Bronco



N5696-C

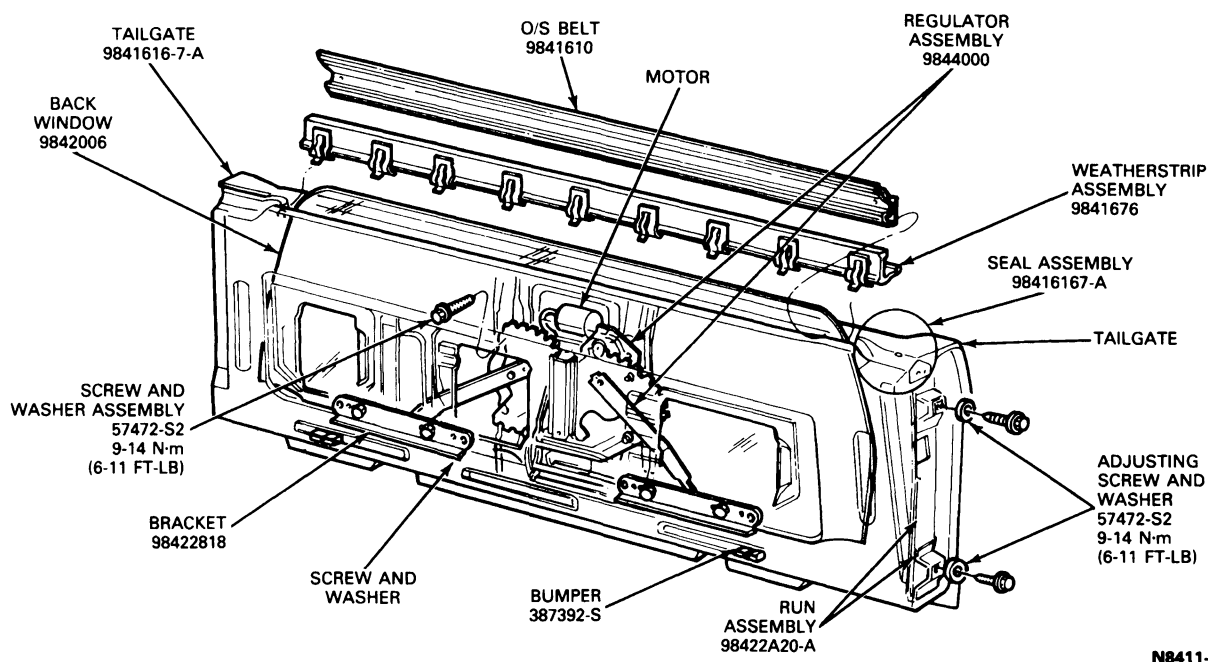
ADJUSTMENTS

Tailgate Glass Mechanism, Bronco

Fore-and-aft adjustments can be made by loosening the back window side glass run attaching screws (two per side). Adjust the glass as required and tighten the attaching screws to 9-14 N·m (6-11 ft·lb).

ADJUSTMENTS (Continued)

Tailgate Glass Mechanism, Bronco



Front Door Window Mechanism, F-Series, F-Super Duty Chassis Cab and Bronco

The front door windows can be adjusted fore or aft on these vehicles by loosening the front division bar lower attaching screws and the rear run retainer lower attaching screws.

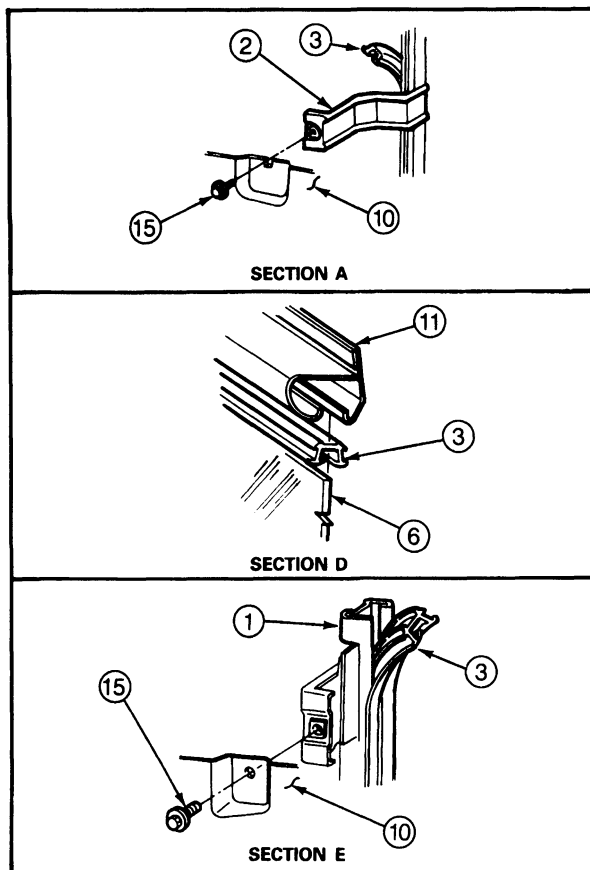
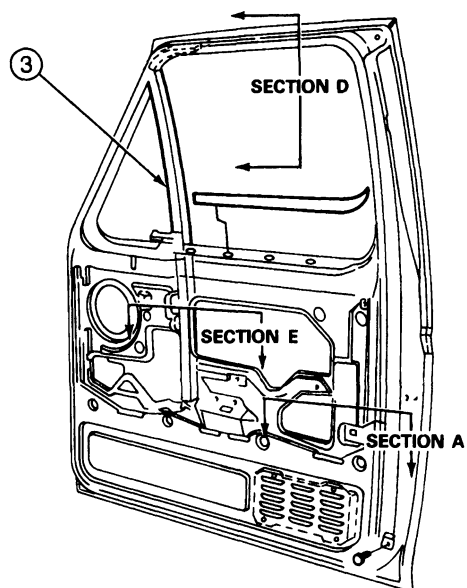
Door Glass

Before making any adjustments, remove the door armrest, trim panel and watershield. Refer to Section 01-05B.

1. Loosen, but do not remove, upper regulator retaining nuts.
2. Raise glass to full up position and tighten nuts to 8-14 N-m (6-10 ft-lb).
3. Loosen, but do not remove, rear glass retainer bolt.
4. Move glass to rearward position and tighten retainer bolt to 7-11 N-m (6-8 ft-lb).

ADJUSTMENTS (Continued)

Door Glass Adjustment, F-150-250-350, F-Super Duty Chassis Cab and Bronco



N7420-B

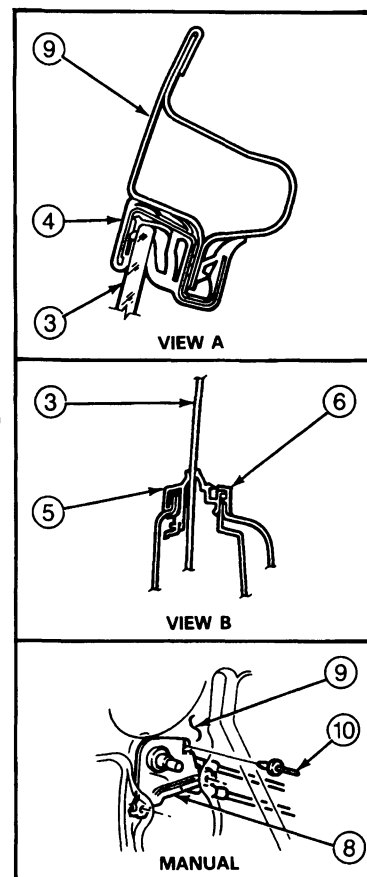
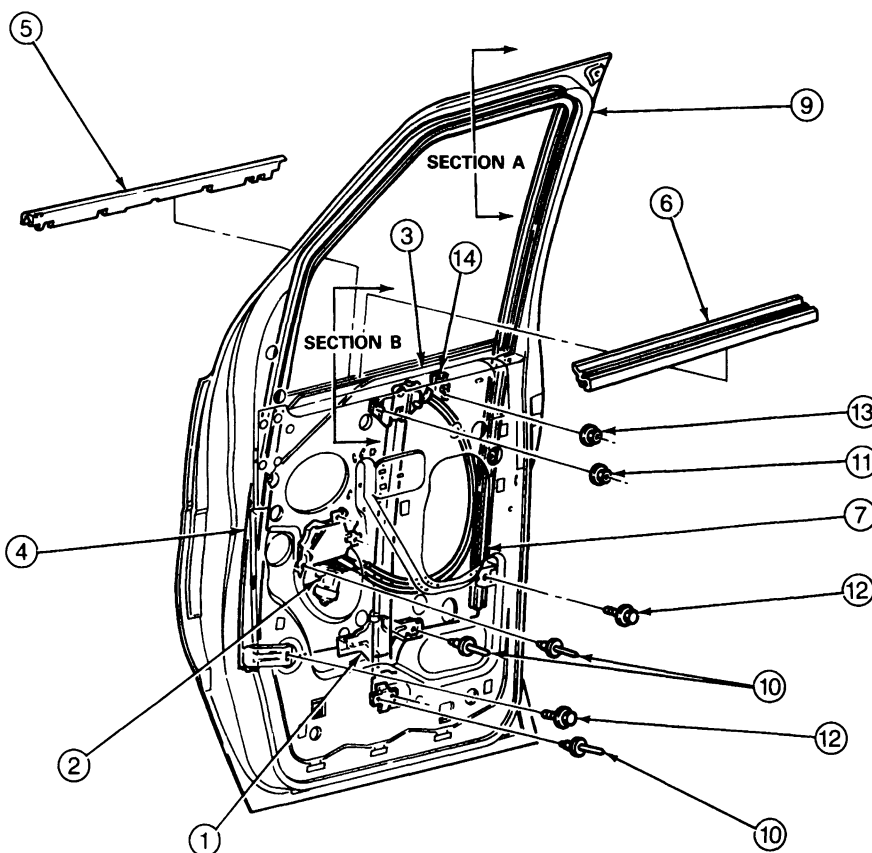
Item	Part Number	Description
1	21402	Vent Window Retainer Assembly
2	21532	Run Assembly
3	21596	

(Continued)

Item	Part Number	Description
6	—	Glass — Door Window
10	—	Door Inner Panel
11	—	Door Outer Panel
15	800510-S100	Screw and Washer Assembly

ADJUSTMENTS (Continued)

Front Door Window Glass Adjustment, Econoline



N9902-A

Item	Part Number	Description
1	Ref.	Regulator Glider
2	23200	Power Cable Drive
3	21478	Window Glass
4	15767	Guide Retainer
5	21452-3	Outside Belt
6	21439-5	Inside Belt
7	222A0-1	Rear Run Assembly
8	23200-A	Manual Cable Drive

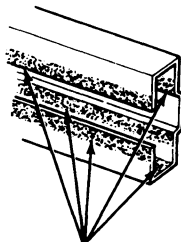
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Item	Part Number	Description
9	Ref.	Front Door
10	385189-S100	Rivet
11	N621907-S36	Nut and Washer Assembly 8-14 N·m (6-10 Ft-Lb)
12	N800508-S36	Screw and Washer Assembly 7-11 N·m (6-8 Ft-Lb)
13	N621906-S36	Nut and Washer Assembly 7-11 N·m (6-8 Ft-Lb)
14	Ref.	Stabilizer Assembly

LUBRICATION

Window Mechanism

The door window mechanism should be properly lubricated to provide ease of operation. The window glass mechanism should be lubricated whenever the glass channel or window regulator is removed, or excessive effort is required to operate the windows. To lubricate a door window mechanism, apply an even coating of Multi-Purpose Grease D7AZ-19584-AA (ESR-M1C159-A) or equivalent to the window regulator rollers, shafts and the entire length of the roller guides as illustrated by the shaded areas.





NOTE: APPLY AN EVEN COATING OF MULTI-PURPOSE GREASE, D7AZ-19584-AA OR EQUIVALENT TO ALL WINDOW REGULATOR ROLLERS, SHAFTS AND THE ENTIRE LENGTH OF ROLLER GUIDES AS ILLUSTRATED BY THE SHADED AREA.

N6024-D

TORQUE SPECIFICATIONS (Cont'd)

Description	N-m	Lb-Ft
Body Side Window Nut (Extended Cab-Econoline)	1.4-2	12-17 (In-Lb)
Regulator Handle Screw (F-Series, Crew Cab)	2.1-3.3	18-30 (In-Lb)
Power Window Motor Retaining Screws (F-Series / Bronco)	5.6-9.6	50-85 (In-Lb)
Bolt / Grommet and Screw (Cargo Glass-Econoline)	1-2	9-17 (In-Lb)
Body Side Window Nut (Econoline)	1.4-2	12-17 (In-Lb)
Motor Retaining Screw(s) (F-Series and Bronco)	5.6-9.6	50-85 (In-Lb)
Tailgate Adjusting Screws and Washer	9-14	6-11
Tailgate Motor Screw and Washer	9-14	6-11
Tailgate Regulator Screw(s)	9-14	6-11
Window Regulator Screw	3.7-5.4	5.4

SPECIAL SERVICE TOOLS / EQUIPMENT

Tool Number / Description	Illustration
T64P-42006-B Moulding Removal Tool	 T64P-42006-B
T64P-42006-C Moulding Removal Tool	 T64P-42006-C

Tool Number	Description
D81P-42006-B	Dual Handle Knife
D81T-33610	Glass Holding Tool
2900	Glass and Channel Remover

ROTUNDA EQUIPMENT

Tool Number	Description
007-00001	Digital Volt-Ohmmeter
107-00600	Hydraulic Rivet Gun
163-00001	Equalizer Cutting Knife

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
Tailgate Glass Attaching Screws (Bronco)	9-14	6-11
Upper Door Retaining Nuts (Econoline)	8-14	6-10
Door Glass Retainer Nut (Econoline)	7-11	6-8
Door Glass Rear Run Screw (Econoline)	7-11	6-8
Power Window Motor Mounting Bracket Screws	5.5-7.0	4.0-5.2
Front Side Glass Nut (Econoline)	1-2	9-17 (In-Lb)
Back Door Glass Bolt / Grommet and Nut (Econoline)	1.4-2	12-17 (In-Lb)

(Continued)

SECTION 01-12A Instrument Panel and Console, F-Series and Bronco

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING.....	01-12A-1	REMOVAL AND INSTALLATION (Cont'd.)	
REMOVAL AND INSTALLATION		Instrument Cluster.....	01-12A-8
Ash Receptacle	01-12A-3	Instrument Panel	01-12A-8
Cigar Lighter	01-12A-3	Latch Assembly, Glove Compartment	01-12A-6
Cluster Finish Panel.....	01-12A-6	Pad and Retainer Assembly	01-12A-7
Console Assembly, Floor-Mounted and		Power Point.....	01-12A-5
Seat-Mounted	01-12A-4	SPECIFICATIONS.....	01-12A-16
Glove Compartment Door Assembly	01-12A-6	VEHICLE APPLICATION	01-12A-1

VEHICLE APPLICATION

F-150-250-350, F-Super Duty Chassis Cab and
Bronco Vehicles

DIAGNOSIS AND TESTING

Possible problems associated with the cigar lighter
are listed in the following Diagnosis Guide along with
possible causes and correction steps.

CONDITION	POSSIBLE SOURCE	ACTION
Cigar lighter knob pops out before adequate heating.	<ul style="list-style-type: none"> ● Cigar lighter element. ● Cigar lighter socket. 	<ul style="list-style-type: none"> ● Substitute another element. Replace if necessary. ● Replace socket.
Cigar lighter element stays in, will not heat up.	<ul style="list-style-type: none"> ● Fuse burnt out. ● Open circuit in wiring. ● Cigar lighter element. ● Cigar lighter socket. 	<ul style="list-style-type: none"> ● Replace fuse. If fuse blows again, check for short circuit. ● Check for power to socket. Repair if necessary. ● Substitute another element. Replace if necessary. ● Replace socket.

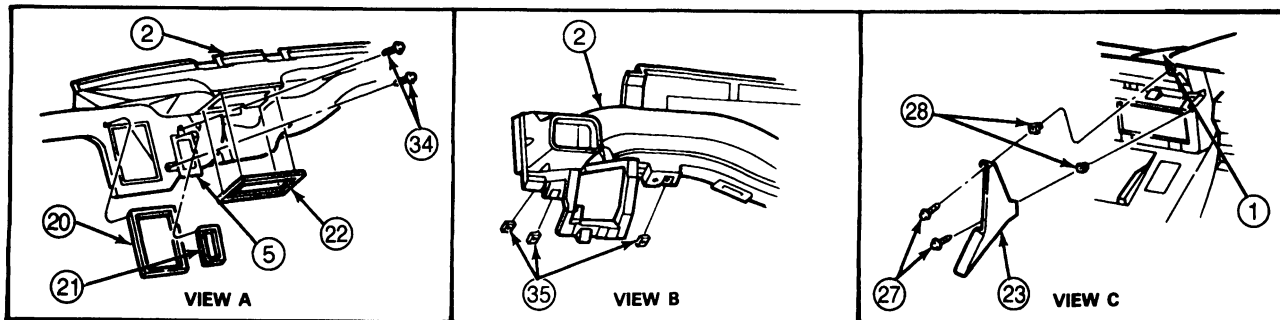
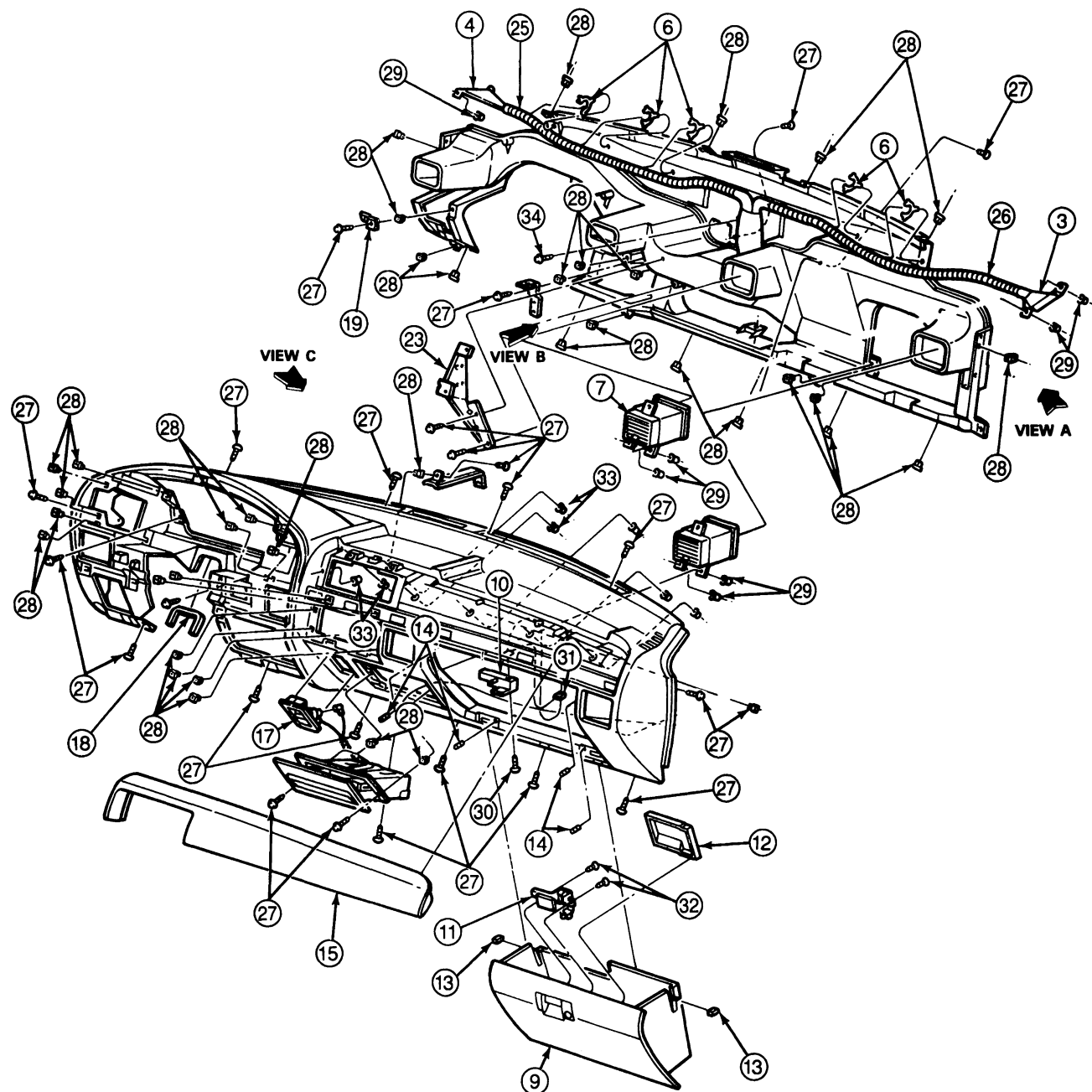
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REMOVAL AND INSTALLATION

Refer to the following illustration for the location of the
components covered in this portion of this section.

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Exploded View



R8423-A

REMOVAL AND INSTALLATION (Continued)

INSTRUMENT PANEL EXPLODED VIEW (LEGEND)

Item No.	Part Number	Description
1	04326	Instrument Panel
2	19E726	Duct and Support Assembly
3	19E656	Demister Duct, RH
4	19E657	Demister Duct, LH
5	19E680	Connector
6	19E632	A/C Tube Support Clip
7	19C639	A/C Registers
8	044F80	Radio Mounting Bracket
9	06024	Glove Compartment
10	5A563	Lamp and Catch Assembly
11	106004	Glove Compartment Door Latch
12	061A40	Glove Compartment Door Latch Cover
13	06115	Glove Compartment Bumpers
14	N804428-S	Glove Compartment Bumpers
15	04282	Pad and Retainer
16	04810	Ash Receptacle
17	19N236	Power Point
18	01657	Steering Column Opening Insulator

Item No.	Part Number	Description
19	14W163	Fuse Block Bracket
20	19C901	A/C Seal
21	19C901	Demister Seal
22	18C367	Defrost Seal Nozzle
23	047A30	Instrument Panel Center Bracket
24	10D876	Seat Belt Warning Buzzer/Chime Bracket
25	19E659	Side Window Demister Hose, LH
26	19E658	Side Window Demister Hose, RH
27	N803876-S36	Screw, Tapping
28	N803685-S11	Nut, Hex
29	N800488-S36	Nut, Hex
30	N84251-S36	Screw, Tapping
31	N804436-S32	Nut, U-Lock
32	385754-S36	Screw
33	N621901-S36	Nut and Washer, Hex
34	N803946-S36	Rivet, Blind Truss Head
35	N800854-S2	Nut, U-Lock

CR8424-A

Cigar Lighter**Removal and Installation**

1. Disconnect the battery ground cable.
2. Open ash receptacle drawer.
3. Remove the lighter element.
4. Disconnect the push-on connectors from the lighter socket.
5. Unscrew the socket and retainer and remove from the drawer.

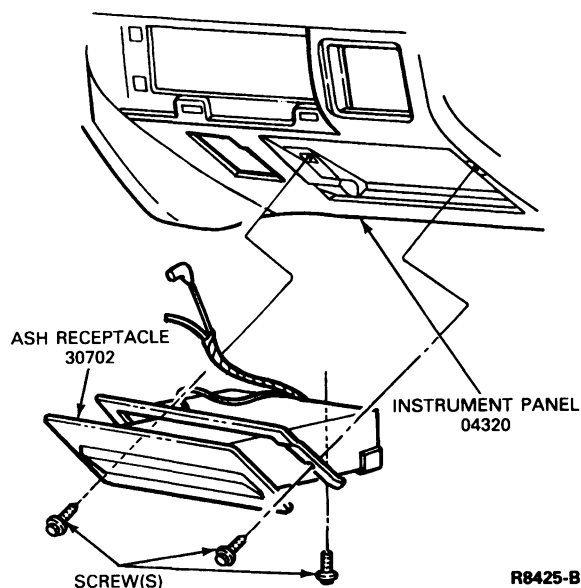
For installation, follow removal procedures in reverse order.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

4. Pull the ash receptacle assembly rearward from the front of the instrument panel and disconnect the wiring.

For installation, follow removal procedures in reverse order.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.



R8425-B

Ash Receptacle**Removal and Installation**

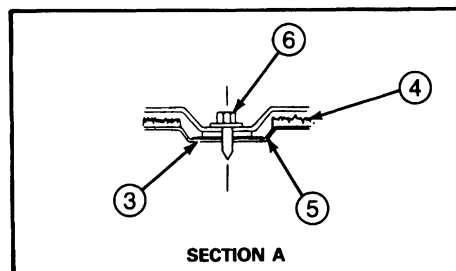
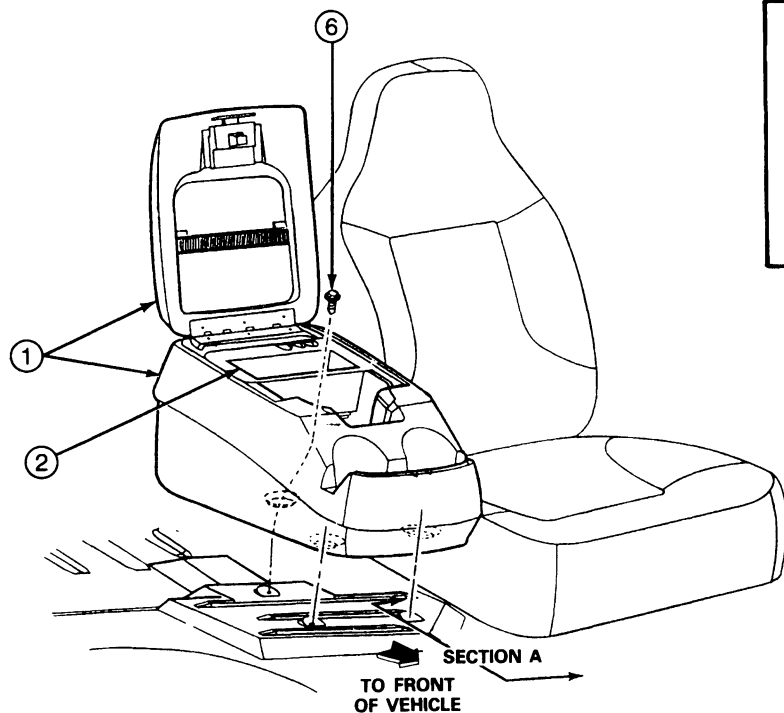
1. Disconnect the battery ground cable.
2. Remove one screw from underneath instrument panel at rear of drawer retainer.
3. Open ash receptacle drawer and remove two screws at front drawer retainer.

REMOVAL AND INSTALLATION (Continued)**Console Assembly, Floor-Mounted and Seat-Mounted****Removal and Installation**

1. For floor-mounted console, remove the bolts from the base of the console panel.

2. For seat-mounted console, lift the console up and forward to disengage from the shoulder bolts.
3. Remove the console from the vehicle.

For installation, follow removal procedures in reverse order.

Console Assembly, Floor-Mounted

R8427-A

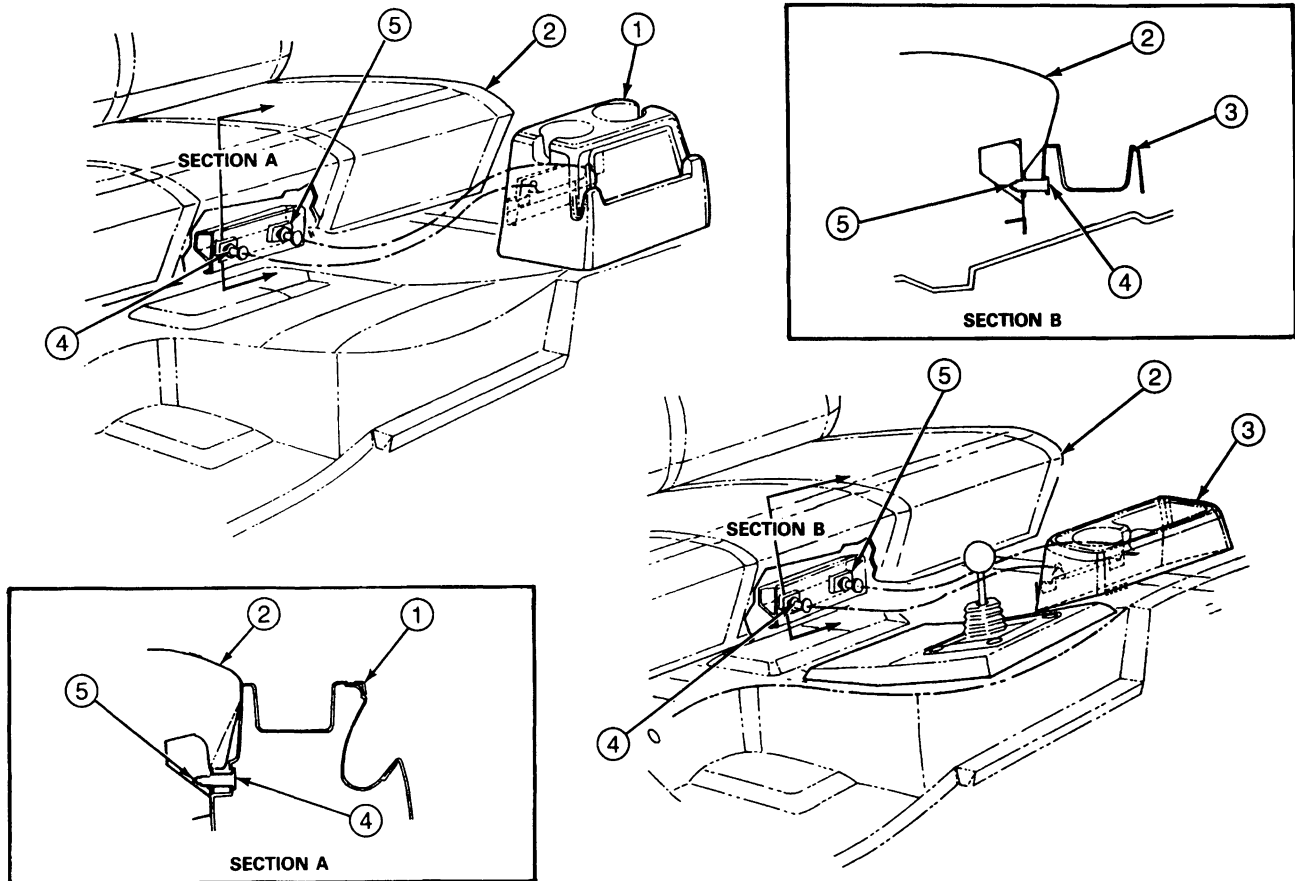
Item	Part Number	Description
1	45A06	Console Assembly
2	19A089	Stereo Tape Container
3	20552	Insulator

(Continued)

Item	Part Number	Description
4	Ref.	Carpet Assembly
5	Ref.	Front Door Pan
6	N804421-S36	Screw and Washer Assembly (3 Req'd)

REMOVAL AND INSTALLATION (Continued)

Console Assembly, Seat-Mounted



R8429-A

Item	Part Number	Description
1	45A06	Console Assembly, Floor (Automatic Transmission)
2	Ref.	Front Seat Cushion

(Continued)

Item	Part Number	Description
3	45A36	Console Assembly, Panel (Manual Transmission and All 4x4)
4	N806632-S58	Shoulder Bolt (2 Req'd)
5	N623332-S100	Spring Nut (2 Req'd)

Power Point

Removal

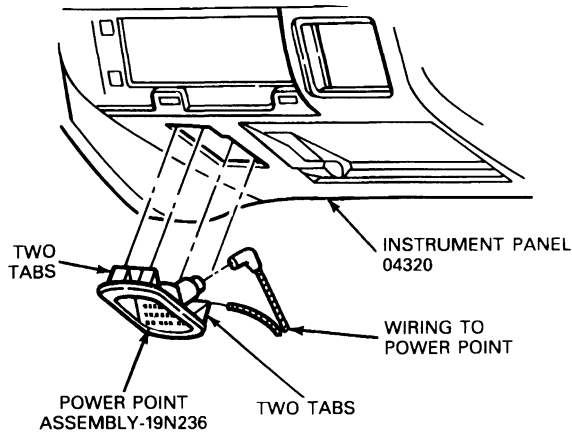
1. Remove ash receptacle as described in this section.
NOTE: Do not pry on plastic bezel to remove.
2. Reach through ash receptacle opening and squeeze four tabs on back of bezel.

3. Pull assembly from instrument panel.

CAUTION: Do not use cigar lighter in place of power point.

Installation

1. Position power point assembly in mounting hole and push to engage the locking tabs.
2. Install ash receptacle as described in this section.

REMOVAL AND INSTALLATION (Continued)**Power Point Assembly**

R8431-B

Glove Compartment Door Assembly**Removal**

1. Depress right and left tabs on side of glove compartment bin and rotate the door and bin assembly until the keeper feature engages, holding the assembly in the open and fully down position.
2. If necessary to remove the complete door and bin assembly, pull down and out on the door and bin assembly, wedge and rotate the blade of a flat-head screwdriver between each hinge and tension tab.
3. Remove assembly.

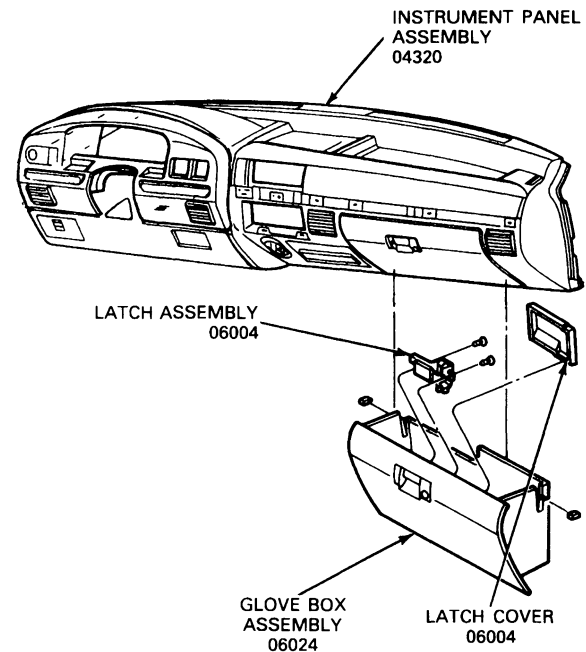
NOTE: If the door and bin assembly is forcibly removed from the hinges, the keeper feature located on the back side of each hinge is designed to break away without harming normal operation.

Installation

1. Position bottom of door assembly on instrument panel.
2. Rotate door assembly to a closed position. Right and left tabs should be in the opening stop position.

Latch Assembly, Glove Compartment**Removal and Installation**

1. Remove latch cover from inside of glove compartment by unsnapping the four tabs.
 2. Remove the two screws attaching the latch.
- For installation, follow removal procedure in reverse order.



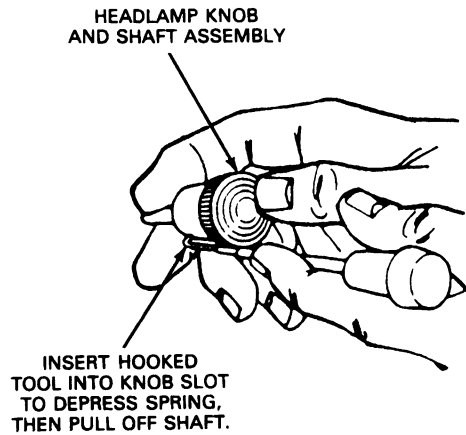
R8433-B

Cluster Finish Panel**Removal and Installation**

1. Vehicles with tilt column, position steering wheel in full down position.
2. Vehicles with column shift, set parking brake and position shift lever to the lowest position.
3. Unsnap the right and left moulding by carefully prying on the notches at bottom of mouldings.

REMOVAL AND INSTALLATION (Continued)

4. Remove the headlamp knob by depressing the spring inside of the knob.

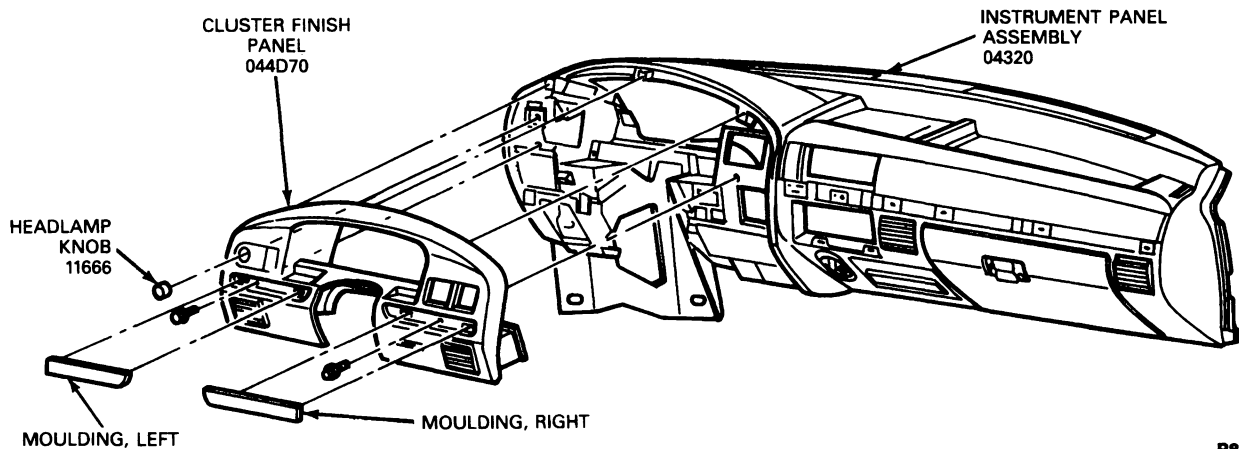


R8435-A

5. Remove the two exposed screws under the right and left moulding.

NOTE: Wiring is connected to the finish panel.

6. Unsnap five retaining clips by pulling the panel rearward starting with the two at the steering column (one each side) and then the three at the top of the panel.
 7. Disconnect the wiring connectors from the panel.
- For installation, follow removal procedures in reverse order.

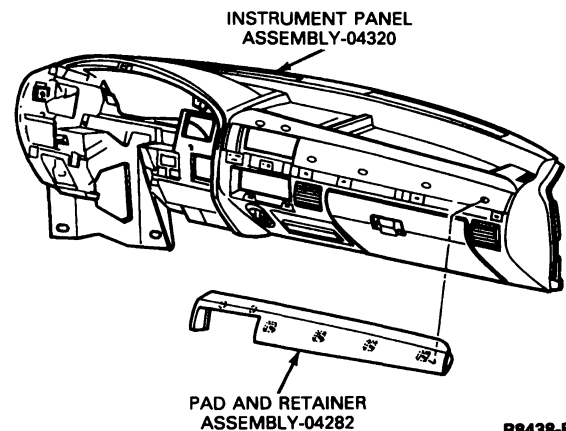
Cluster Opening Finish Panel

R8436-B

Pad and Retainer Assembly**Removal and Installation**

1. Remove radio.
2. Remove glove box door assembly.
3. Using the radio and glove box door opening, remove the seven nuts retaining the pad assembly.

For installation, follow removal procedures in reverse order.

Instrument Panel Pad and Retainer Assembly

R8438-B

REMOVAL AND INSTALLATION (Continued)

Instrument Cluster

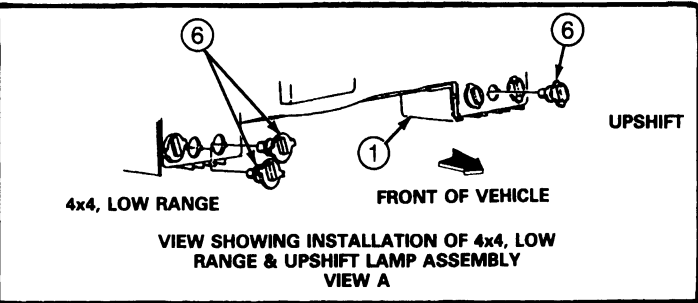
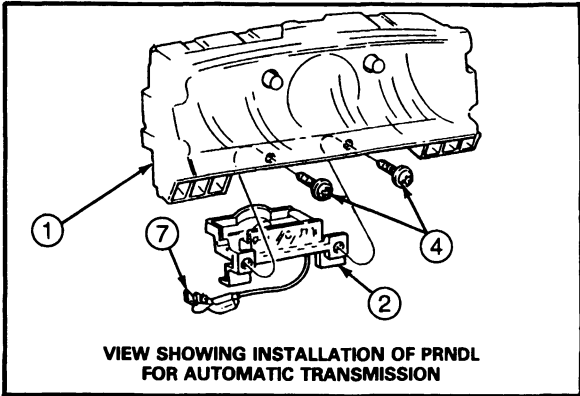
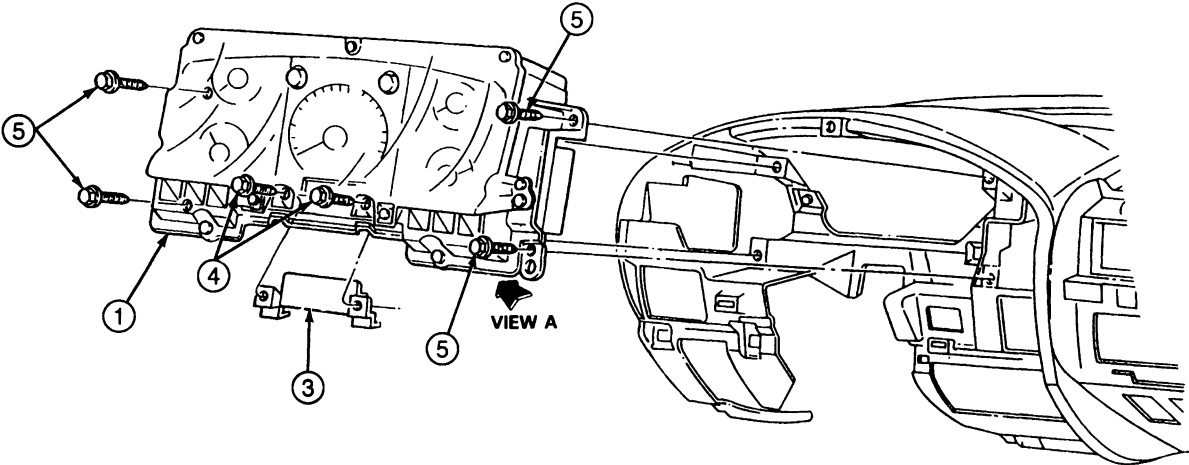
Removal and Installation

1. Remove cluster finish panel as described in this section.
2. Remove four screws retaining cluster to instrument panel.
3. Carefully pull / rotate bottom of cluster toward steering wheel.

4. Vehicle with automatic transmission, remove two screws and PRNDL cable from bottom of cluster.
5. Disconnect three wiring connectors from the back of the cluster.
6. Remove cluster.

For installation, follow removal procedures in reverse order.

Instrument Cluster Installation



R8440-A

Item	Part Number	Description
1	10849	Cluster Assembly
2	7B053	Indicator Assembly
3	7B100	Transmission Selector Indicator

(Continued)

Item	Part Number	Description
4	N800705-S2	Screw 1.4 N·m (12 In-Lb)
5	N803877-S2	Screw 1.9-2.5 N·m (17-22 In-Lb)
6	10D977	Bulb and Socket Assembly
7	Ref.	Captive Screw 2.3-3.3 N·m (21-29 In-Lb)

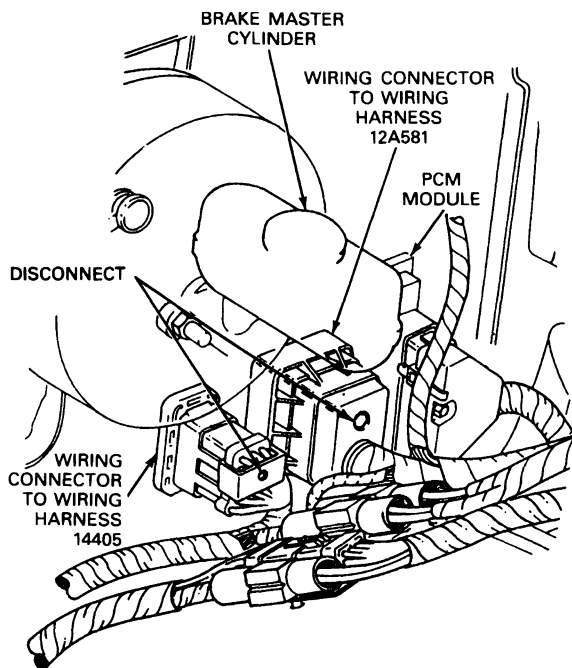
Instrument Panel

Removal and Installation

1. Disconnect battery ground cable.

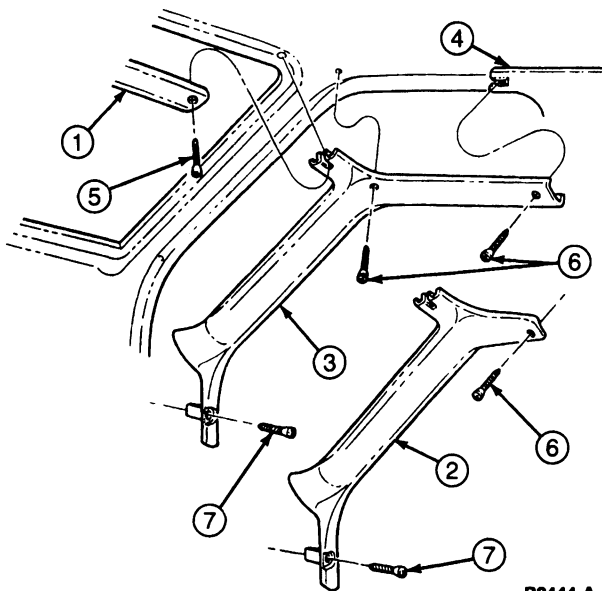
REMOVAL AND INSTALLATION (Continued)

2. Disconnect two wiring connectors to instrument panel in engine compartment by loosening the bolts and separating the connectors.



R8442-B

3. Remove radio using Tool T87P-19061-A.
 4. Remove right and left side windshield garnish mouldings.



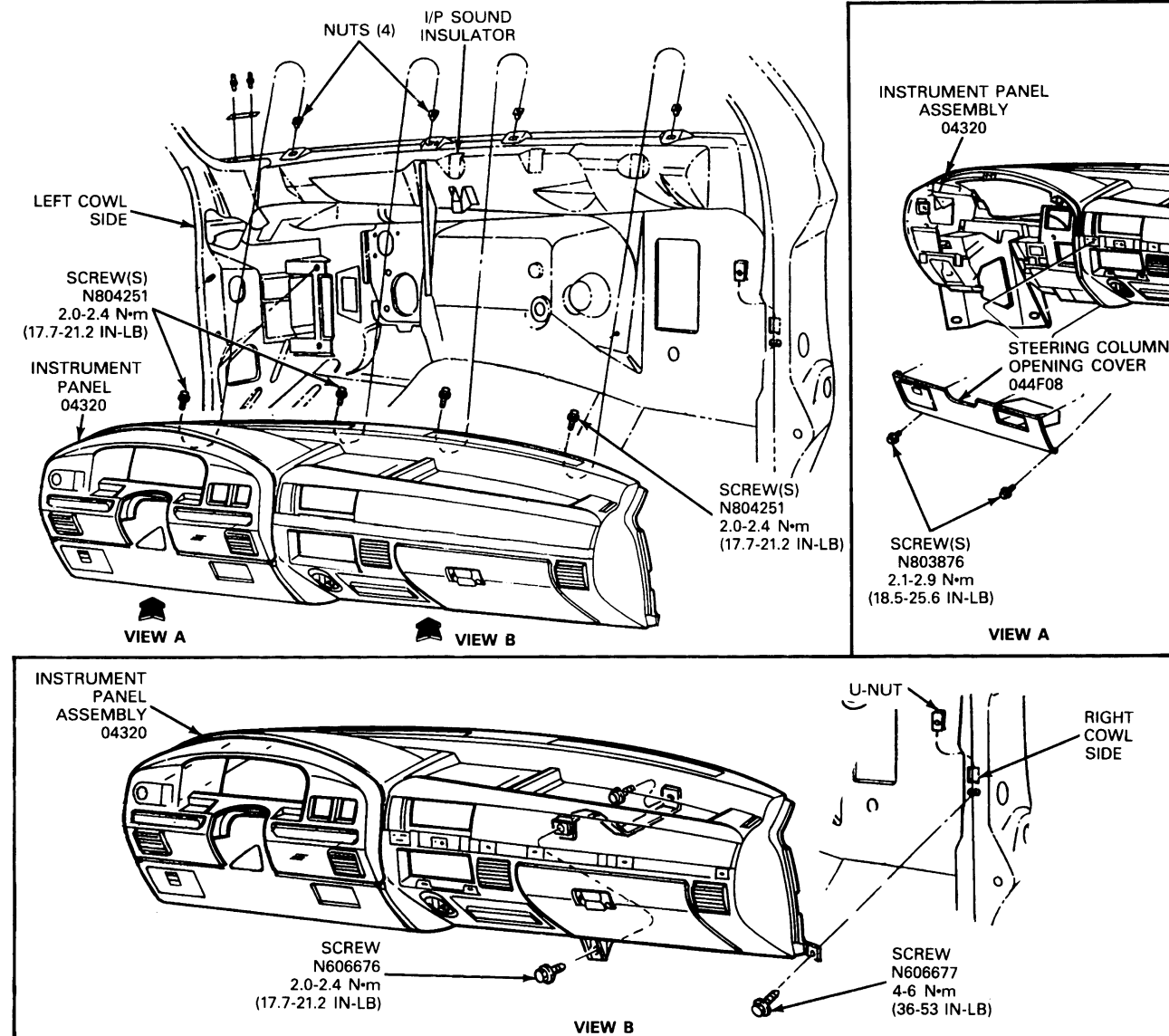
R8444-A

Item	Part Number	Description
1	03686	Windshield Garnish Upper Moulding
2	25A84	Pillar Inside Moulding
3	25A84	Pillar Inside Moulding
4	Ref.	Lock Pillar Trim Panel
5	N610132-S58	Screw (3 Req'd)
6	N801157-S58	Screw and Washer (3 Req'd)
7	N806578-S58	Screw and Washer (1 Req'd)

5. Remove four screws attaching top of instrument panel to cowl top.

REMOVAL AND INSTALLATION (Continued)

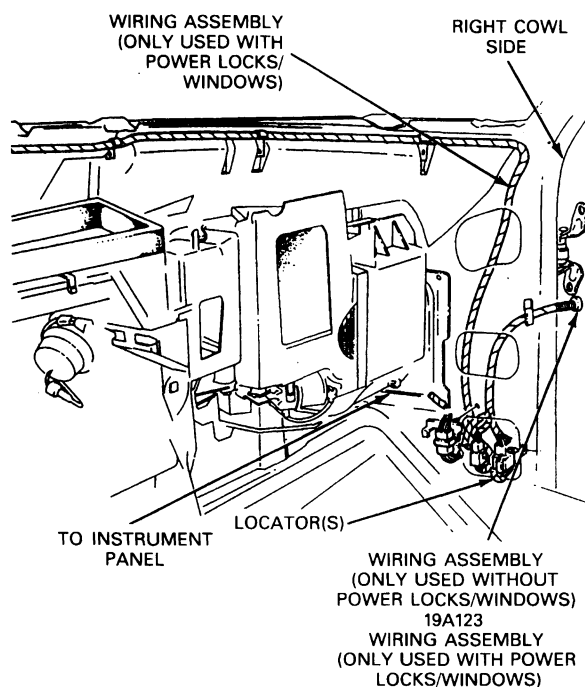
Instrument Panel to Cowl Top Assembly



R8446-B

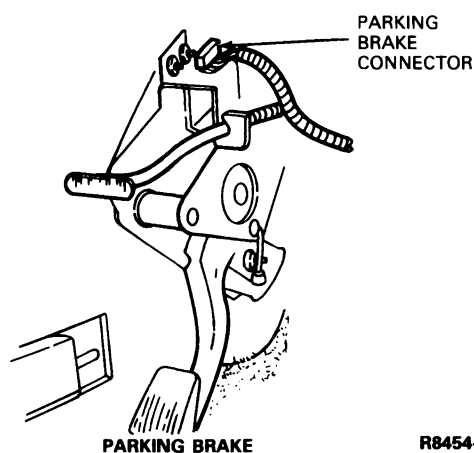
6. Remove hood release cable assembly from left cowl side trim panel and lay assembly on front floor.
7. Remove right and left cowl side trim panels.
8. Remove two screws securing the instrument panel steering column opening cover assembly to underside of instrument panel.
9. Remove cover by pulling at top of cover to unsnap the four retaining clips.
10. Pull antenna wire down and unsnap wire from bottom of instrument panel and lay wire on floor.

11. Remove bolt attaching instrument panel to panel brace.
NOTE: Some vehicles may have two lower braces.
12. Remove screw and washer assembly located at lower corner on right side of instrument panel.
13. Disconnect the wiring connectors from the main wiring harness at the right cowl side.

REMOVAL AND INSTALLATION (Continued)**Right Cowl Side, Wiring Connectors**

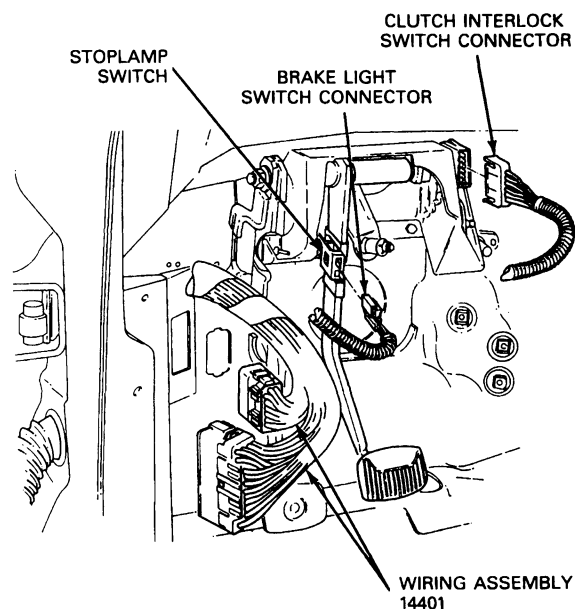
R8452-B

14. Disconnect the wiring connector from the parking brake assembly.
15. Remove three nuts attaching the parking brake assembly to the left cowl side and lay assembly on front floor. Do not disconnect the cable.



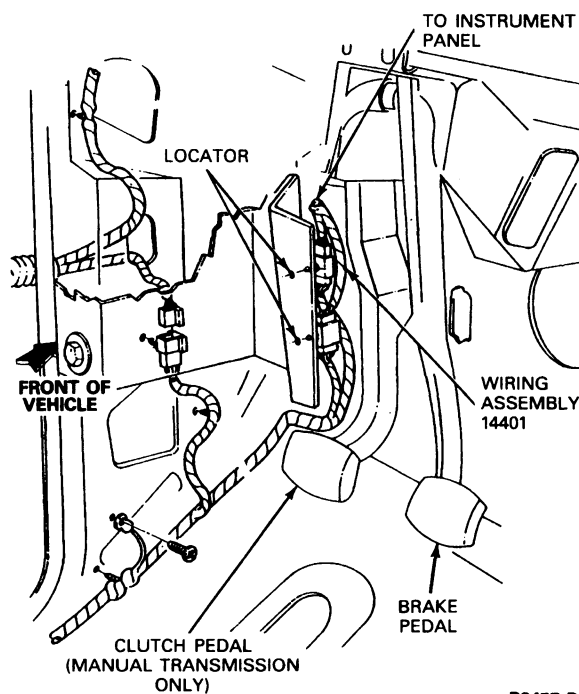
R8454-A

16. Vehicles with column shift: disconnect the shift cable from the steering column and the shift cable retainer.
17. Disconnect the wiring connector from the brake light switch.
18. Vehicles with manual transmission, disconnect the wiring connector from the clutch switch.



R8455-B

19. Disconnect the wiring connectors from the main wiring harness at left cowl side.



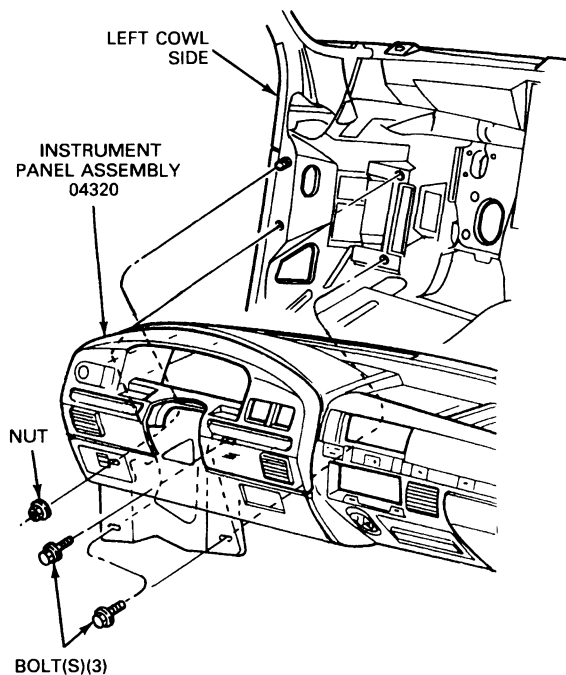
R8457-B

REMOVAL AND INSTALLATION (Continued)

20. Remove pinch bolt from steering column to extension shaft. Compress extension shaft toward engine and separate from the column U-joint.

NOTE: Steps 21, 22 and 23 require two technicians.

21. Support the instrument panel and remove the three bolts and one nut attaching the left side of the panel.



R8459-B

22. Pull panel rearward and disconnect the heater control cables and the air conditioner vacuum liner connector, if equipped. Remove any remaining wiring connectors.

23. Carefully remove instrument panel from vehicle through driver's side door opening.

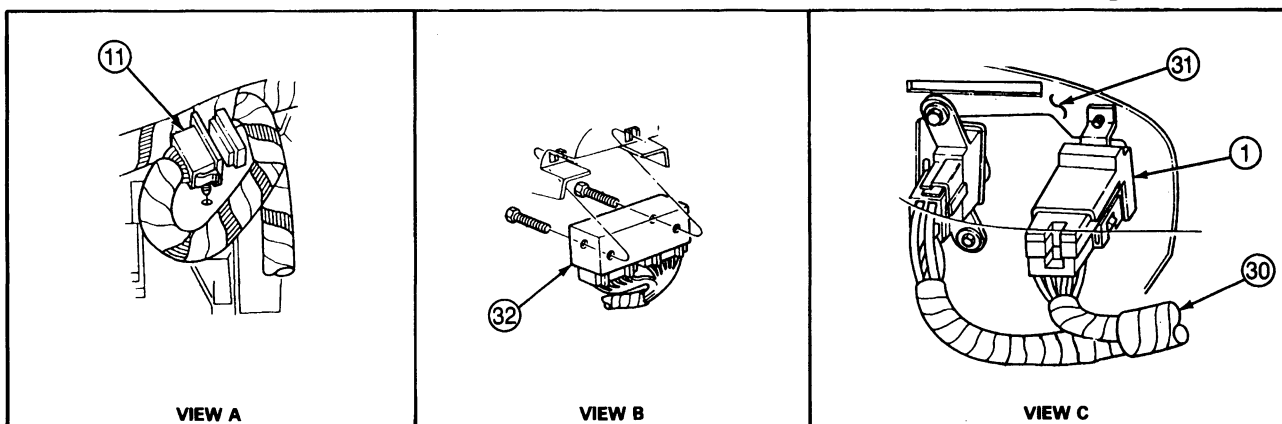
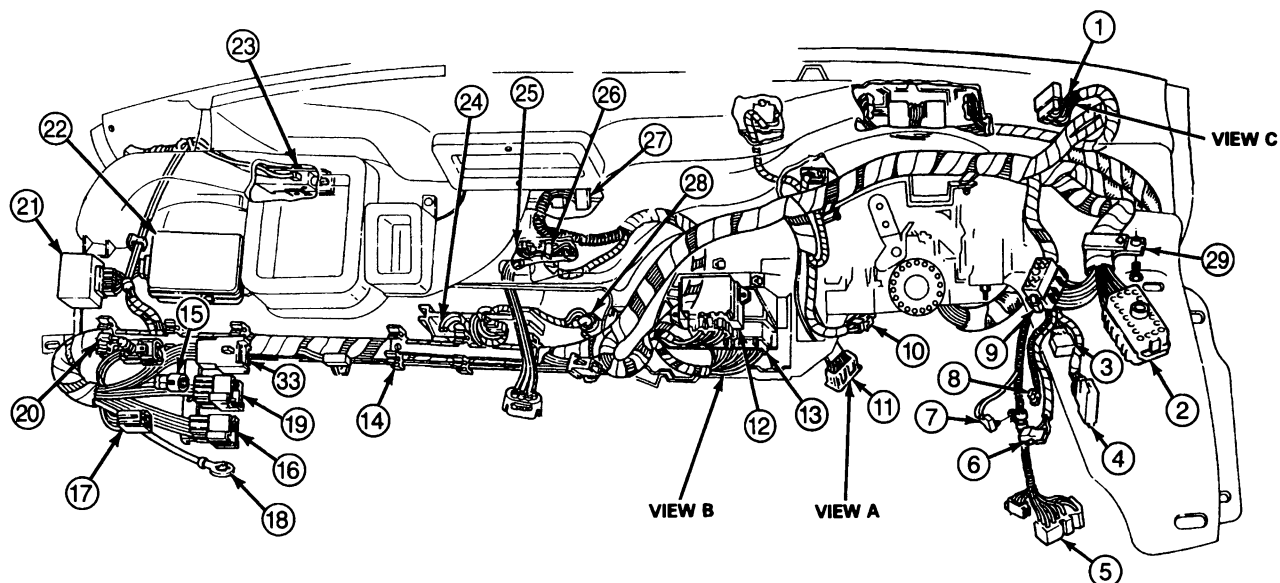
24. If replacing panel, transfer all components to the replacement panel.

For installation, follow removal procedures in reverse order.

NOTE: On EEC-equipped vehicles, when the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Wiring, Gasoline Engines



R8461-A

REMOVAL AND INSTALLATION (Continued)**INSTRUMENT PANEL WIRING, GASOLINE ENGINES (LEGEND)**

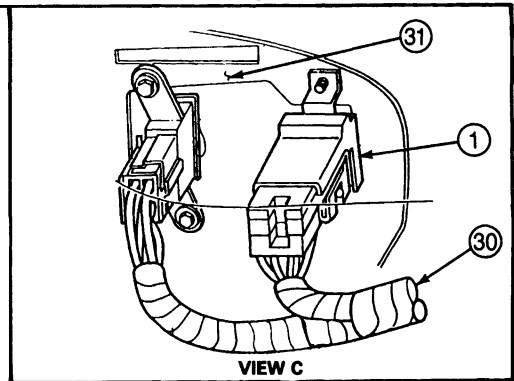
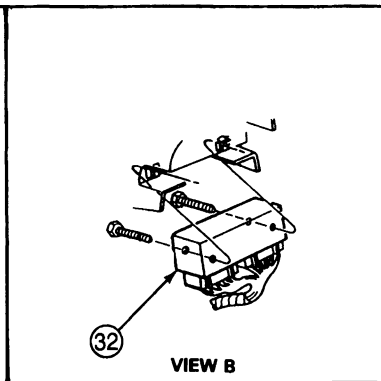
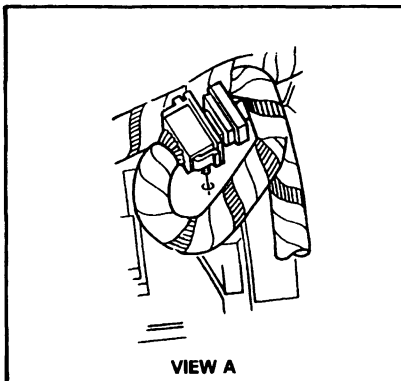
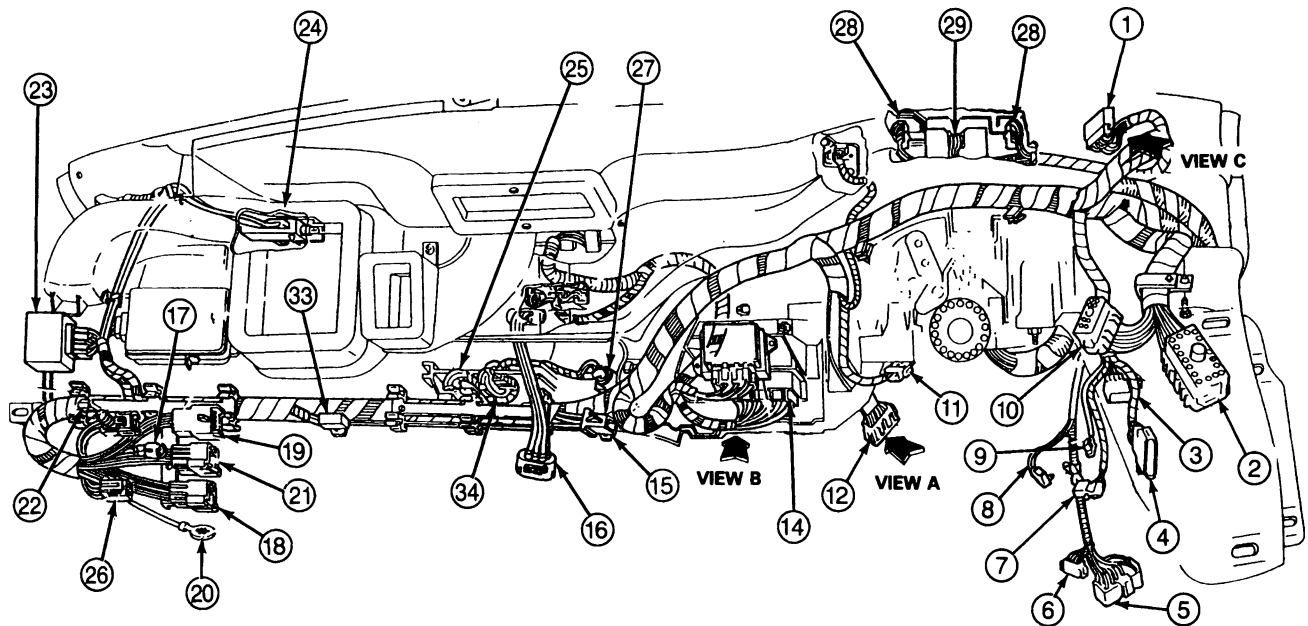
Item No.	Part Number	Description
1	—	Wiring to Headlamp Switch
2	12A581	Connector to 12A581 Wiring Assembly
3	14504	Connector to 14504 Wiring Assembly
4	14504	Connector to 14504 Wiring Assembly
5	—	Wiring to Multi-Function Switch
6	—	Wiring to Stoplamp Switch
7	—	E4OD Pigtail
8	—	Connector to Park Signal Lamp Switch
9	14405	Connector to 14405 Wiring Assembly
10	9C899	Connector to 9C899 Wiring Assembly
11	—	Wiring to Clutch Interlock Switch
12	—	Wiring to Warning Buzzer/Chime
13	—	Wiring to Speed Control Amplifier
14	14A099	Shield (2 Req'd)
15	—	Wiring to Right Courtesy Lamp Switch
16	18A586	Connector to 18A586 Wiring Assembly
17	—	Connector to Inertia Switch

Item No.	Part Number	Description
18	—	Wiring to Ground
19	14630	Connector to 14630 Wiring Assembly
20	—	Connector to Brake Anti-Lock Module Test Circuit
21	—	Connector to Wiper Control Module
22	—	Wiring to Rear Brake Anti-Lock Module
23	—	Wiring to Glove Compartment Lamp
24	—	Wiring to Cigar Lighter
25	—	Wiring to Heater Mode Switch
26	—	Wiring to A/C Illumination
27	—	Wiring to Radio
28	19N236	Wiring to Power Point
29	14A282	Retainer Assembly
30	14401	Wiring Assembly
31	04320	Instrument Panel Assembly
32	14A163	Retainer Assembly

CR8462-A

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Wiring, Diesel Engine



R8463-A

REMOVAL AND INSTALLATION (Continued)**INSTRUMENT PANEL WIRING, DIESEL ENGINE (LEGEND)**

Item No.	Part Number	Description
1	—	Connector to Headlamp Switch
2	12A581	Connector to 12A581 Wiring Assembly
3	—	Locator
4	14A504	Connector to 14A504 Wiring Assembly
5	—	Connector to Multi-Function Switch
6	—	Connector to Multi-Function Switch
7	—	Connector to Stoplamp Switch
8	—	Connector to E40D Pigtail
9	—	Connector to Park Signal Lamp Switch
10	14405	Connector to 14405 Wiring Assembly
11	9C899	Wiring to 9C899 Wiring Assembly
12	—	Connector to Clutch Interlock Switch
13	—	Wiring to Warning Buzzer/Chime
14	—	Wiring to Speed Control Amplifier
15	—	Connector to Trailer Brake Controller
16	—	Vacuum Connector

Item No.	Part Number	Description
17	—	Connector to Right Courtesy Lamp Switch
18	18A856	Connector to 18A856 Wiring Assembly
19	7A786	Connector to 7A786 Wiring Assembly
20	—	Wiring to Ground
21	14630	Connector to 14630 Wiring Assembly
22	—	Wiring to Brake Anti-Lock Module Test Circuit
23	17D599	Wiper Control Module
24	—	Wiring to Glove Compartment Lamp
25	—	Wiring to Cigar Lighter
26	—	Connector to Inertia Switch
27	19N236	Wiring to Power Point
28	—	Wiring to Cluster
29	—	Wiring to PSOM
30	14401	Wiring Assembly
31	04320	Instrument Panel Assembly
32	14A163	Retainer

CR8464-A

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	In-Lb
Instrument Panel-to-Dash Screw(s)	1.9-2.5	17-22
Selector Indicator-to-Instrument Cluster	1.4	12
Captive Screw	2.3-3.3	21-29

(Continued)

TORQUE SPECIFICATIONS (Cont'd)

Description	N·m	In-Lb
Steering Column Opening Cover Screw(s)	2.1-2.9	18.5-25.6
Lower Instrument Panel Screw	4-6	36-53
Instrument Panel to Right Side Cowl	2.0-2.4	17.7-21.2

SECTION 01-12B Instrument Panel and Console, Econoline

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING.....	01-12B-2	REMOVAL AND INSTALLATION (Cont'd.)	
REMOVAL AND INSTALLATION		Steering Column Opening Cover Assembly and Reinforcement.....	01-12B-3
Ash Receptacle	01-12B-2	SERVICE PRECAUTIONS	
Ash Receptacle Drawer	01-12B-2	Deployed Modules, Air Bag	01-12B-1
Cigar Lighter	01-12B-3	General Instructions	01-12B-2
Cluster Finish Panel.....	01-12B-4	Live Modules, Air Bag	01-12B-1
Instrument Cluster.....	01-12B-5	SPECIFICATIONS.....	01-12B-13
Instrument Panel	01-12B-6	VEHICLE APPLICATION	01-12B-1

VEHICLE APPLICATION

E-150-250-350 Vehicles

SERVICE PRECAUTIONS

WARNING: SAFE HANDLING OF AIR BAG MODULES REQUIRES FOLLOWING THE PROCEDURES DESCRIBED BELOW FOR BOTH LIVE AND DEPLOYED AIR BAGS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING AN AIR BAG VEHICLE, AND WHEN HANDLING AN AIR BAG MODULE

Live Modules, Air Bag

When carrying a live air bag module, make sure the bag and trim cover are pointed away from your body. In the unlikely event of an accidental deployment, the bag will then deploy with minimal chance of injury. In addition, when placing a live air bag module on a bench or other surface, always face the bag and trim cover up, away from the surface. This will reduce the motion of the module if it is accidentally deployed.

Deployed Modules, Air Bag

Safety precautions must also be observed when handling a deployed module. After deployment, the air bag surface may contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Always wear gloves and safety glasses when handling a deployed air bag module, and wash your hands with mild soap and water afterwards.

SERVICE PRECAUTIONS (Continued)

General Instructions

Because of the critical operating requirements of the system, do not attempt to service sensor assemblies, the clockspring assembly, the monitor assembly or the air bag module. Corrections are made by replacement only.

Never probe the connectors on the air bag module. Doing so may result in air bag deployment which could result in personal injury.

All component replacements and wiring repairs must be made with the positive battery cable disconnected for a minimum of one minute before any repair is attempted.

The instruction “disconnect” always refers to a connector. Never detach a component from the vehicle when instructed to “disconnect”.

After all service, **verify the air bag lamp**. This means turn the ignition switch to RUN and count the flashes only after the code (series of flashes) has cycled twice. If the air bag lamp comes on continuously for 4 to 8 seconds and then goes out, the system is functioning properly and all faults have been repaired.

DIAGNOSIS AND TESTING

CONDITION	POSSIBLE SOURCE	ACTION
Cigar lighter knob pops out before adequate heating.	<ul style="list-style-type: none"> ● Cigar lighter element. ● Cigar lighter socket. 	<ul style="list-style-type: none"> ● Substitute another element. Replace if necessary. ● Replace socket.
Cigar lighter element stays in, will not heat up.	<ul style="list-style-type: none"> ● Fuse burnt out. ● Open circuit in wiring. ● Cigar lighter element. ● Cigar lighter socket. 	<ul style="list-style-type: none"> ● Replace fuse. If fuse blows again, check for short circuit. ● Check for power to socket. Repair if necessary. ● Substitute another element. Replace if necessary. ● Replace socket.

TCL2776E

REMOVAL AND INSTALLATION

CAUTION: Before performing any removal or installation on the instrument panel, the positive battery cable must be disconnected for a minimum of 60 seconds to discharge the air bag back-up power supply.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

3. Unsnap and remove the center moulding.
4. Remove one screw that attaches the rear of the drawer retainer to the instrument panel.
5. Remove ash receptacle assembly from instrument panel.

For installation, follow removal procedures in reverse order.

Ash Receptacle

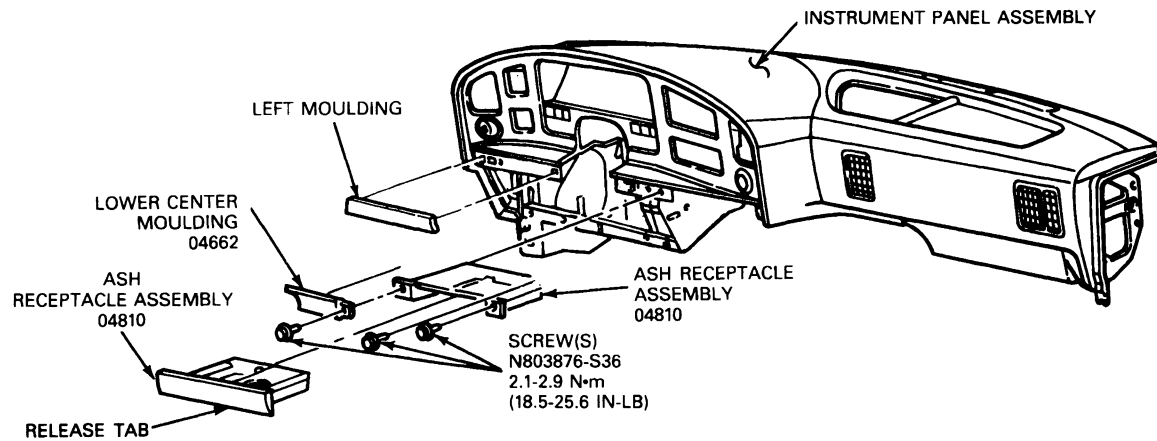
Removal and Installation

1. Remove the engine cover. Refer to Section 01-05B.
2. Open ash receptacle drawer and remove two screws attaching front of drawer retainer to the instrument panel.

Ash Receptacle Drawer

Removal and Installation

To remove the ash receptacle drawer, pull it out to the stop and reach under the drawer and push the release tab at the back center. To install, slide the drawer into the retainer to the full closed position.

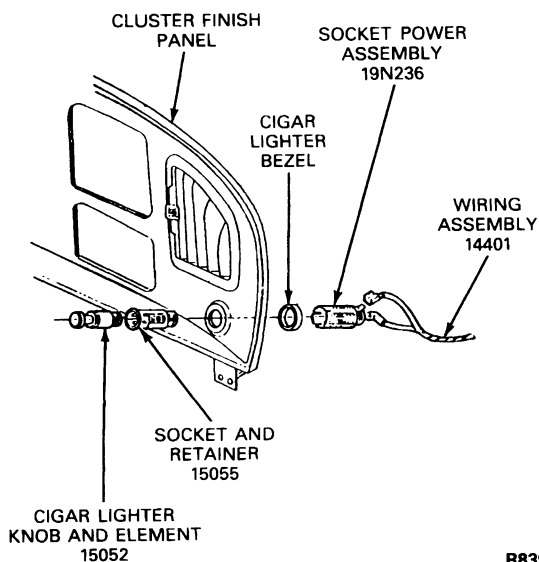
REMOVAL AND INSTALLATION (Continued)**Instrument Panel Ash Receptacle**

R8393-B

Cigar Lighter**Removal and Installation**

1. Remove the lighter element.
2. Remove cluster finish panel.
3. Disconnect the push-on connectors from the lighter socket.
4. Unscrew the socket and retainer and remove from the finish panel.

For installation, follow removal procedures in reverse order.

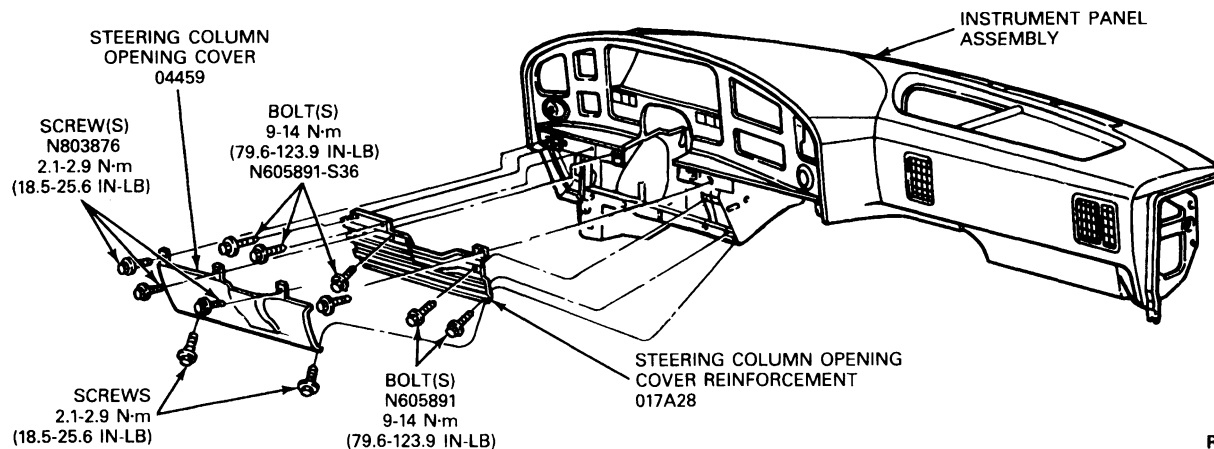


R8395-B

Steering Column Opening Cover Assembly and Reinforcement**Removal and Installation**

1. Remove five screws and steering column opening cover.
2. Remove nine bolts and steering column opening reinforcement.

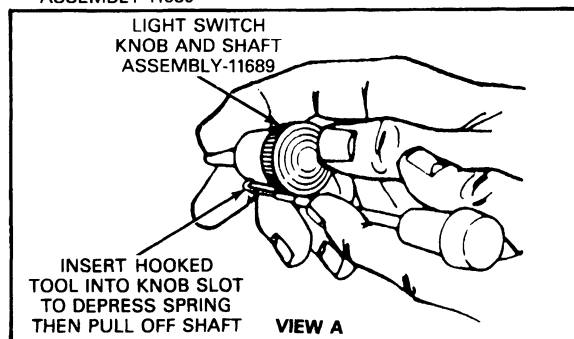
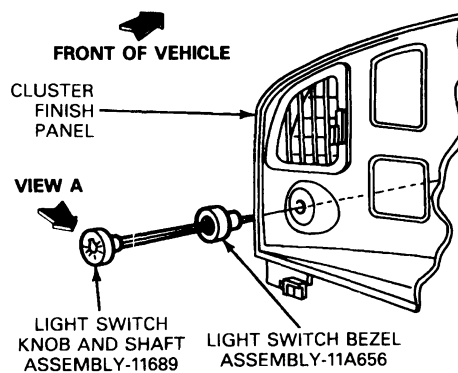
For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)**Instrument Panel Steering Column Opening Cover and Reinforcement**

R8397-B

Cluster Finish Panel**Removal and Installation**

1. Remove the engine cover. Refer to Section 01-05B.
2. Pull out and remove the ash receptacle drawer.
3. Remove three screws retaining the ash receptacle drawer retainer and remove the drawer retainer.
4. Remove center and left-hand snap-in moulding on each side of the steering column.
5. Remove the cigar lighter element.
6. Remove headlight switch knob and unscrew the bezel.

Lighting Switch and Wiring

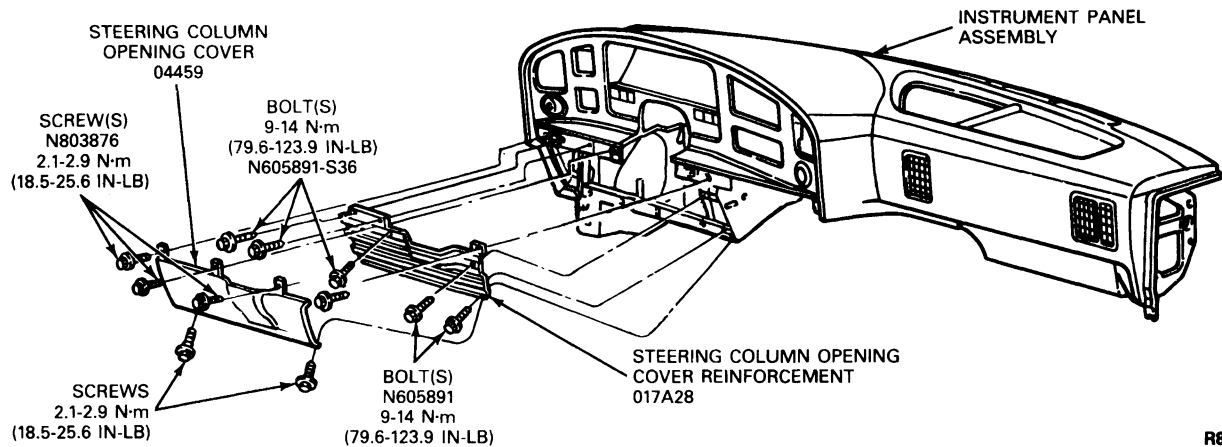
R8401-B

7. Remove five screws and steering column opening cover.
8. Remove the steering column opening lower reinforcement.
9. Remove seven screws retaining instrument cluster finish panel.
10. Pull cluster finish panel away from the instrument panel by unsnapping the snap-in retainers and disconnect all wiring from the finish panel.

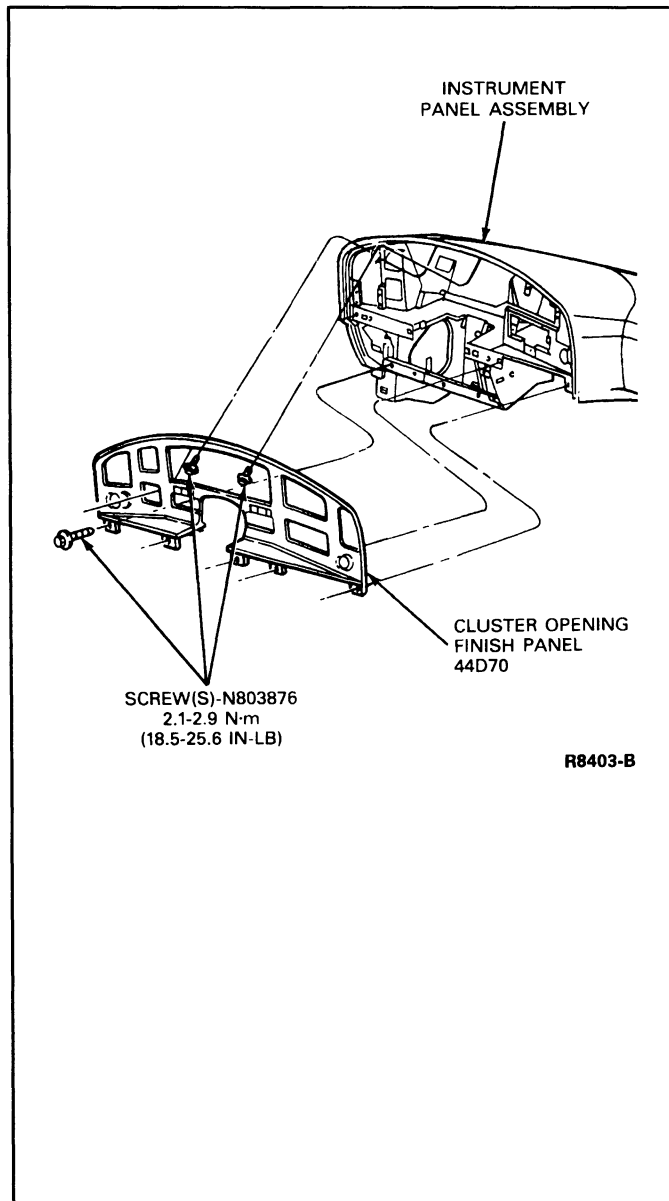
For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Steering Column Opening Cover and Reinforcement



R8397-B



R8403-B

Instrument Cluster

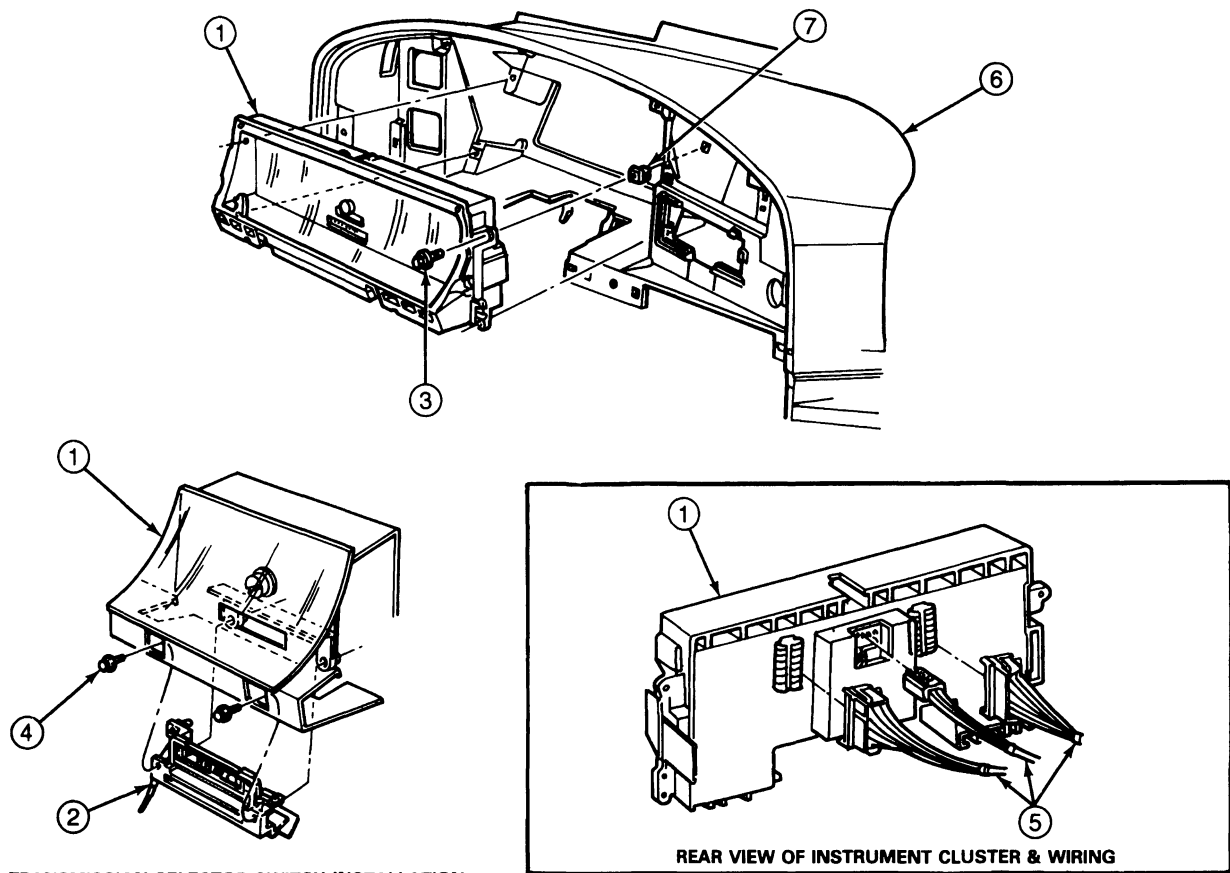
Removal and Installation

1. Remove cluster finish panel as outlined.
2. Remove four screws retaining cluster to instrument panel.
3. Remove two screws and PRNDL cable from bottom of cluster.
4. Pull cluster rearward and disconnect the three wiring connectors.
5. Remove cluster.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Instrument Cluster and Wiring



R8405-A

TRANSMISSION SELECTOR SWITCH INSTALLATION

Item	Part Number	Description
1	10849	Cluster Assembly
2	7B053	Transmission Selector Switch
3	N803877-S36	Screw (4 Req'd)

Item	Part Number	Description
4	N800705-S2	Screw (2 Req'd)
5	14401	Wiring Assembly
6	Ref.	Instrument Panel Assembly
7	Ref.	Nut (4 Req'd)

(Continued)

Instrument Panel

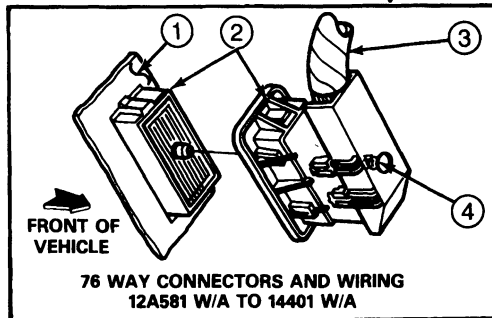
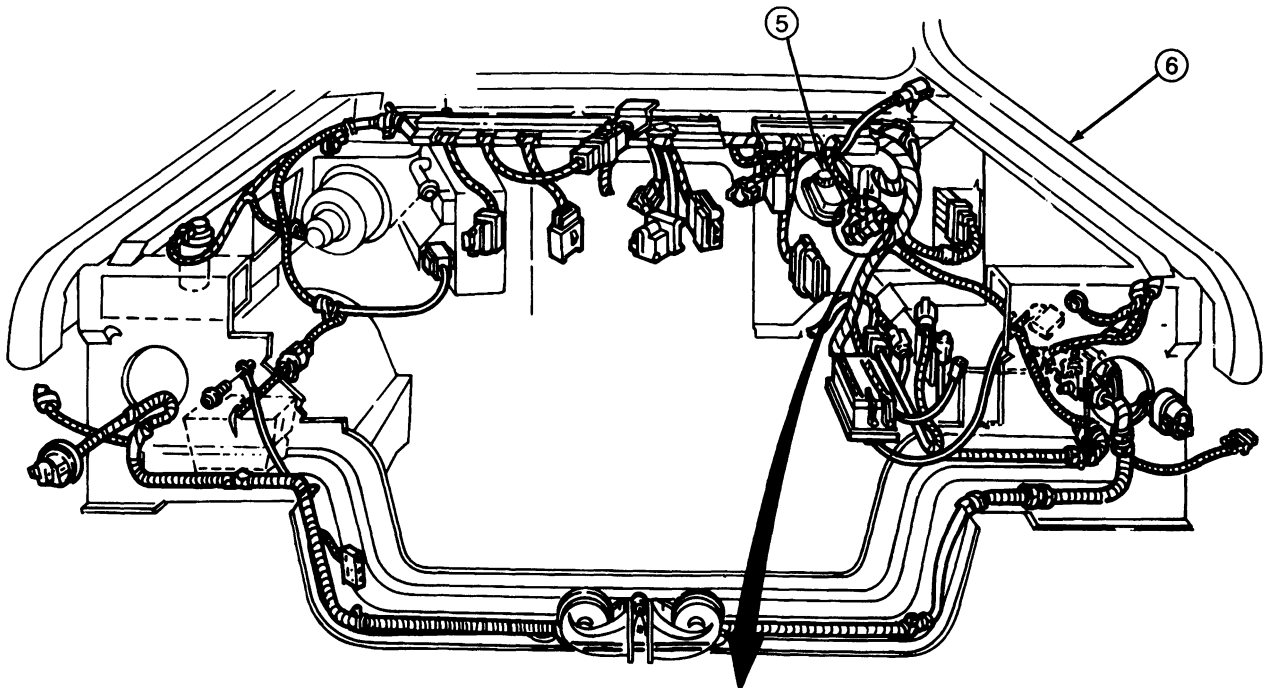
Removal and Installation

1. Disconnect battery positive terminal.

2. Disconnect dash panel wiring in engine compartment by loosening connector center bolt.

REMOVAL AND INSTALLATION (Continued)

Engine Compartment Wiring



R8407-A

Item	Part Number	Description
1	Ref.	Dash Panel (Inner Engine Compartment)
2	Ref.	Connector, 76-Way

(Continued)

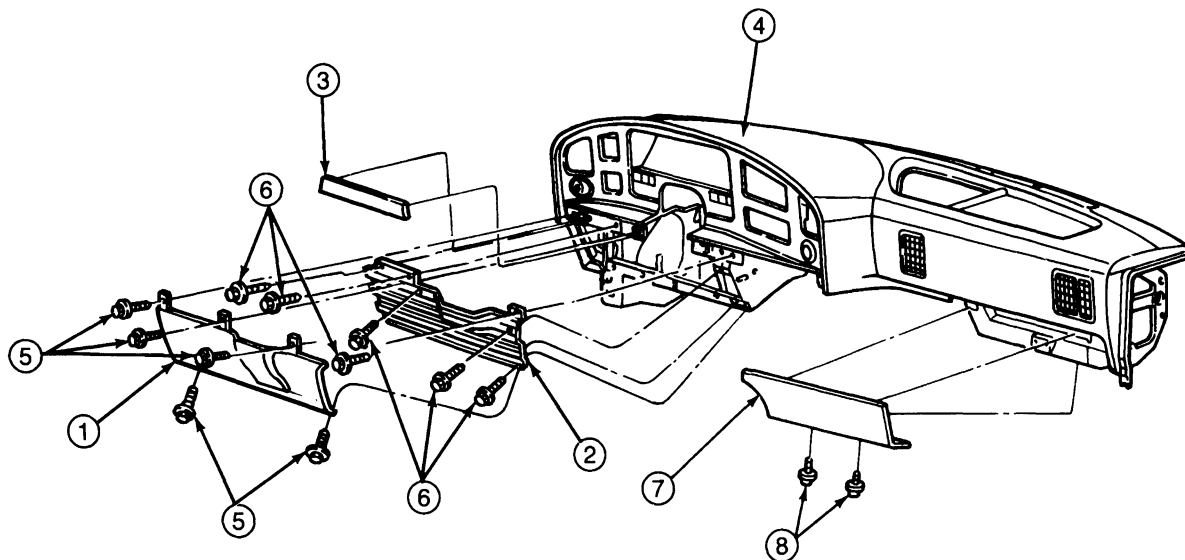
Item	Part Number	Description
3	12A581	Wiring Harness
4	—	Connector Screw 5.65-7.9 N·m (50-70 In-Lb)
5	Ref.	Brake Master Cylinder
6	Ref.	Fender Assembly, LH

3. Remove right and left inside windshield mouldings.
4. Remove the engine cover. Refer to Section 01-05B.
5. Remove left and center snap-in moulding on each side of the steering column.

6. Remove five screws and steering column opening cover.
7. Remove nine bolts and steering column opening reinforcement.
8. Remove steering column shrouds.

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Covers and Mouldings



R8409-B

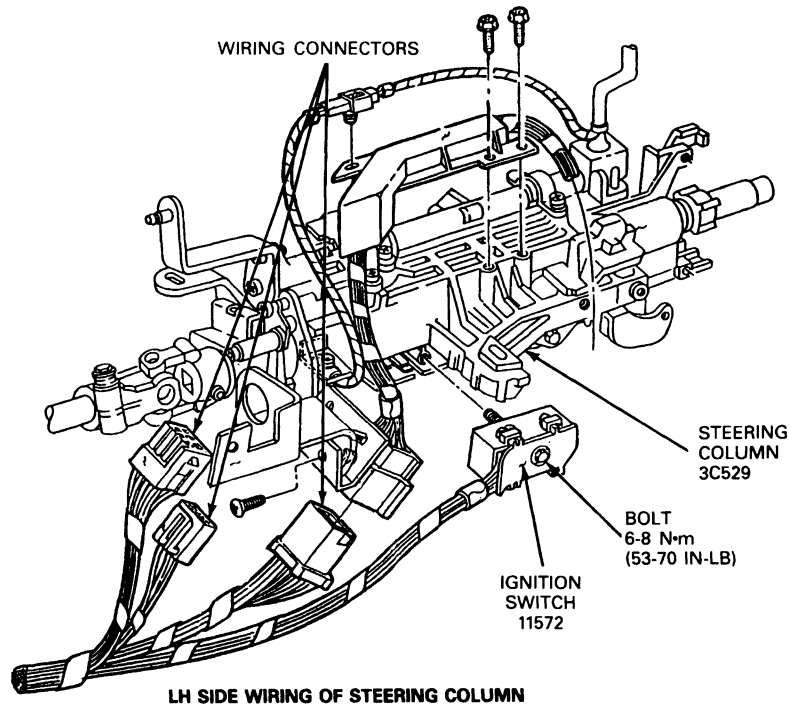
Item	Part Number	Description
1	04459	Steering Column Opening Cover
2	017A28	Steering Column Opening Cover Reinforcement
3	04389	Lower Left Side Moulding
4	Ref.	Instrument Panel Assembly

(Continued)

Item	Part Number	Description
5	N803876-S36	Screw 2.1-2.9 N-m (18.5-25.6 In-Lb)
6	N605891-S36	Bolt 9-14 N-m 79.6-123.9 In-Lb)
7	044082	Instrument Panel Access Cover
8	N804306-S36	Screw 2.1-2.9 N-m (18.5-25.6 In-Lb)

9. Disconnect three wiring connectors at bottom of steering column.

10. Loosen retaining bolt and disconnect ignition switch connector from steering column.

REMOVAL AND INSTALLATION (Continued)**Steering Column Wiring**

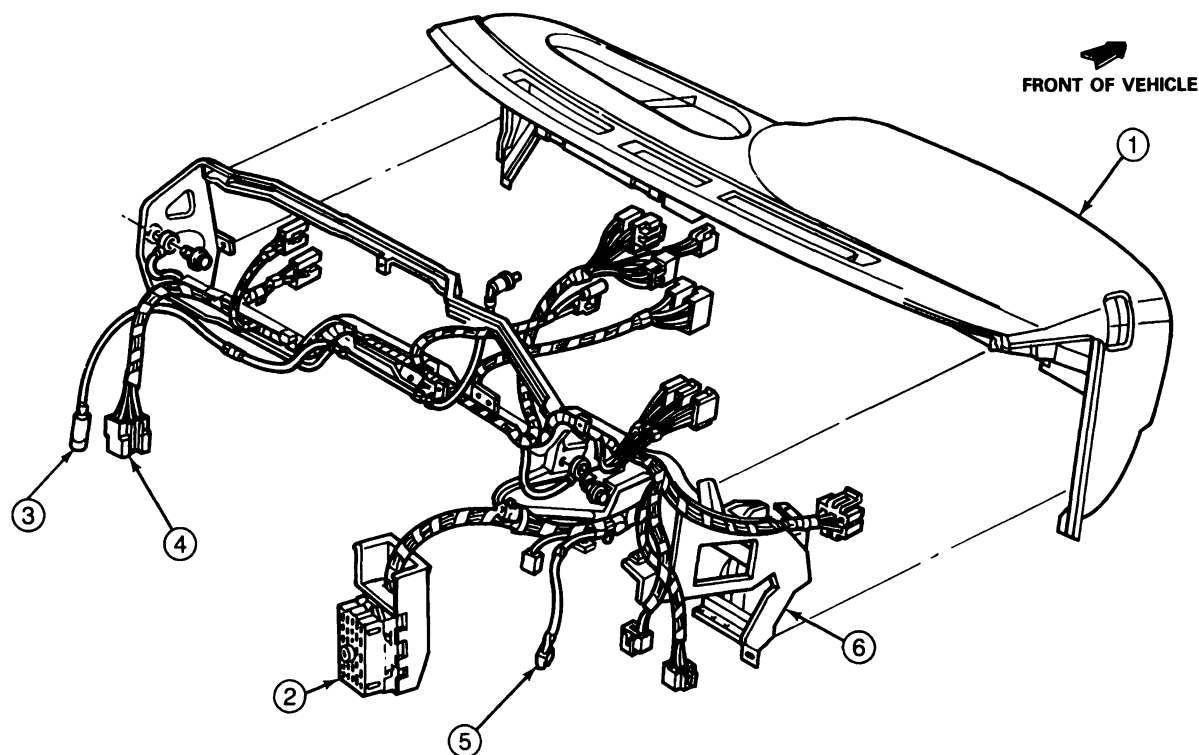
R8411-B

11. Remove two screws and right-hand side lower trim panel.
12. Remove right and left cowl side trim panels and disconnect the park brake wiring.
13. Remove three nuts attaching the parking brake assembly to the left-hand cowl side and lay assembly on front floor. Do not disconnect cable.

14. Disconnect wiring at right cowl side.
15. Disconnect radio antenna at right cowl side.
16. Disconnect wiring connector at brake light switch.

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Wiring



REAR VIEW OF INSTRUMENT PANEL WIRING

R8415-A

Item	Part Number	Description
1	04320	Instrument Panel Assembly
2	Ref.	Connector, 76-Way
3	18812	Antenna Lead-In Cable
4	14A200	Connector to 14A200 Wiring Assembly

(Continued)

Item	Part Number	Description
5	—	Connector to Parking Brake Switch Assembly
6	—	Instrument Panel Holding Bracket (Part of 04320 Instrument Panel Assembly)

17. Disconnect heater control cables and, if so equipped, disconnect the air conditioner vacuum line connector on the right side of instrument panel.
18. Remove one bolt attaching the right side of the instrument panel.
19. Remove one bolt attaching the center of the instrument panel.
20. Remove one bolt attaching the center of the instrument panel below the center instrument panel register.

21. Remove pinch bolt from steering column to extension shaft. Compress extension shaft toward engine and separate it from the column U-joint.
22. Disconnect the transmission shift cable from the steering column.
23. Remove four bolts attaching left side of instrument panel to the cowl side.
NOTE: The following steps (24, 25, 26) require two technicians.
24. Remove four screws attaching the top of the instrument panel.

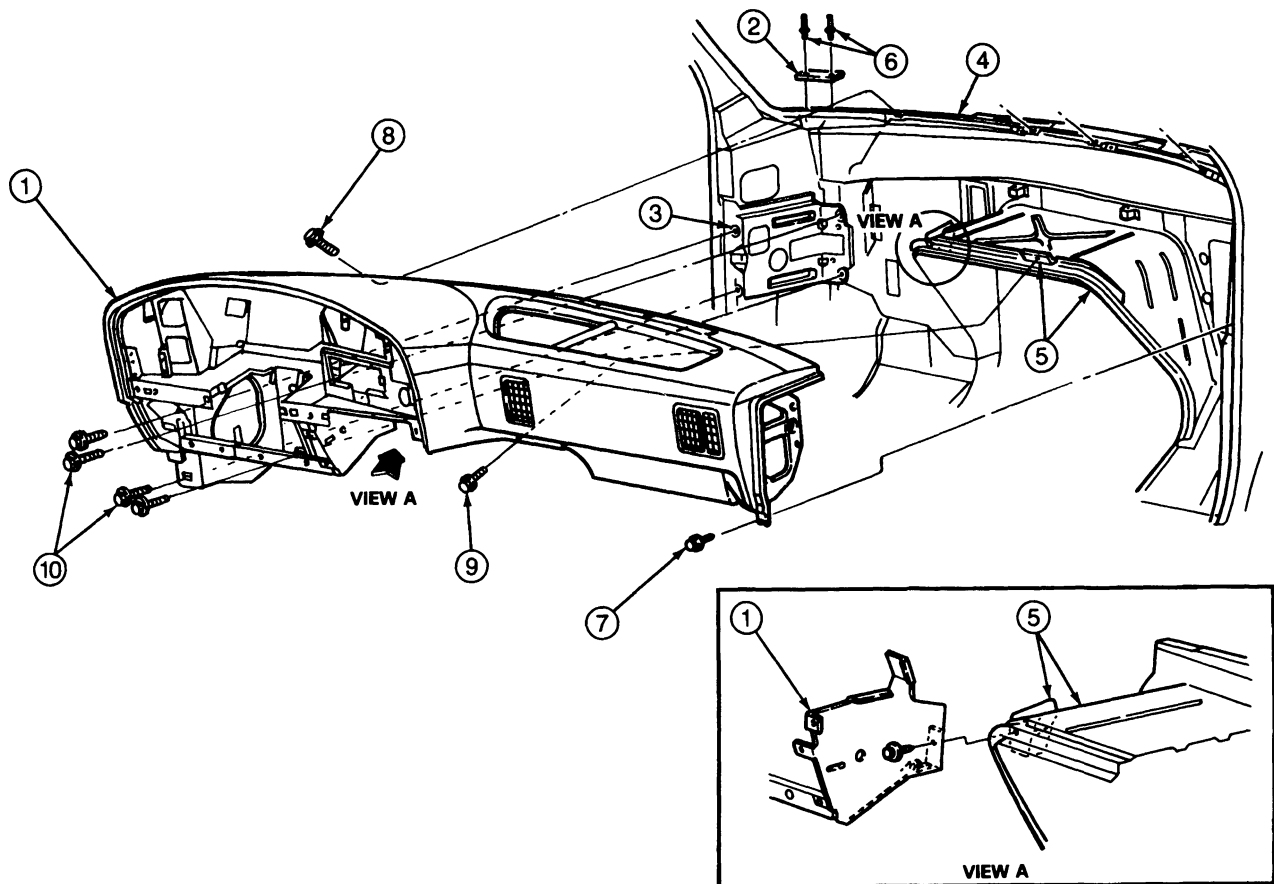
REMOVAL AND INSTALLATION (Continued)

25. Support the instrument panel and pull rearward and disconnect any remaining wires or other components.
26. Carefully remove the instrument panel through the driver's side door.

27. If replacing panel, transfer all components to the replacement panel.

For installation, follow removal procedures in reverse order.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Instrument Panel and Vehicle Identification Plate

R8417-B

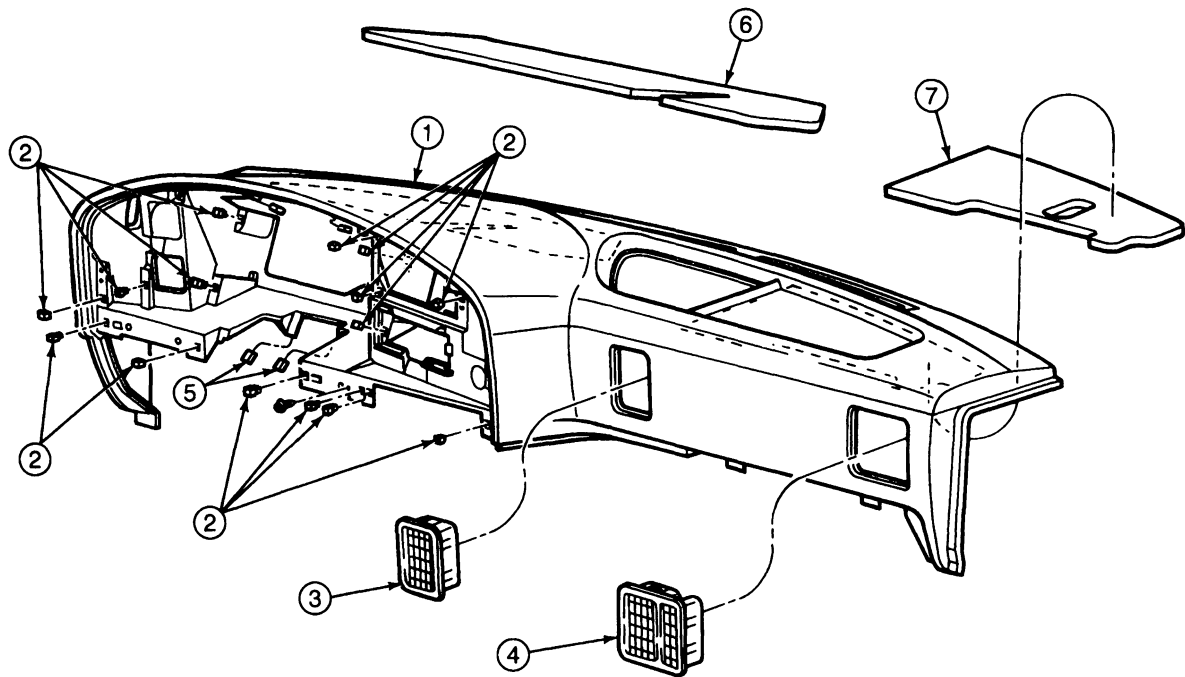
Item	Part Number	Description
1	04320	Instrument Panel Assembly
2	01631	Vehicle Identification Plate
3	Ref.	Cowl Side Assembly, LH
4	Ref.	Cowl Top Assembly
5	Ref.	Center Dash Panel
6	383554-S100	Rivet (2 Req'd)

(Continued)

Item	Part Number	Description
7	N606676-S36	Bolt 9-14 N-m (79.6-123.9 In-Lb)
8	N805949-S58	Screw 2.1-2.9 N-m (18.5-25.6 In-Lb)
9	N803876-S36	Screw 2.1-2.9 N-m (18.5-25.6 In-Lb)
10	—	Screw (4 Req'd)

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Assembly



R8419-A

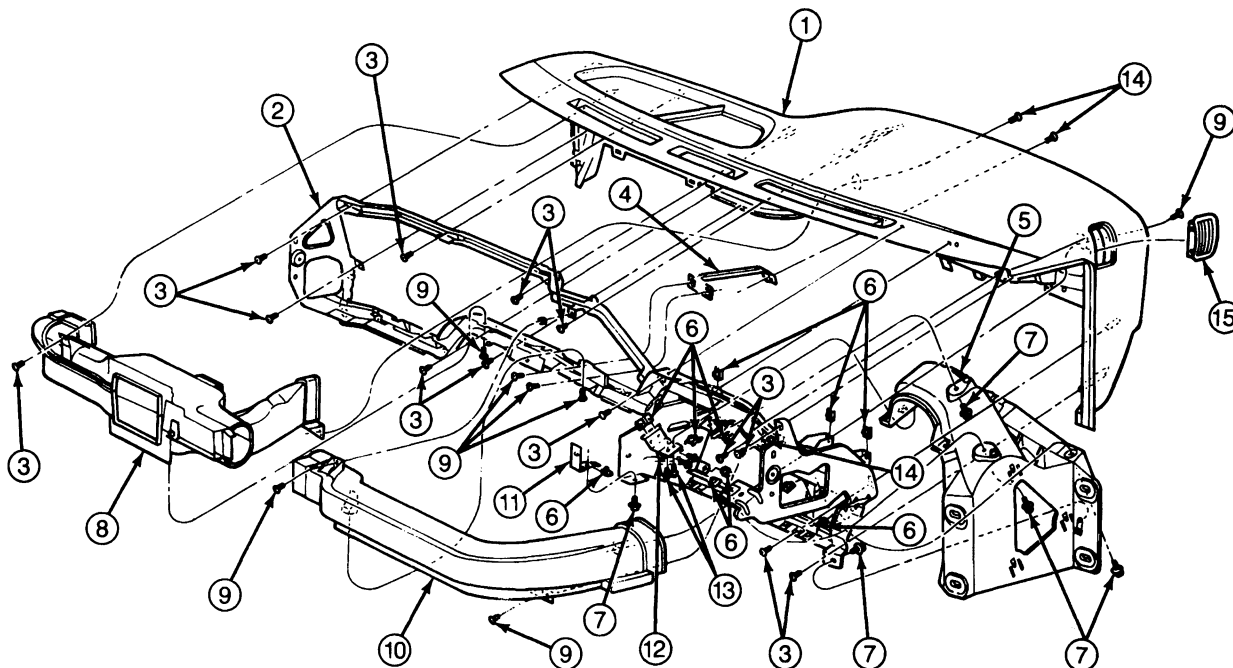
Item	Part Number	Description
1	04320	Instrument Panel Assembly
2	N803685-S11	Pushnut
3	19893	Register Assembly, RH
4	15043C38	Register Assembly, Instrument Panel

(Continued)

Item	Part Number	Description
5	15046B82	Steering Column Opening Insulators
6	1504399	Instrument Panel Sound Insulator, LH
7	1504398	Instrument Panel Sound Insulator, RH

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Rear



R8421-A

Item	Part Number	Description
1	04320	Instrument Panel Assembly
2	04545	Instrument Panel Reinforcement
3	N803875-S36	Screw
4	044F80	Radio Mounting Bracket
5	3B139	Steering Column Bracket
6	N805927-S36	Nut
7	N606676-S36	Bolt
8	19D633	Duct Assembly, RH

(Continued)

Item	Part Number	Description
9	N803876-S36	Screw
10	19A843	Duct Assembly, LH
11	045A54	Instrument Panel Center Support Bracket
12	04502	Steering Column Reinforcement
13	N80589-S36	Bolt
14	N803685-S11	Pushnut
15	046A77	Instrument Panel Defog Register, LH

SPECIFICATIONS

Torque Specifications

Description	N-m	In-Lb
Lower Center Moulding Screw(s)	2.1-2.9	18.5-25.6
Ashtray Receptacle Screw(s)	2.1-2.9	18.5-25.6
Steering Column Opening Cover Reinforcement Bolt(s)	9-14	79.6-123.9
Steering Column Opening Cover Screw(s)	2.1-2.9	18.5-25.6
Cluster Opening finish panel Screw(s)	2.1-2.9	18.5-25.6

(Continued)

Torque Specifications (Cont'd)

Description	N-m	In-Lb
Dash Panel Connector Center Screw	5.65-7.9	50-70
I/P to Right Side Cowl Bolt	9-14	79.6-123.9
I/P to Center Dash Panel Screw	2.1-2.9	18.5-25.6
I/P to Cowl Top Assembly Screw	2.1-2.9	18.5-25.6

SECTION 01-14A Handles, Locks, Latches and Mechanisms

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Latch Striker Adjustment F-150-250-350, F-Super Duty and Bronco	01-14A-31	Door Lock Switch, Econoline	01-14A-29
Latch Striker Adjustment, Econoline	01-14A-31	Door Lock Switch, F-150-250-350	01-14A-29
Rear Latch Cable Adjustment, Sliding Door, Econoline	01-14A-33	Door Outside Handle	01-14A-20
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VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and
Bronco Vehicles

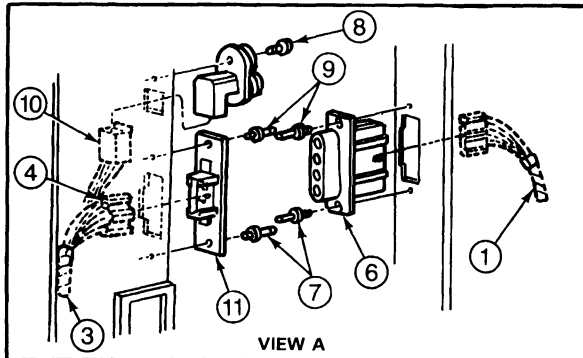
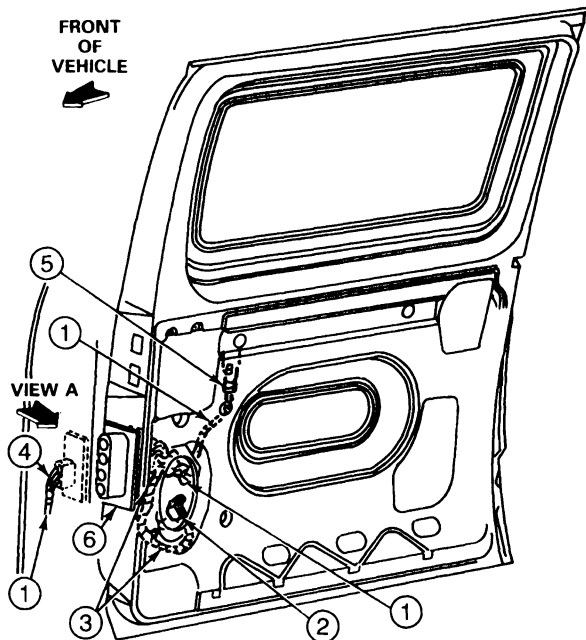
DESCRIPTION AND OPERATION

On Econoline, the power door lock control system uses electric actuator motors, controlled by pushbutton switches mounted on the front door trim panels. The switches direct current to the door lock actuator motors to lock or unlock the doors.

F-Series and Bronco use a power door lock control system with electric rocker-type switches located in the door trim panel.

DESCRIPTION AND OPERATION (Continued)

Door Lock Assembly



N10835-A

Item	Part Number	Description
1	14026-BF	Wiring Assembly
2	Ref.	To Sliding Door Speaker
3	Ref.	Locator Holes
4	Ref.	B-Pillar Connector — Wiring Harness
5	Ref.	Door Lock Actuator
6	—	Sliding Door Connector Terminal Assembly
7	N805592-S100	Rivet(s) (4 Req'd)
8	56911-S55	Screw — Courtesy Lamp 1.5-2.0 N-m (9-18 In-Lb)
9	13713-AA	Courtesy Lamp Switch Assembly
10	—	Courtesy Lamp Switch Wire Harness Connector
11	14A658-BD	Terminal Connector

DIAGNOSIS AND TESTING

Refer to the Diagnosis Guide for power door lock diagnosis.

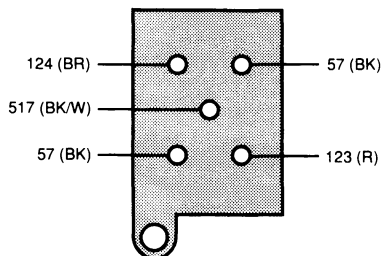
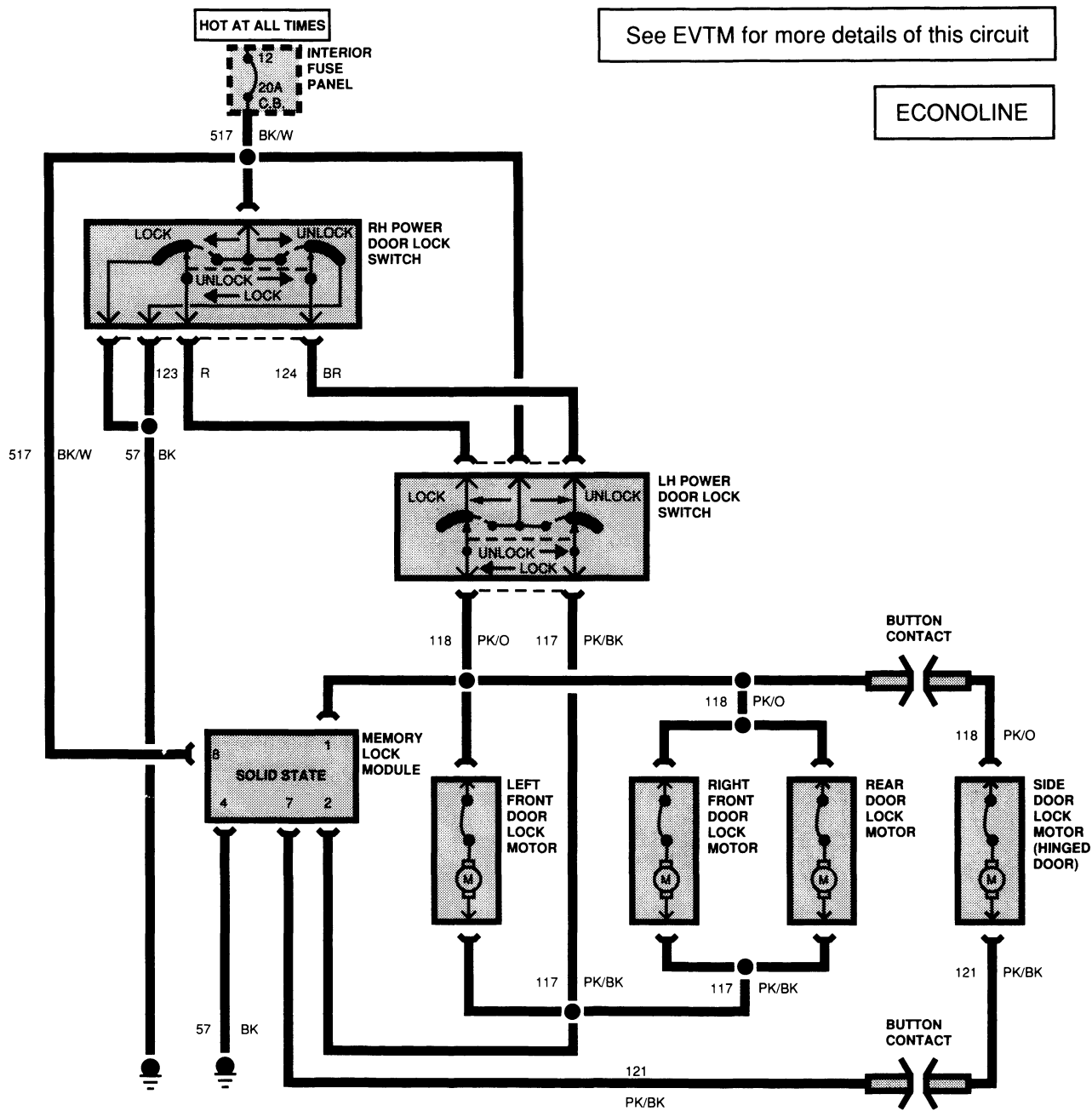
Motor

Apply 12 volts directly to one terminal of the motor's (actuator) connector and ground the other terminal. The motor (actuator) should finish its travel in less than one second. Reverse the polarity for opposite travel.

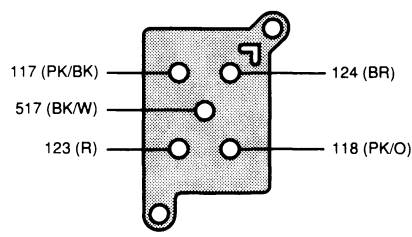
Using a Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, the motor current draw (stall test) should not exceed 6.2 amps. Reverse the power and ground leads to the connector and re-test.

DIAGNOSIS AND TESTING (Continued)

Power Door Locks with Memory Lock, Econoline



C605
RH POWER DOOR LOCK SWITCH

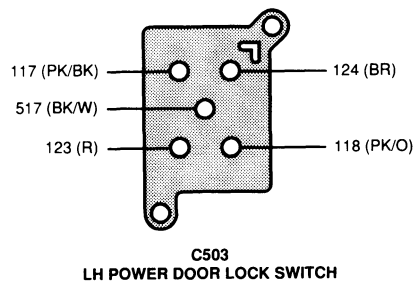
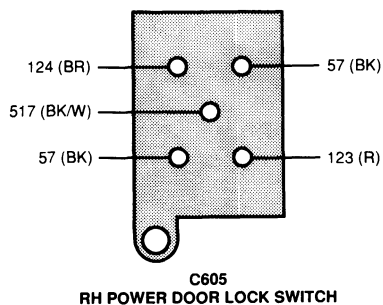
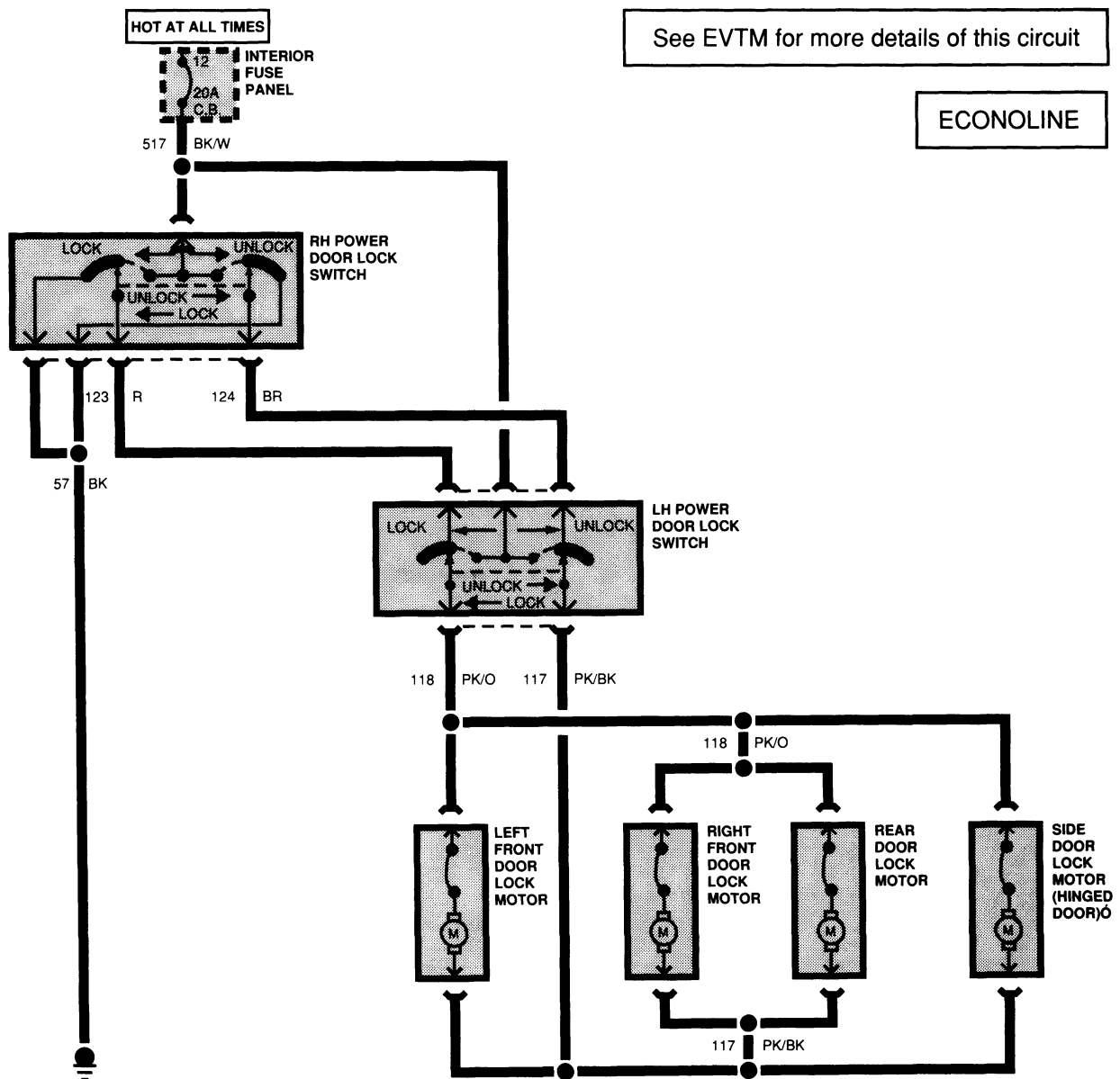


C503
LH POWER DOOR LOCK SWITCH

N10289-A

DIAGNOSIS AND TESTING (Continued)

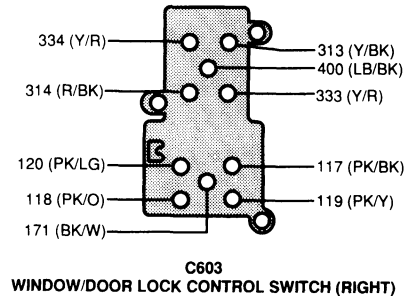
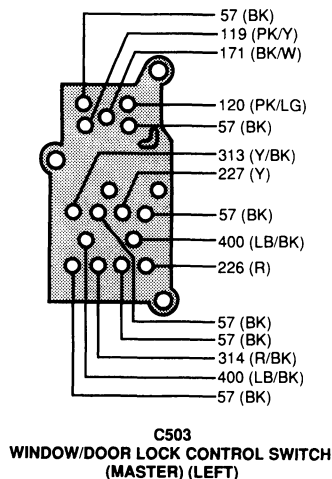
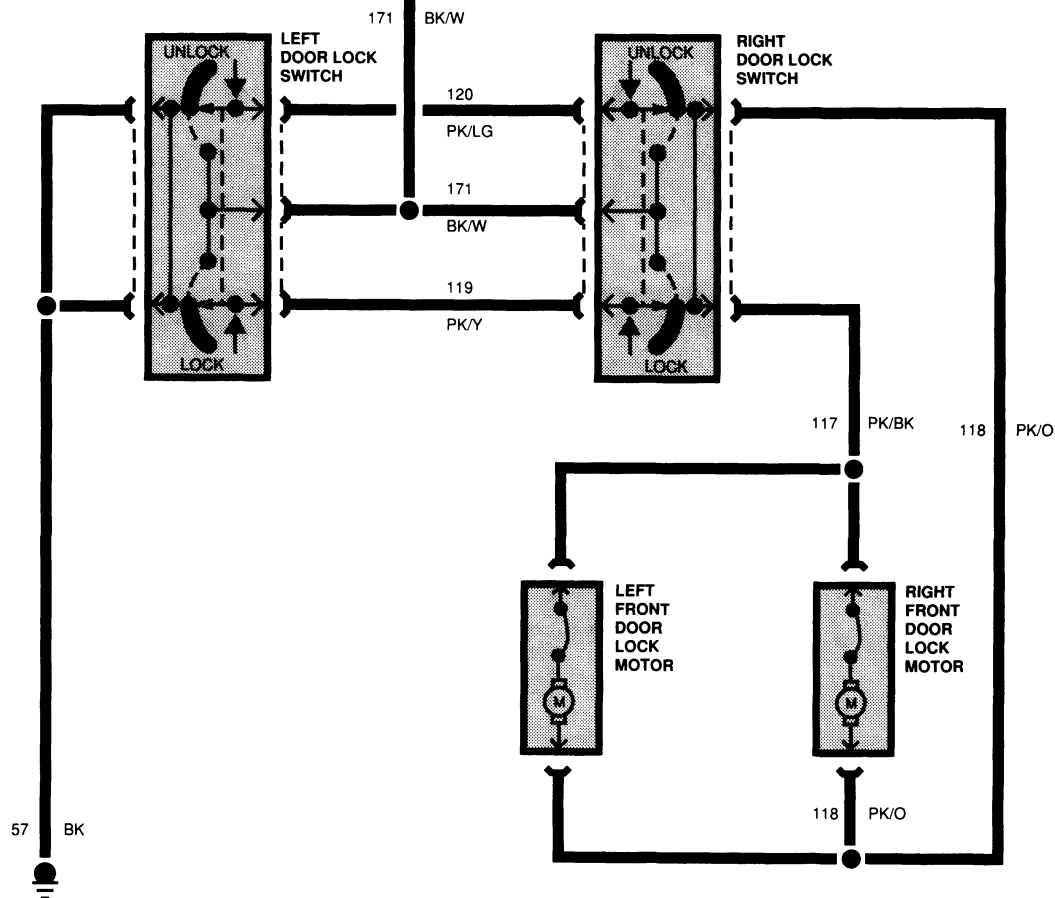
Power Door Locks without Keyless Entry, Econoline



N10288-A

DIAGNOSIS AND TESTING (Continued)

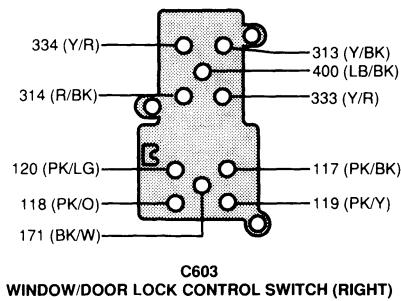
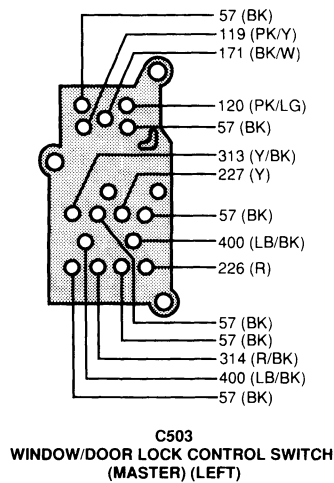
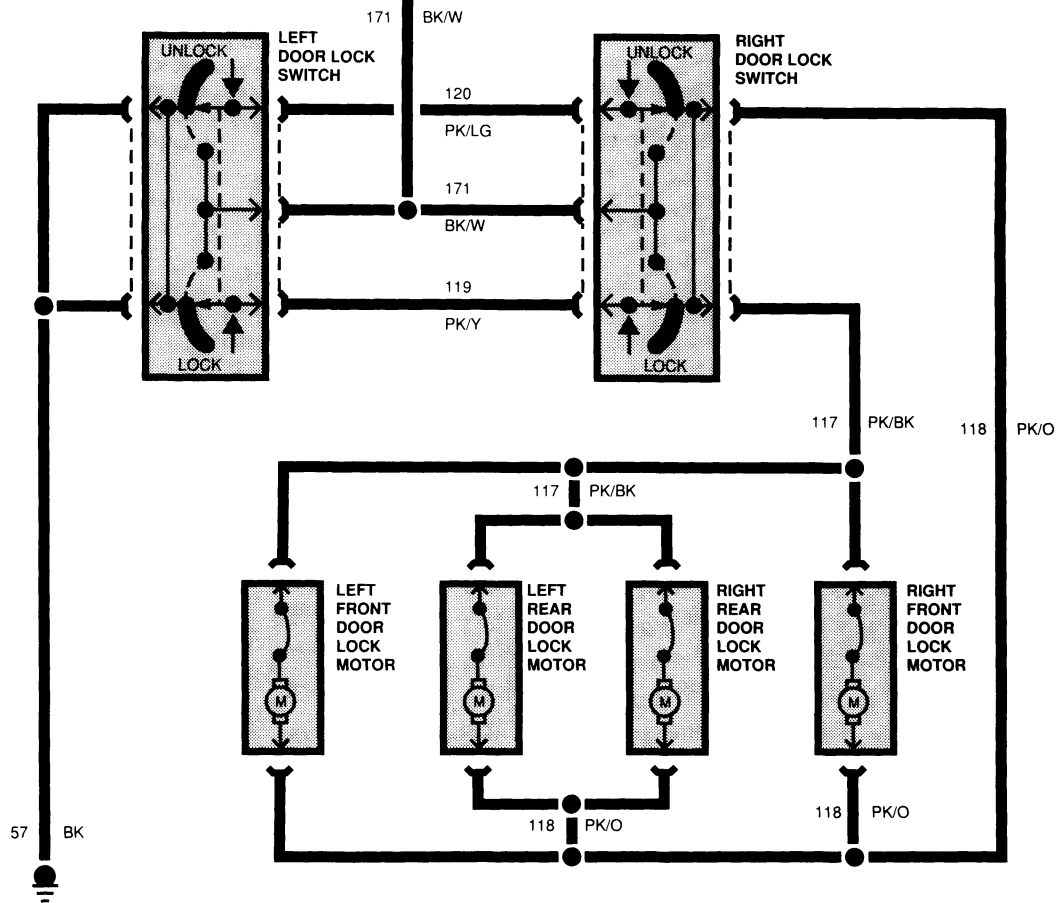
Power Door Locks, F-Series and Bronco (Except Crew Cab)

ALL
EXCEPT
CREW CABHOT AT ALL TIMES
12
20A
C.B.
FUSE
PANELSee EVTM for more
details of this circuitF-SERIES
AND
BRONCO

N10291-A

DIAGNOSIS AND TESTING (Continued)

Power Door Locks, F-350 Crew Cab

CREW CAB
ONLYHOT AT ALL TIMES
12
20A
C.B.
FUSE PANELSee EVTM for more
details of this circuitF-SERIES
AND
BRONCO

N10290-A

DIAGNOSIS AND TESTING (Continued)

Diagnosis Guides

DOOR LOCKS INOPERATIVE

CONDITION	POSSIBLE SOURCE	ACTION
All door locks do not work.	<ul style="list-style-type: none"> ● Malfunctioning circuit breaker. ● Open or shorted circuit. ● Malfunctioning switch. ● Open ground circuit. 	<ul style="list-style-type: none"> ● Check circuit breaker. Replace if necessary. Refer to Section 18-01. ● Check wiring and connections between circuit breaker and door lock switches. Service if necessary. ● Test switch. Refer to Testing in this section. Replace if necessary. ● Check ground circuit from left switch. Repair if necessary.
Locks do not work in below freezing weather.	<ul style="list-style-type: none"> ● Frozen door latch or linkage. 	<ul style="list-style-type: none"> ● Bring vehicle into heated garage to allow lock system to thaw. Verify that all locks now work. Using Multi-Purpose Grease Spray D7AZ-19584-AA (ESR-M1C159-A and ESB-M1C10G-B) or equivalent, spray into latch opening and manually cycle ten times. It may be necessary to remove door trim panel to lubricate entire latch and linkage system.
All locks work from one switch only.	<ul style="list-style-type: none"> ● Open or shorted circuit. ● Malfunctioning switch. 	<ul style="list-style-type: none"> ● Check wiring and connections between circuit breaker and inoperative switch. Service if necessary. ● Test switch. Refer to Testing in this section. Replace if necessary.
Door locks operate one way only.	<ul style="list-style-type: none"> ● Open ground circuit. 	<ul style="list-style-type: none"> ● Check ground circuit from left switch. Service if necessary.
Locks work intermittently.	<ul style="list-style-type: none"> ● Loose connections. ● Poor ground at left switch. ● Malfunction switch. 	<ul style="list-style-type: none"> ● Check connectors. Tighten if necessary. ● Check ground circuit from left hand switch. Service if necessary. ● Test switch. Refer to Testing in this section. Replace if necessary.
One door lock does not work.	<ul style="list-style-type: none"> ● Latch or linkage binding. ● Open or shorted circuit. ● Malfunctioning actuator. 	<ul style="list-style-type: none"> ● Using Multi-Purpose Grease Spray D7AZ-19584-AA (ESR-M1C159-A and ESB-M1C10G-B) or equivalent, spray into latch opening and manually cycle ten times. Check for interference around night latch and all linkage. ● Check for voltage at actuator connector, operating switch in both positions. Service circuit if necessary. ● Test actuator. Refer to Testing in this section. Replace if necessary.
Door locks work with engine running only.	<ul style="list-style-type: none"> ● Low charge in battery. ● Loose or corroded connections. ● Latch or linkage binding. 	<ul style="list-style-type: none"> ● Test battery. Refer to Section 14-01. Charge if necessary. ● Check wiring and connections. Service if necessary. ● Using Multi-Purpose Grease Spray D7AZ-19584-AA (ESR-M1C159-A and ESB-M1C10G-B) or equivalent. Spray into latch opening and manually cycle ten times. Check for interference around night latch and all linkage.

DIAGNOSIS AND TESTING (Continued)**DOOR LOCKS INOPERATIVE (Continued)**

CONDITION	POSSIBLE SOURCE	ACTION
Sliding door lock / unlock does not operate.	<ul style="list-style-type: none"> • Open in Circuits 117 / 118 between door switches and door lock control module. • Sliding door lock motor inoperative. • No continuity through button connectors. • Door lock control module inoperative. 	<ul style="list-style-type: none"> • Check wiring or door switches, door lock relay and door lock control module. • Test motor. Refer to Testing in this section. • Service as required. • Test door lock control module inputs. Refer to Testing in this section.

TN9818B

Power Door Lock Switch, Econoline

Using a self-powered test lamp, there should be **no continuity** between any terminals with the switch in its normal position.

Continuity should exist between terminals A and B with the switch held in the down (LOCK) position and between terminals A and C with the switch held in the up (UNLOCK) position.

REMOVAL AND INSTALLATION

NOTE: Due to the conversion from single 90 degree rod end shape to double 90 degree rod end shape, it may be necessary to remove more parts than the instructions indicate. This action will allow more maneuverability of the rod and ease the removal process.

Power Door Lock Switch, F-Series and Bronco

Procedures for testing the power door lock switch is the same as for the single power window switch. Refer to Section 01-11.

There is no relay test. Power is supplied directly to the door lock motor through the switch located in the door trim panel.

Front and Rear Door Latch, F-Series, F-350 Crew Cab and Bronco**Removal**

1. Remove the trim panel and watershield from the door. Refer to Section 01-05A.
2. Disconnect rods from handle and lock cylinder, if necessary, and the cable from the remote control assembly.
3. Remove the latch assembly attaching screws.
4. Remove door latch.

For installation, follow removal procedures in reverse order.

NOTE: Rod should be attached to latch before latch installation.

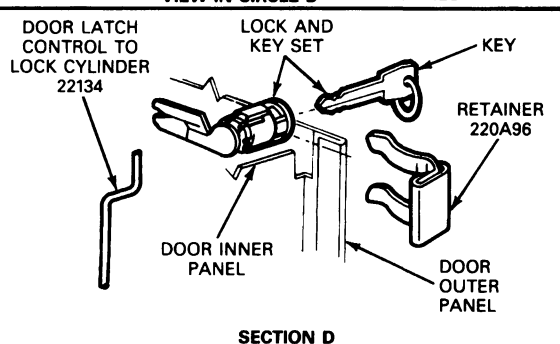
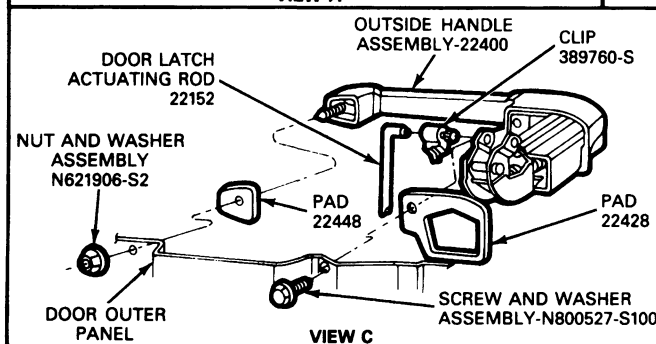
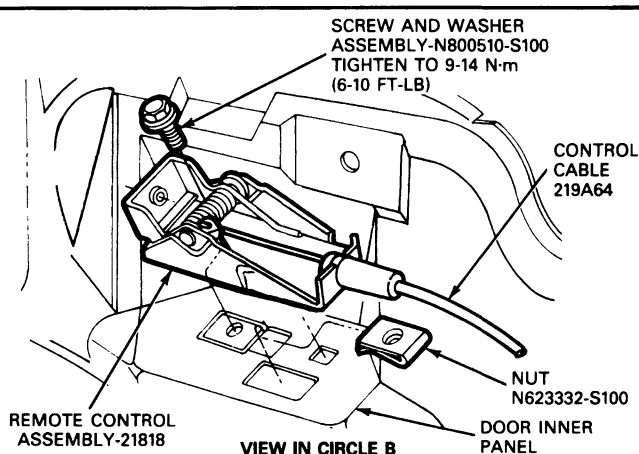
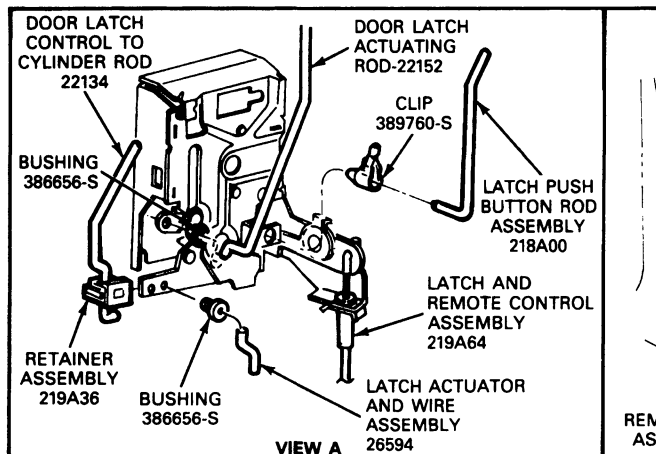
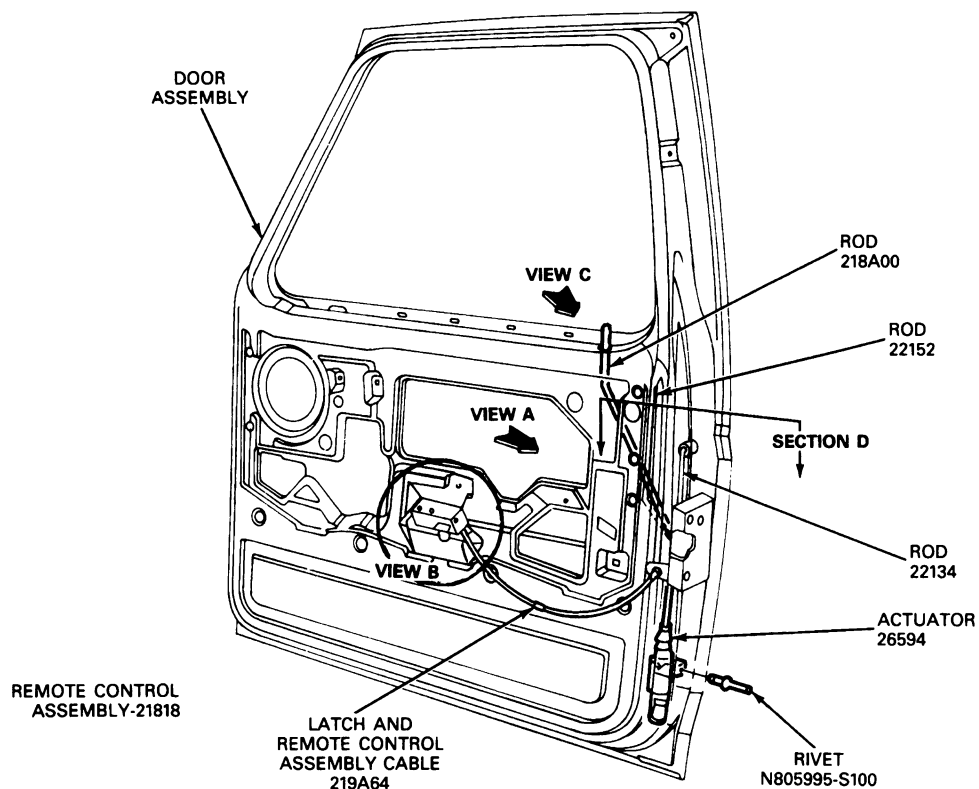
Door Lock Motor

Apply 12 volts directly to one terminal of the motor (actuator) connector and ground the other terminal. The motor (actuator) should finish its travel in less than one second. Reverse polarity for opposite travel.

Using a Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, the motor current draw (stall test) should not exceed 6.2 amps. Reverse the power and ground leads to the connector and repeat test.

REMOVAL AND INSTALLATION (Continued)

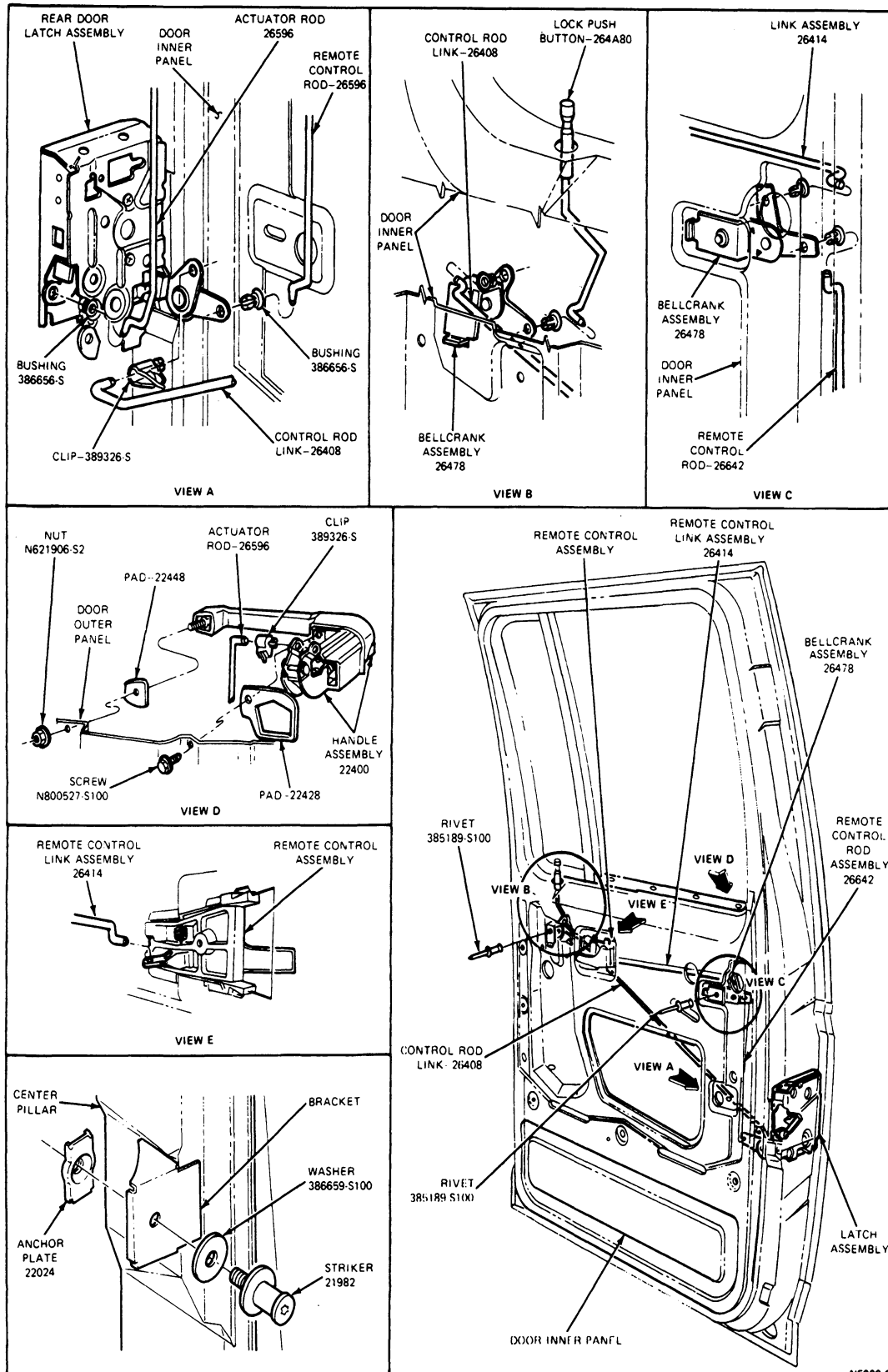
Front Door, F-Series and Bronco



N4607-L

REMOVAL AND INSTALLATION (Continued)

Rear Door, F-350 Crew Cab



REMOVAL AND INSTALLATION (Continued)**Tailgate Latch and Control Assembly****Removal and Installation**

1. Remove tailgate inside panel cover retaining screws. Remove panel.
2. Disconnect two tailgate latch release links from tailgate latch control assembly.
3. If removing handle and control assembly, remove two nut and washer assemblies to tailgate outside panel.
4. Remove tailgate latch assembly screws.
5. Remove latch assembly (both sides) by sliding out link of tailgate.
6. Remove link from latch assembly.
7. Remove support cable from latch assembly by removing screw retaining support cable to latch. Remove cable.

NOTE: Prior to installation take out the slack in links and latches by pulling link to center of tailgate. Close plastic clip over closest thread of link.

For installation, follow removal procedures in reverse order.

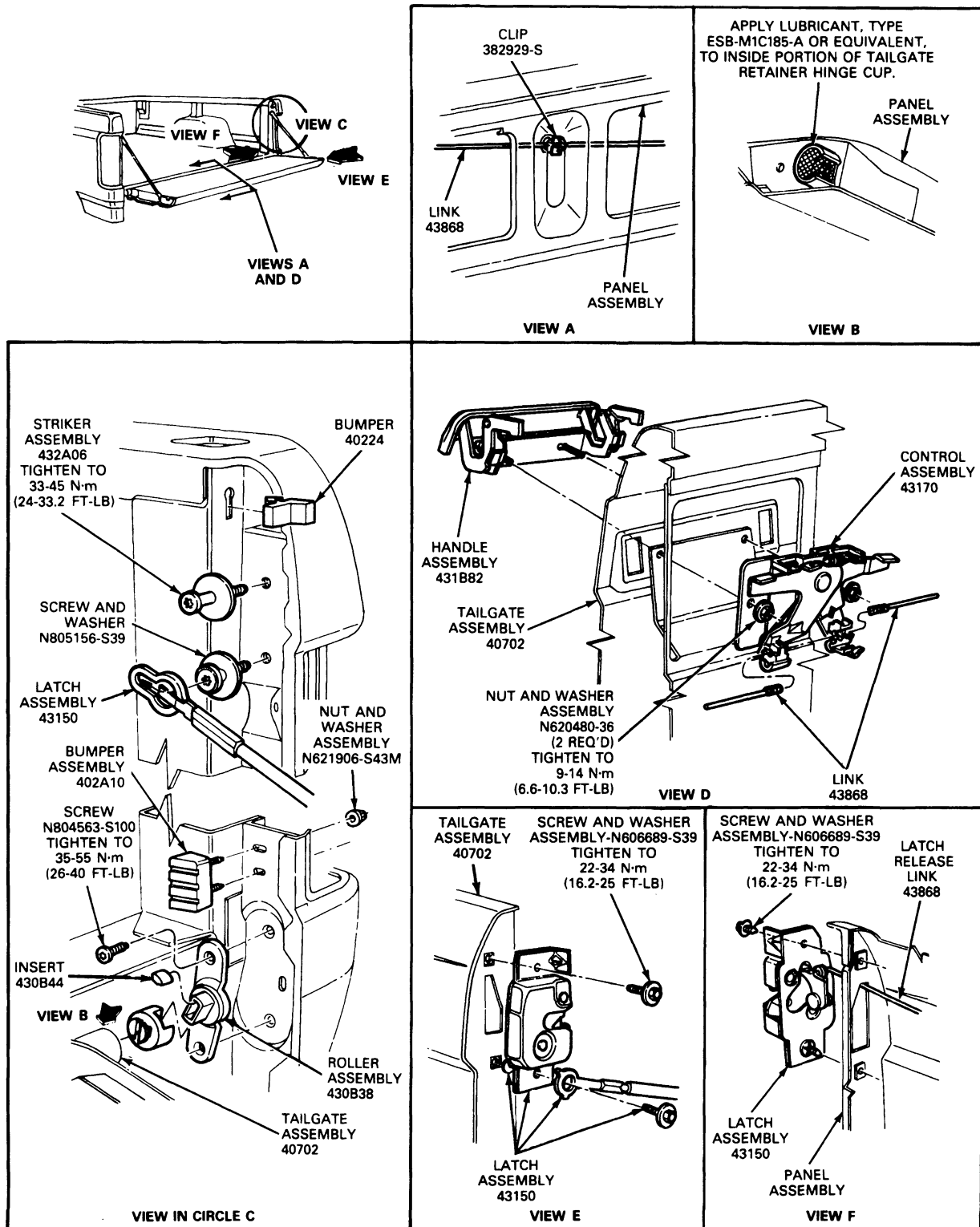
Tailgate Latch Release Handle and Lock Release Control Assemblies, Bronco**Removal and Installation**

1. Lower tailgate and remove inner access cover. Refer to Section 01-03.
2. Remove handle assembly-to-tailgate attaching screws.
3. Remove handle rod retaining clip to lock control.
4. Remove handle and rod assembly.
5. Disconnect latch release links and latch control assembly.
6. Disconnect electrical connector from interlock switch.
7. Remove three lock control-to-tailgate screw and washer assemblies.
8. Remove lock control from tailgate.

For installation, follow removal procedures in reverse order. Tighten screw and washer assemblies to 8-14 N-m (6-11 ft-lb).

REMOVAL AND INSTALLATION (Continued)

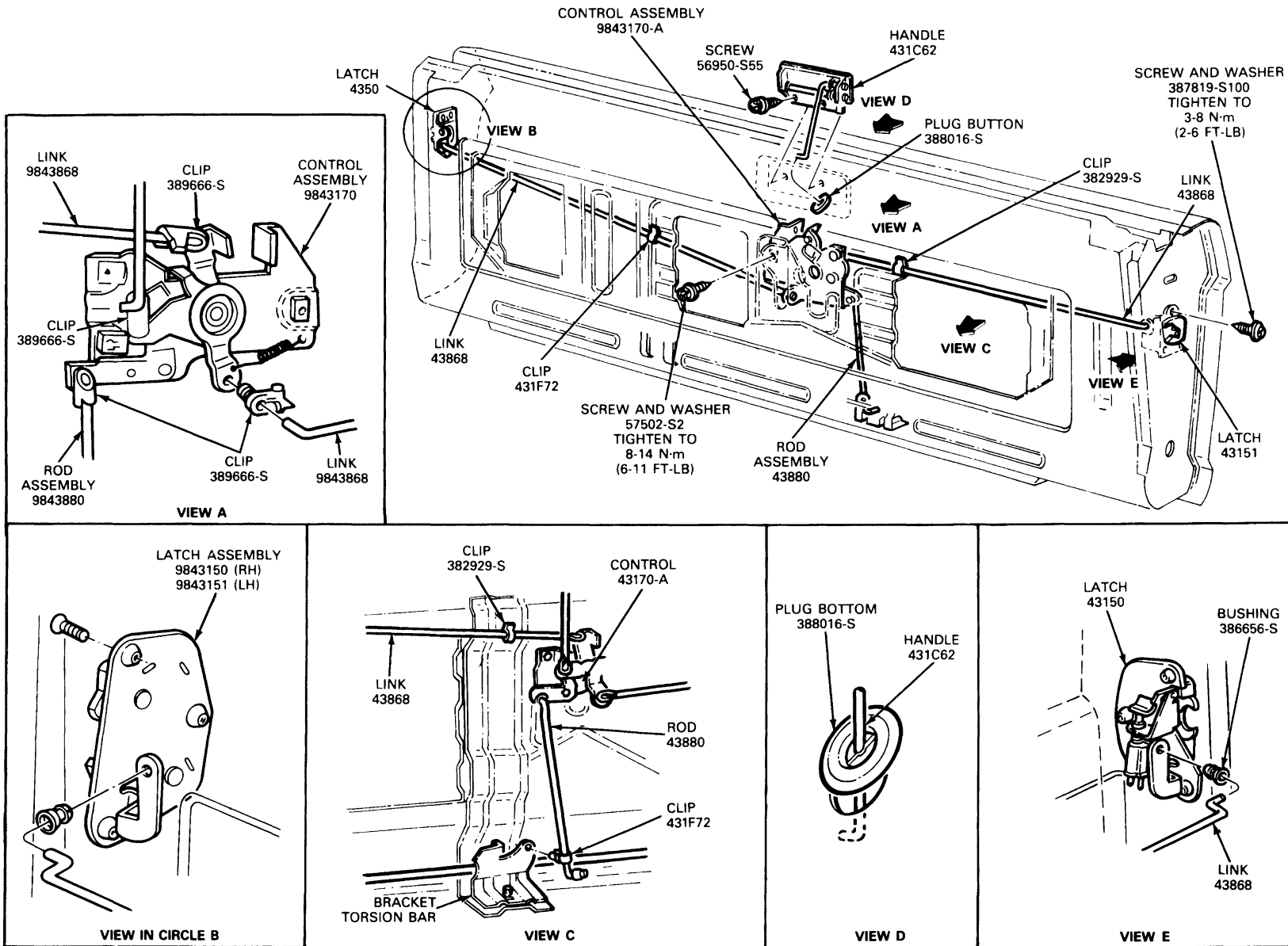
Tailgate Installation, Styleside Pick-Up



N7396-C

REMOVAL AND INSTALLATION (Continued)

Tailgate Latch Release and Lock Control, Bronco



N4236-J

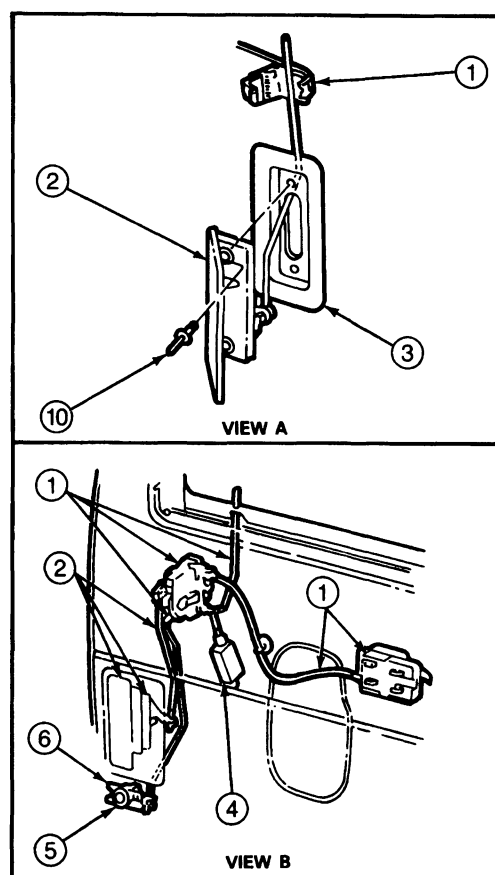
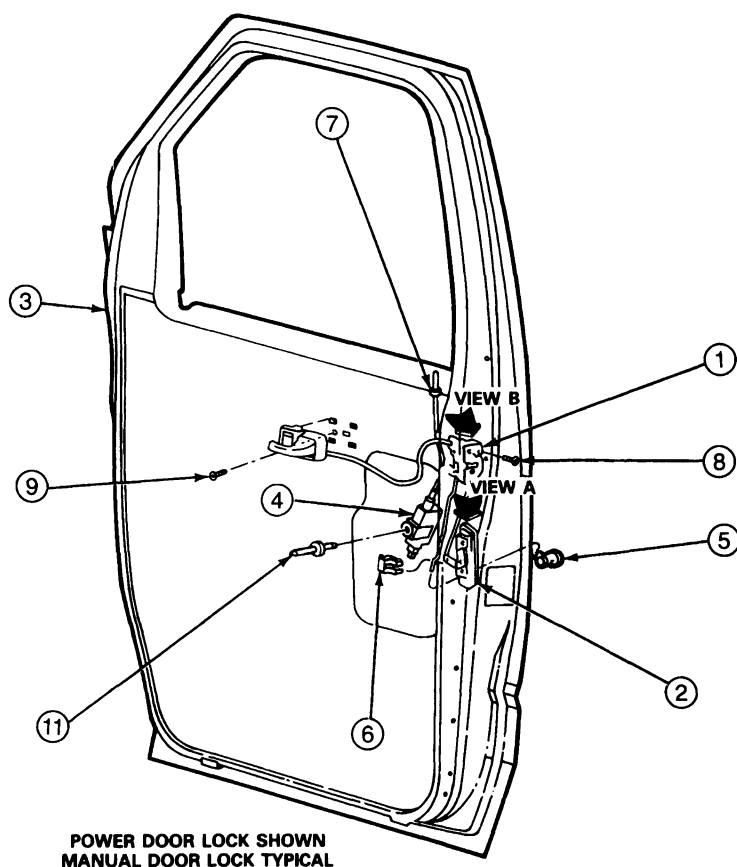
REMOVAL AND INSTALLATION (Continued)**Front Door Latch, Front Side Cargo Door with Hinges, Econoline****Removal and Installation**

1. Remove door access cover or trim panel and watershield. Refer to Section 01-05A.
2. Remove handle-to-inside door attaching screws. Remove handle.
3. Drill out rivet holding remote control handle, if equipped.
4. Unsnap lock cylinder rod from lock cylinder.

5. Drill out rivet holding power lock cylinder actuator, if equipped.
6. Remove three latch attaching screws, using a Torx® T-27 drive-bit.
7. Remove cable clip on cable from door inner panel.
8. Remove latch assembly from door through access hole.

NOTE: If module is not being replaced, remove and replace any defective parts.

For installation, follow the removal procedures in reverse order. Tighten attaching screws to 10-14 N·m (7-10 ft·lb). Replace drilled out rivets with new rivets.

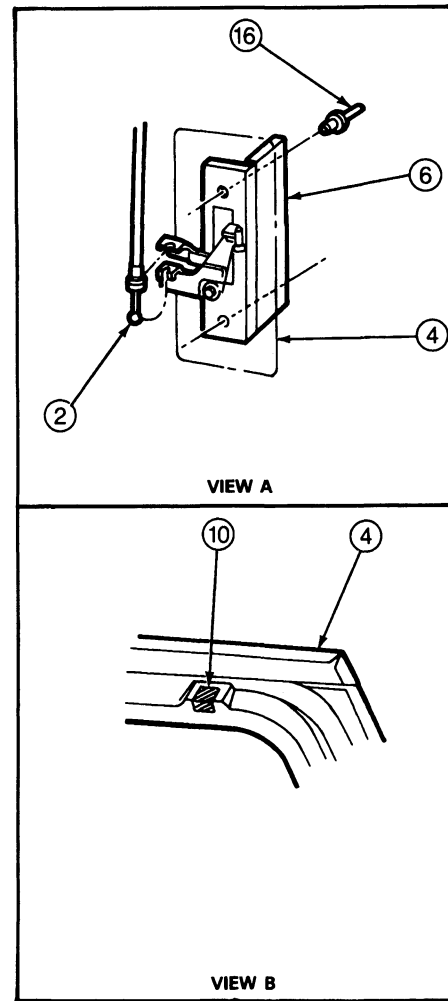
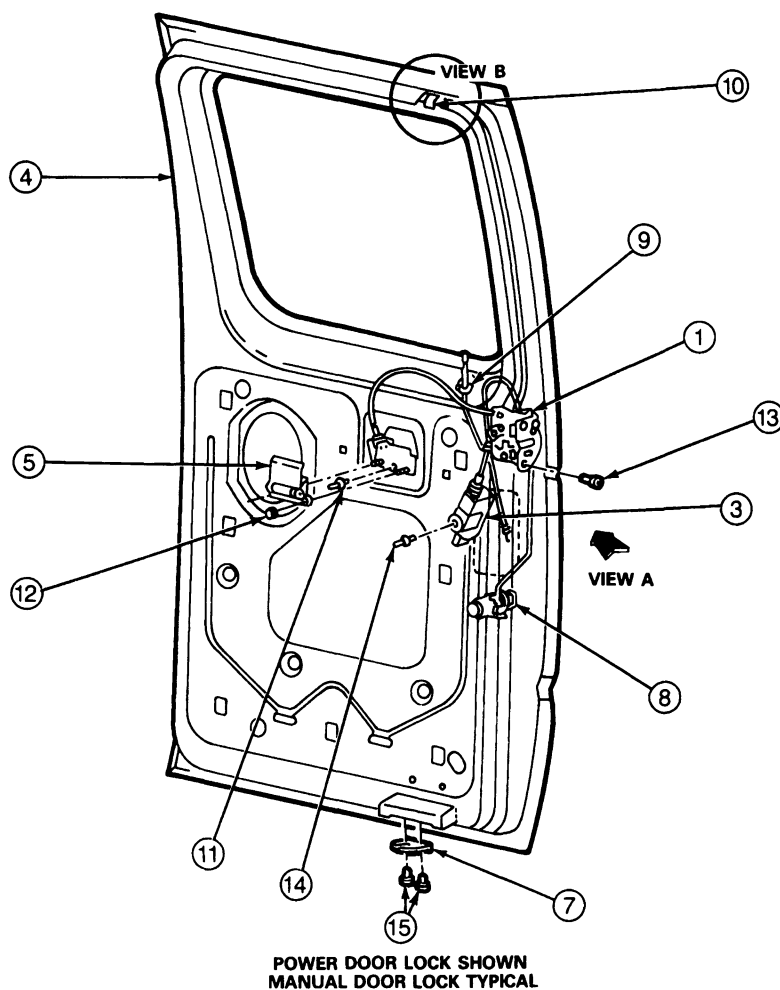
Front Door Latch, Econoline

N9836-A

Item	Part Number	Description
1	219A64	Front Door Latch Assembly
2	22400	Outside Handle Assembly
3	Ref.	Front Door
4	218A42	Actuator Assembly
5	Ref.	Lock Cylinder

(Continued)

Item	Part Number	Description
6	43629	Lock Cylinder Retainer
7	21999	Door Latch Knob Grommet
8	N806679-S100	Screw 10-14 N·m (7-10 Ft·Lb)
9	56912-S58	Screw (1 Req'd)
10	W525172-S417	Rivet (2 Req'd)
11	N805995-S100	Rivet (1 Req'd)

REMOVAL AND INSTALLATION (Continued)**Front Side Cargo Door, Econoline**

Item	Part Number	Description
1	264A00	Remote Control and Latch Assembly
2	—	Cable Sheath and Inner Cable
3	21	Door Latch Actuator
4	Ref.	Body Side Front Door
5	266B10	Inside Handle Assembly
6	26600-B	Outside Handle Assembly
7	40060	Wedge and Plate

(Continued)

Item	Part Number	Description
8	Ref.	Lock Cylinder
9	21999	Grommet
10	11396	Shield (1 Req'd)
11	N801395-S	Rivet (1 Req'd)
12	N800354-S103	Nut 10-20 N-m (7-14 Ft-Lb)
13	N806679-S100	Screw 10-14 N-m (7-10 Ft-Lb)
14	N806772-S100	Rivet (1 Req'd)
15	N802141-S36B	Screw 3-5 N-m (27-44 In-Lb)
16	388047-S102	Rivet (2 Req'd)

Rear Side Cargo Upper and Lower Door Latches, Econoline, with Hinged Doors**Removal**

1. Remove the trim panel and watershield if equipped.

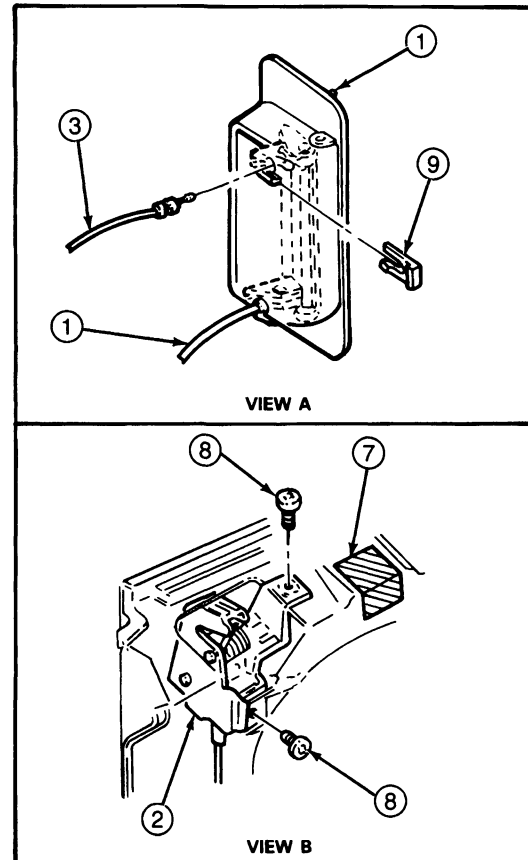
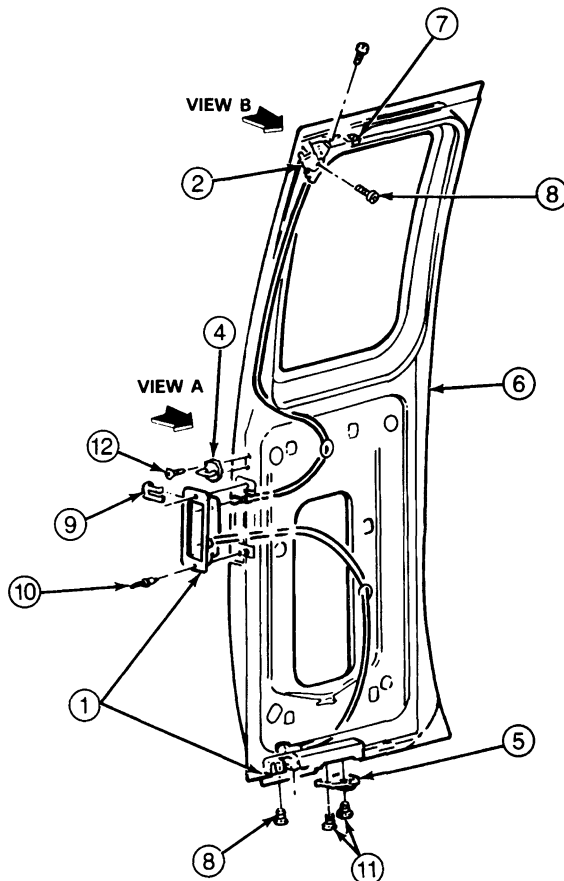
2. Disengage the cable keeper by pushing up the lower leg of the keeper and sliding the keeper toward the outside of the door.
3. Push the cable through the slot in the handle, then open the handle.

REMOVAL AND INSTALLATION (Continued)

4. Move inner cable so it will slide through the slot in the inner side of the handle assembly.
5. Remove the cable from the handle.
6. Pinch the legs of the cable clip together and push them through the hole in the inner panel.

7. Remove the two latch screws.
8. Pull the latch upward to remove.

For installation, follow removal procedures in reverse order. Tighten latch attaching screws to 10-14 N-m (7-10 ft-lb).

Rear Side Cargo Door, Econoline

N9840-A

Item	Part Number	Description
1	264A01	Remote Control and Latch
2	26502	Upper Latch Assembly
3	—	Cable Sheath and Inner Cable
4	265A04	Door Latch Striker Assembly
5	40060	Wedge and Plate
6	Ref.	Body Side Door, Rear

(Continued)

Item	Part Number	Description
7	11396	Shield (1 Req'd)
8	N806679-S100	Screw 10-14 N-m (7-10 Ft-Lb)
9	Ref.	Cable Keeper (2 Req'd)
10	N806772-S100	Rivet
11	N802141-S36B	Screw 3-5 N-m (27-44 In-Lb)
12	N806680-S100	Screw 21-29 N-m (16-21 Ft-Lb)

Back Door Latches, Econoline**Removal**

1. Remove the door trim panel and watershield, if so equipped. Refer to Section 01-05B.
2. Remove the two nuts attaching the door inside handle and remove the handle.

3. Remove the four screws holding the handle and license housing assembly.
4. Pull the housing away from the door being careful of the double adhesive seal at the bottom of the housing.
5. Disengage the rod from the lock cylinder lever.

REMOVAL AND INSTALLATION (Continued)

6. Disengage the cable from the back of the outside handle.
7. Remove the license lamp from the top of the housing. Refer to Section 17-01.
8. Drill out and remove the rivet holding the remote control assembly.
9. Drill out and remove the rivet holding the power lock actuator, if equipped.
10. Remove the three latch attachment screws using a Torx® T-27 drive bit.
11. Remove the latch module assembly from the door through the large center access hole.

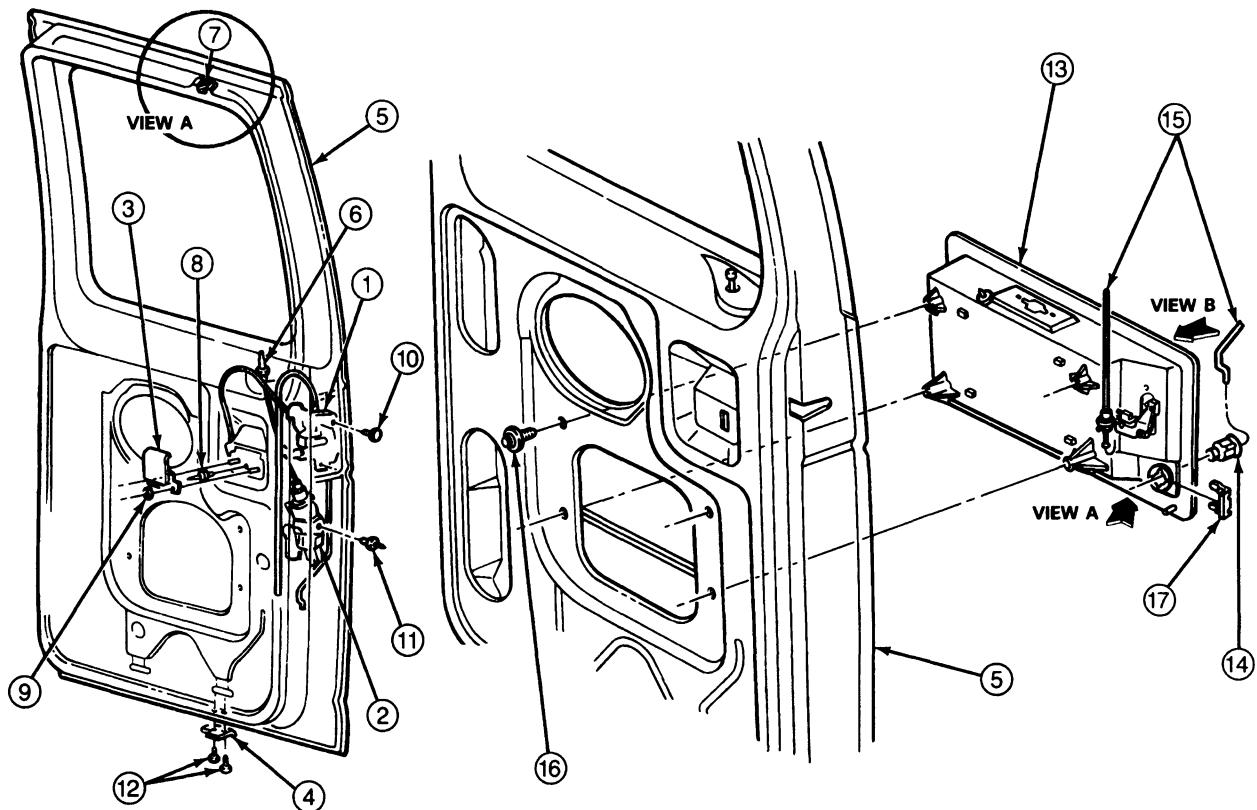
Installation

1. If the complete module is not being replaced, remove and replace the defective part. The inside handle remote control, cables and rods are serviceable.
2. Position the latch in the door making sure the push-button rod is positioned into its hole in the inner panel. Install latch attaching screws and tighten to 10-14 N·m (7-10 ft-lb).
3. Attach power lock actuator to inner panel with rivet.
4. Attach inside handle remote control to inner panel with rivet.

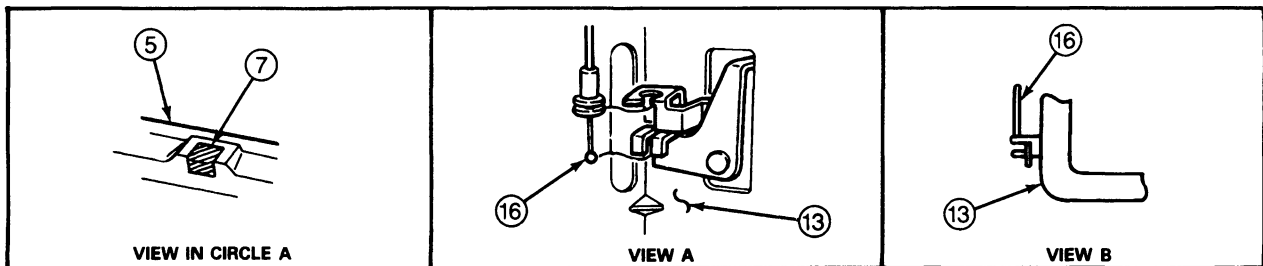
5. Attach the inside handle to the remote control with two nuts.

NOTE: Be sure that the finger of the handle is positioned under the remote control lever during assembly.

6. Replace plastic under handle, if equipped.
7. Repair or replace the double adhesive foam on the bottom of the handle and housing assembly.
8. Replace the license plate lamp. Refer to Section 17-01.
9. Install the cable to the outside handle.
10. Snap the rod into the lock cylinder lever.
11. Place the handle and housing into the door panel opening using the locating pins at the bottom of the housing for guidance.
12. Install the four housing attaching screws.
13. Snap cable clip into hole in the inner panel, if equipped.
14. On lower latch, position latch into locating tabs at bottom of door.
15. Replace the door access cover or trim panel and watershield, if equipped.

REMOVAL AND INSTALLATION (Continued)**Right Back Door, Remote Control, Latch Assembly, Inside and Outside Handle Assembly, Econoline**

POWER DOOR LOCK SHOWN
MANUAL DOOR LOCK TYPICAL



N9842-A

REMOVAL AND INSTALLATION (Continued)

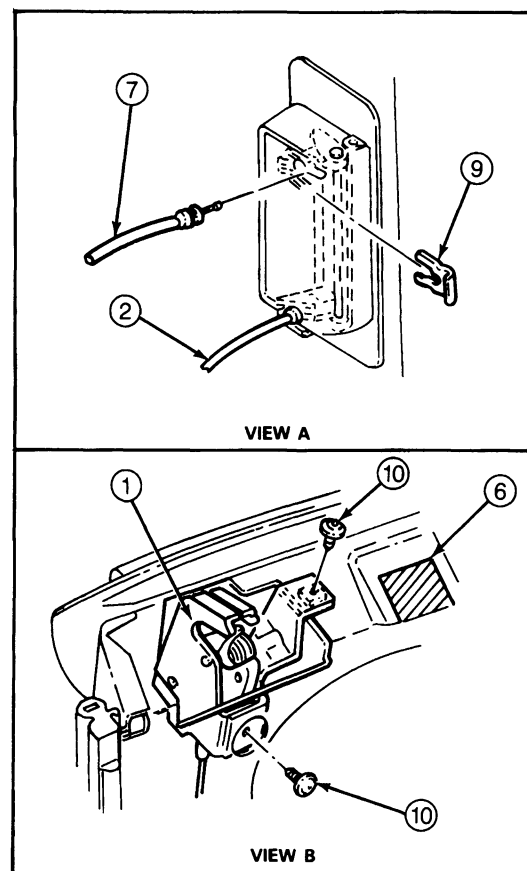
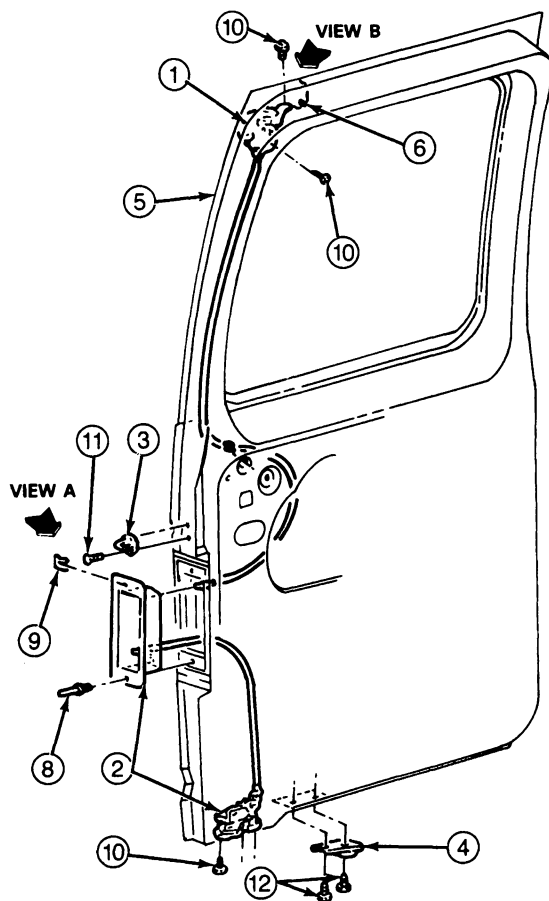
RIGHT BACK DOOR, REMOTE CONTROL, LATCH ASSEMBLY, INSIDE AND OUTSIDE HANDLE ASSEMBLY, E-150-250-350 (LEGEND)

Item No.	Part Number	Description
1	431A02	Remote Control and Latch Assembly
2	218A42	Door Latch Actuator
3	266B10	Body Side Front Door Inside Handle
4	40060	Wedge and Plate Assembly
5	Ref.	Right Back Door
6	21999	Grommet
7	11396	Shield
8	N801395-S	Rivet (1 Req'd)
9	N800354-S103	Nut 1.2-1.8 N·m (11-15 In·Lb)
10	N806679-S100	Screw 10-14 N·m (89-123 In·Lb)

Item No.	Part Number	Description
11	N806772-S100	Rivet (1 Req'd)
12	N802141-S36B	Screw 2.7-4.5 N·m (23.8-39.8 In·Lb)
13	434A20	Handle and Housing Assembly
14	Ref.	Lock Cylinder
15	Ref.	Remote Control and Latch Assembly (Cable and Rod)
16	N806691-S2	Screw and Washer Assembly 1.0-2.0 N·m (8.8-17.7 In·Lb)
17	22023	Tailgate Lock Retainer

CN9843-A

Left Back Door, Remote Control Latch Assembly, Econoline



N9844-A

Item	Part Number	Description
1	43287	Back Door Upper Latch Assembly
2	431A03	Remote Control and Latch
3	264A10	Striker Assembly
4	40060	Wedge and Plate
5	Ref.	Left Back Door
6	11396	Shield

(Continued)

Item	Part Number	Description
7	—	Cable Sheath and Inner Cable
8	N806772-S100	Rivet (2 Req'd)
9	Ref.	Cable Keeper (2 Req'd)
10	N806679-S100	Screw 10-14 N·m (7-10 Ft·Lb)
11	N806680-S100	Screw 21-29 N·m (16-21 Ft·Lb)
12	N802141-S36B	Screw 3-5 N·m (27-44 In·Lb)

REMOVAL AND INSTALLATION (Continued)**Door Inside Handle**

F-150-250-350 and Bronco (except F-350 Crew Cab Rear Door)

Removal and Installation

To remove the door inside handle, remove one screw and remove the handle. To install, position handle on shaft and secure with set screw.

F-350 Crew Cab, Rear Door

The door inside handle is an integral part of the remote control assembly. Refer to Remote Control Assembly, F-350 Crew Cab, Rear Door, removal and installation.

2. Disconnect the latch actuating rod from the handle link connector.
3. Remove one nut and screw (Bronco and F-150-250-350).
4. On Econoline, remove two rivets by punching out center pin and drilling out remaining portion with 1/4-inch drill.

Door Outside Handle

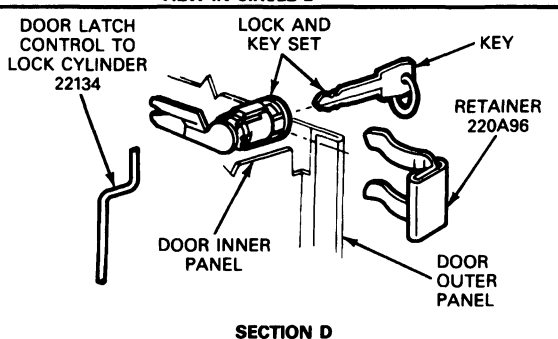
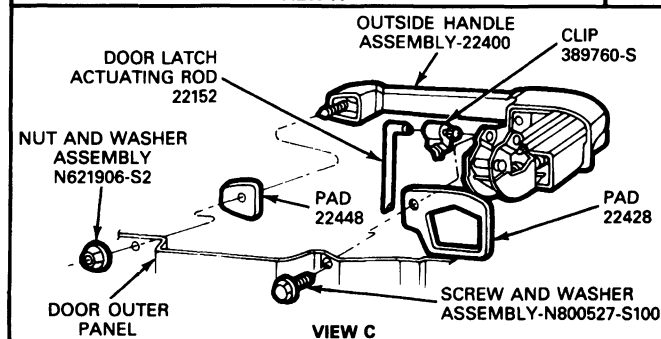
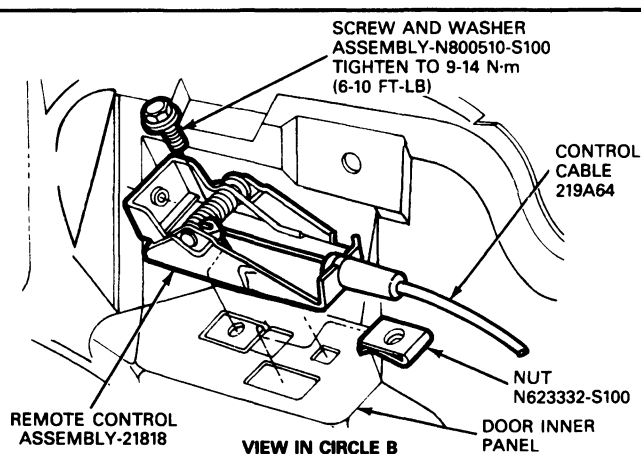
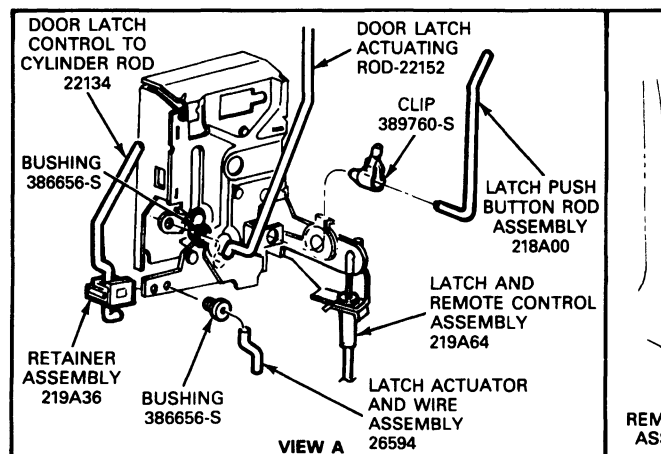
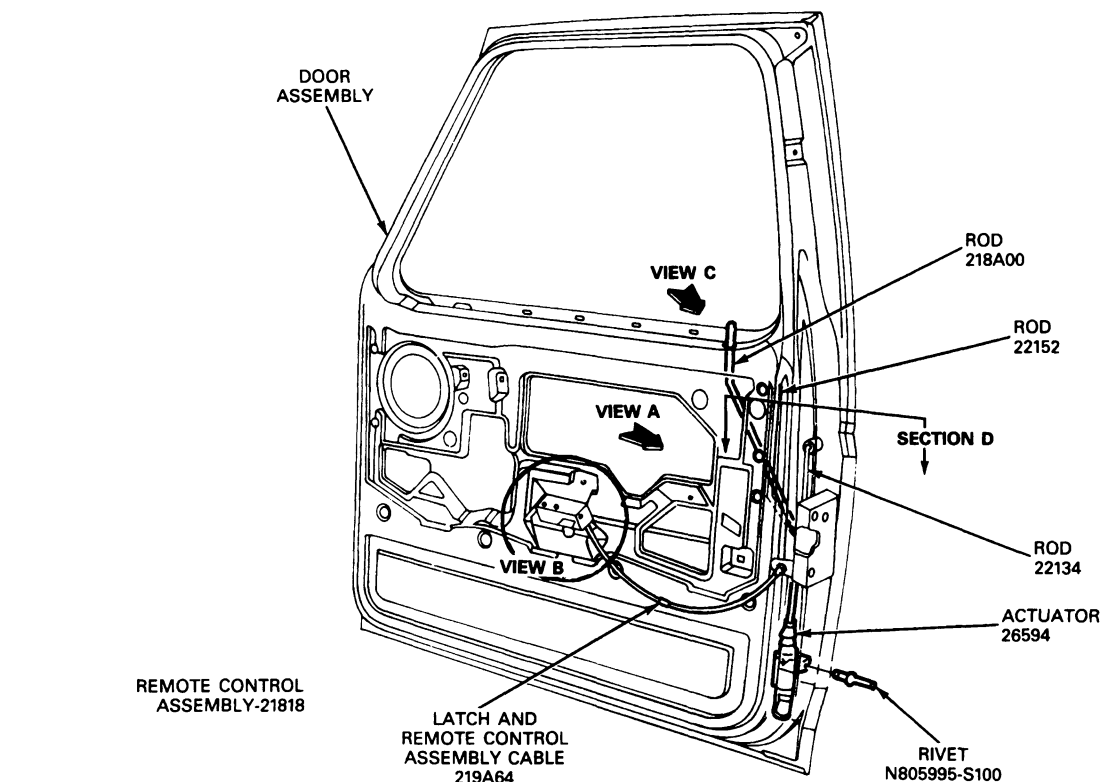
Bronco, F-Series and Econoline

Removal and Installation

1. Remove the door trim panel and watershield from the door. Refer to Section 01-05A or B.

REMOVAL AND INSTALLATION (Continued)

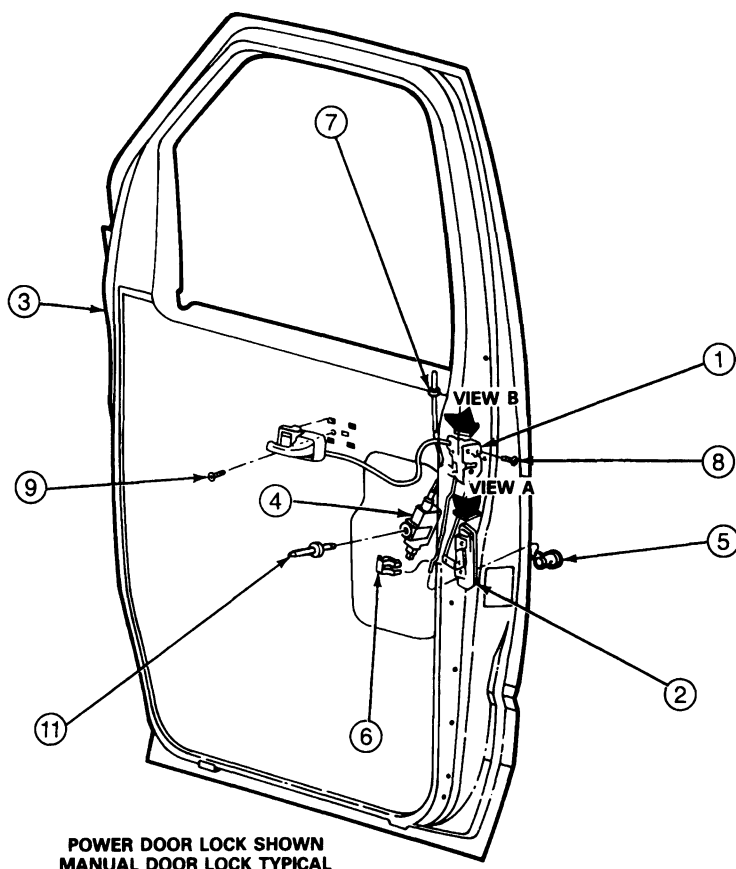
Front Door Latch, F-Series and Bronco



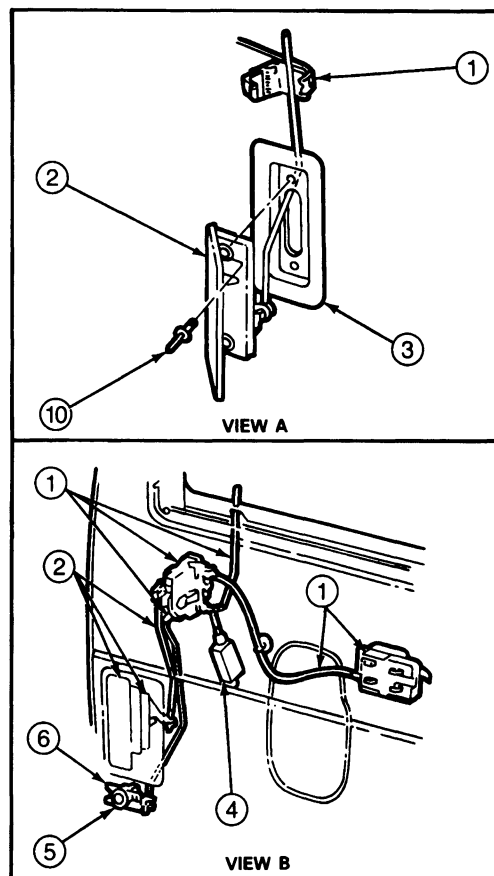
N4607-L

REMOVAL AND INSTALLATION (Continued)

Side Door Latch, E-150-250-350



POWER DOOR LOCK SHOWN
MANUAL DOOR LOCK TYPICAL



N9836-A

Item	Part Number	Description
1	219A64	Front Door Latch Assembly
2	22400	Outside Handle Assembly
3	Ref.	Front Door
4	218A42	Actuator Assembly
5	Ref.	Lock Cylinder
6	43629	Lock Cylinder Retainer

(Continued)

Item	Part Number	Description
7	21999	Door Latch Knob Grommet
8	N806679-S100	Screw 10-14 N-m (7-10 Ft-Lb)
9	55928-S2	Screw (1 Req'd.)
10	388047-S102	Rivet (2 Req'd.)
11	N805995-S100	Rivet (1 Req'd.)

TN9836A

5. Remove handle and pads from door.
6. Attach actuator rod and pads to new handle.
7. Install one nut and one screw (Bronco and F-150-250-350).
8. On Econoline, install rivets.
9. Install door trim panel and watershield. Refer to Section 01-05A or B.
10. Check operation.

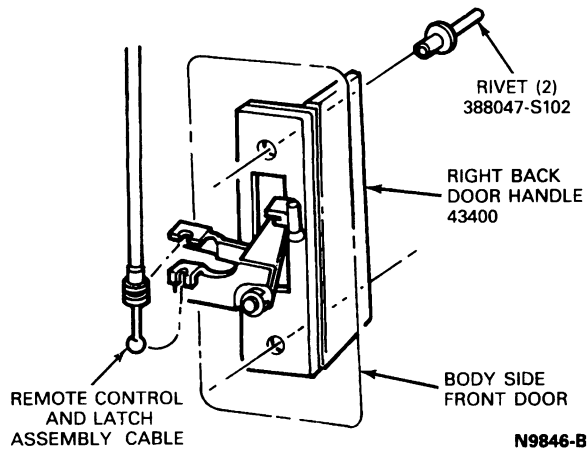
Front Side Cargo Door and Right Back Door Outside Handle, Econoline

Removal and Installation

1. While holding the handle open, drill out the two attaching rivets.
2. While still holding the handle open, carefully pull the handle mechanism through the door or housing opening.
3. Disengage the cable from the handle.

NOTE: Keep the cable end outside of the door.

For installation, follow removal procedures in reverse order.

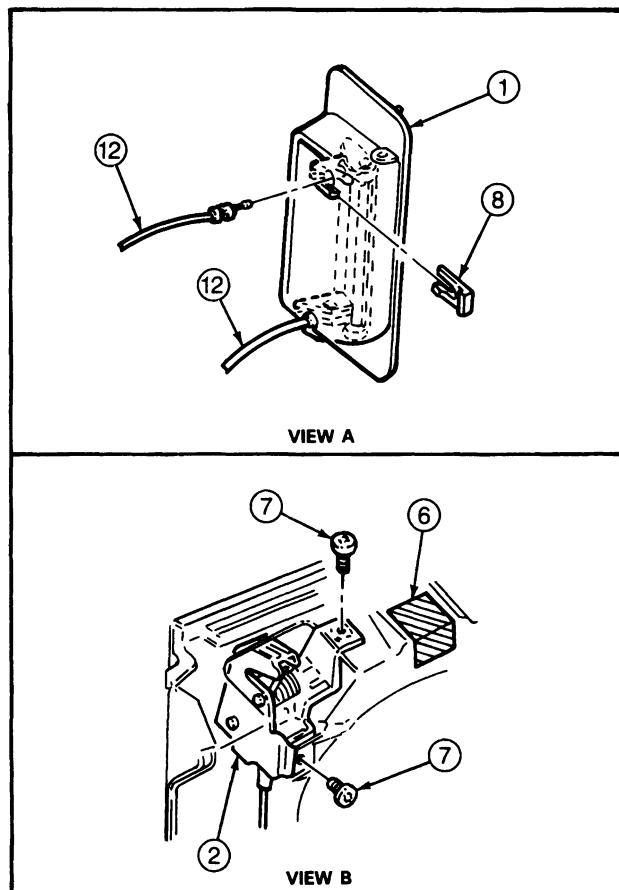
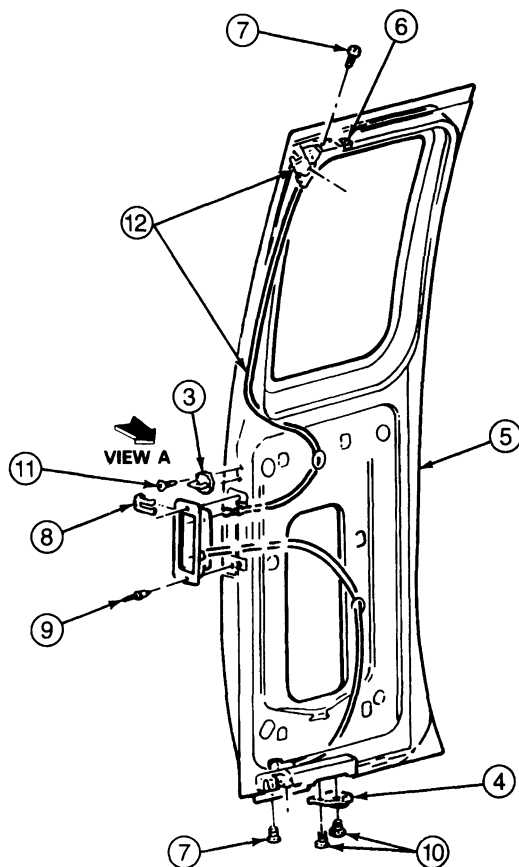
REMOVAL AND INSTALLATION (Continued)**Front Side Cargo Door, Remote Control Latch, Econoline**

2. Pinch the legs of the cable clip together and push through the hole in the inner panel.
3. Drill out and remove the two attaching rivets and discard.
4. Remove handle from door.
5. Disengage the cable keepers by pushing up on the end of the lower leg of the keeper and sliding the keeper toward the outside of the door.
6. For each cable, push the cable through the slot in the handle then open the handle and move the inner cable so it will slide through the slot in the inner side of the handle arm.
7. Remove the cable from the handle.

For installation, follow removal procedure in reverse order. Replace drilled out rivets with new rivets.

Rear Side Cargo Door and Left Back Door Outside Handle, Econoline**Removal and Installation**

1. Remove the door trim panel and watershield if equipped.

REMOVAL AND INSTALLATION (Continued)**Rear Side Cargo Door, Remote Control Latch, Econoline**

N9848-B

Item	Part Number	Description
1	264A01	Remote Control and Latch Assembly
2	26502	Upper Latch Assembly
3	264A10	Striker Assembly
4	40060	Wedge and Plate Assembly
5	Ref.	Body Side Rear Door
6	11396	Shield (1 Req'd)

(Continued)

Item	Part Number	Description
7	N806679-S100	Screw 4-8 N-m (35-71 In-Lb)
8	Ref.	Cable Keeper (2 Req'd)
9	N805995-S100	Rivet
10	N802141-S36B	Screw 3-5 N-m (27-44 In-Lb)
11	N806680-S100	Screw 21-29 N-m (16-21 Ft-Lb)
12	Ref.	Remote Control and Latch Cable

Door Lock Mechanisms
Striker, Front and Rear Sliding Door
Removal and Installation

1. Remove nine B-pillar trim panel screws.
2. Remove two striker bolts and transfer the shim(s) to the new striker.
3. Position the striker and install the two attaching bolts (snug). Adjust as necessary.

Lock Cylinder**Removal and Installation**

NOTE: When a lock cylinder is replaced, both door lock cylinders should be replaced in a set. This will eliminate carrying an extra key which will fit only one lock. If a key is to be replaced, the new key code number is stamped on a metal tag attached to the key.

1. Roll the window to the up position.
2. Remove access hole cover and / or door trim panel and pull away the watershield, if so equipped. Refer to Section 01-05A or 01-05B.

REMOVAL AND INSTALLATION (Continued)

3. Disconnect the lock actuating rod from the lock door latch operating lever.
4. Slide the lock cylinder retainer away from the lock cylinder.
5. Remove the lock cylinder.

For installation, follow removal procedures in reverse order. To install watershield use rubber cement 8A-19552-B (ESR-M11P16-S) or equivalent.

Door Lock Actuator Motor, Econoline, F-150-250-350 and Bronco

Removal and Installation

1. Remove door trim panel. Refer to Section 01-05A or B.

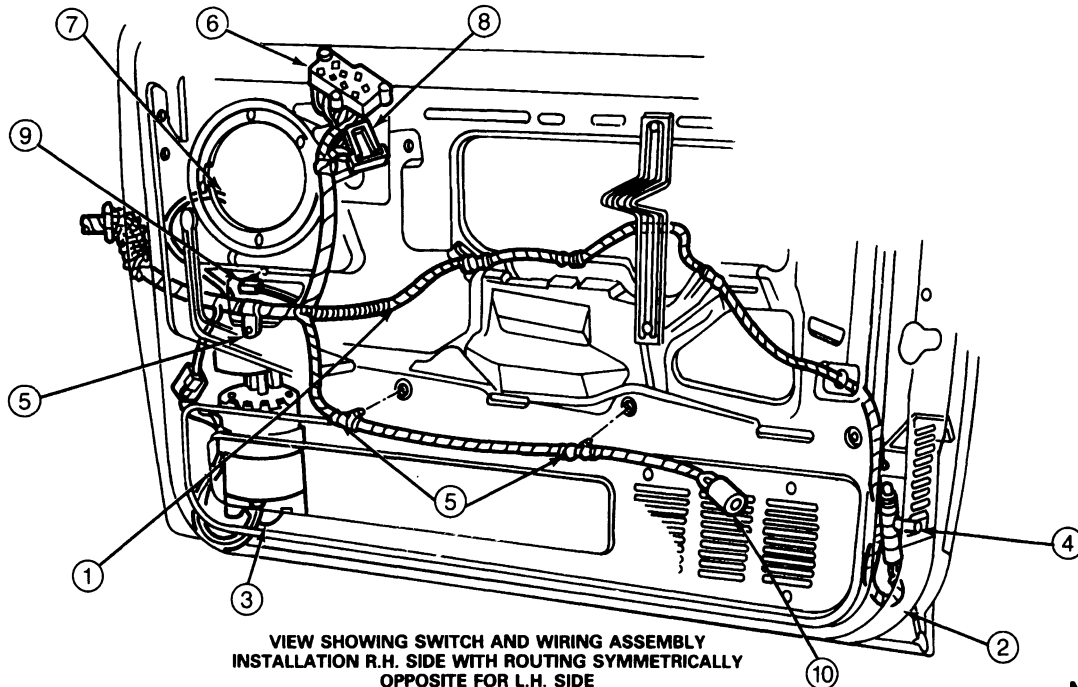
2. Remove actuator motor and swivel bracket assembly from the door by drilling out the retaining pop rivet.
3. Disconnect the wire harness plug at the motor connector.
4. Disconnect the actuator motor link from the door latch.

NOTE: Old motor bracket must be replaced with new bracket which is supplied with replacement actuator motor assembly.

For installation, follow removal procedures in reverse order. Replace the drilled out pop rivet with a new one.

NOTE: Pop rivet must retain the actuator bracket securely. A loose bracket will affect actuator function by causing a loss of travel, or by causing binding or rattle.

Electric Door Lock Actuator and Control Switch Wiring, F-150-250-350 and Bronco



N9852-A

Item	Part Number	Description
1	14A509 (LH)	Wiring Assembly
1	14265 (RH)	Wiring Assembly
2	Ref.	Door
3	Ref.	Power Window Motor
4	14A626	Door Lock Actuator
5	Ref.	Locator

(Continued)

Item	Part Number	Description
6	Ref.	Wiring to Power Window Lock Switch
7	Ref.	Wiring to Radio Speaker
8	Ref.	Wiring to Power Mirror Switch
9	Ref.	Wiring to Power Mirror Pigtail
10	Ref.	Wiring to Courtesy Lamp

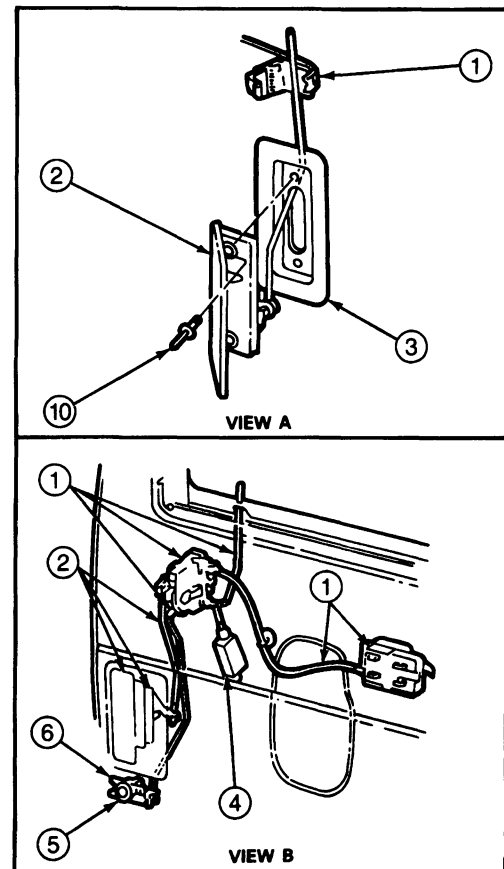
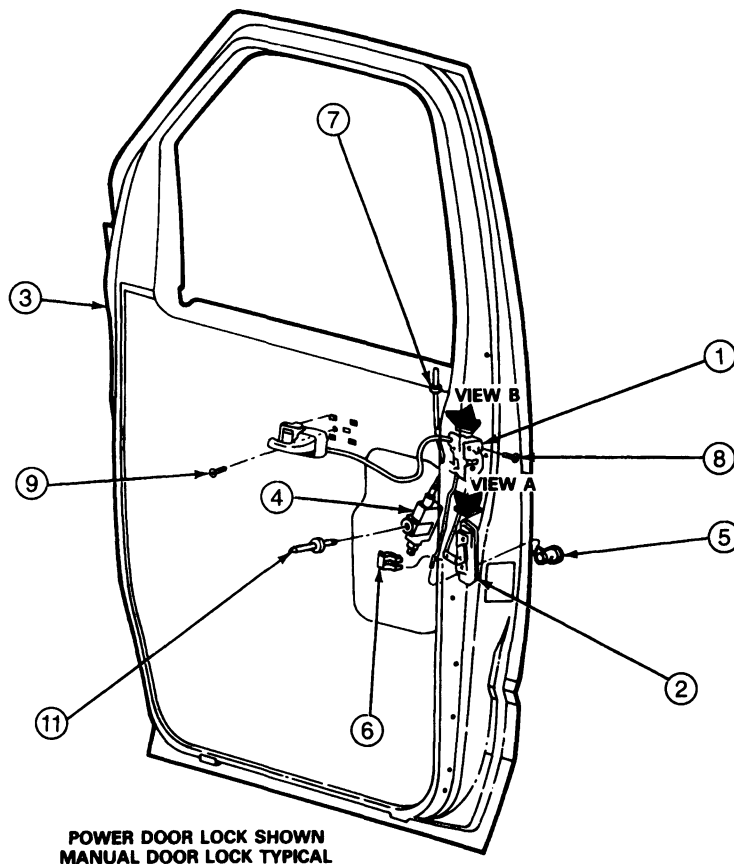
REMOVAL AND INSTALLATION (Continued)**Remote Control Assembly, Front Door****F-Series and Bronco****Removal and Installation**

1. Remove the door trim panel and watershield. Refer to Section 01-05A.
2. Remove the screws attaching the remote control to the door inner panel. Remove the remote control.
3. Disconnect the latch remote control cable from remote control.

For installation, follow removal procedures in reverse order.

Econoline**Removal and Installation**

1. Remove the door inside handle and inside handle cup.
2. Remove door trim panel from the door inner panel. Refer to Section 01-05B.
3. Remove the screw attaching the remote control to the door inner panel.
4. Disengage the cable from the remote control. Remove the remote control from the door.
5. Connect the cable to the remote control. Install the remote control to the door inner panel with the attaching screw.
6. Install the watershield and door trim panel.
7. Install the window regulator handle, inside handle cup, if equipped, and door inside handle.

Side Door Latch, E-150-250-350

N9836-A

Item	Part Number	Description
1	219A64	Front Door Latch Assembly
2	22400	Outside Handle Assembly
3	Ref.	Front Door

(Continued)

Item	Part Number	Description
4	218A42	Actuator Assembly
5	Ref.	Lock Cylinder
6	43629	Lock Cylinder Retainer
7	21999	Door Latch Knob Grommet

(Continued)

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
8	N806679-S100	Screw 10-14 N-m (7-10 Ft-Lb)
9	55928-S2	Screw (1 Req'd.)

(Continued)

Item	Part Number	Description
10	388047-S102	Rivet (2 Req'd.)
11	N805995-S100	Rivet (1 Req'd.)

TN9836A

Remote Control Assembly, Rear Door**F-350 Crew Cab****Removal and Installation**

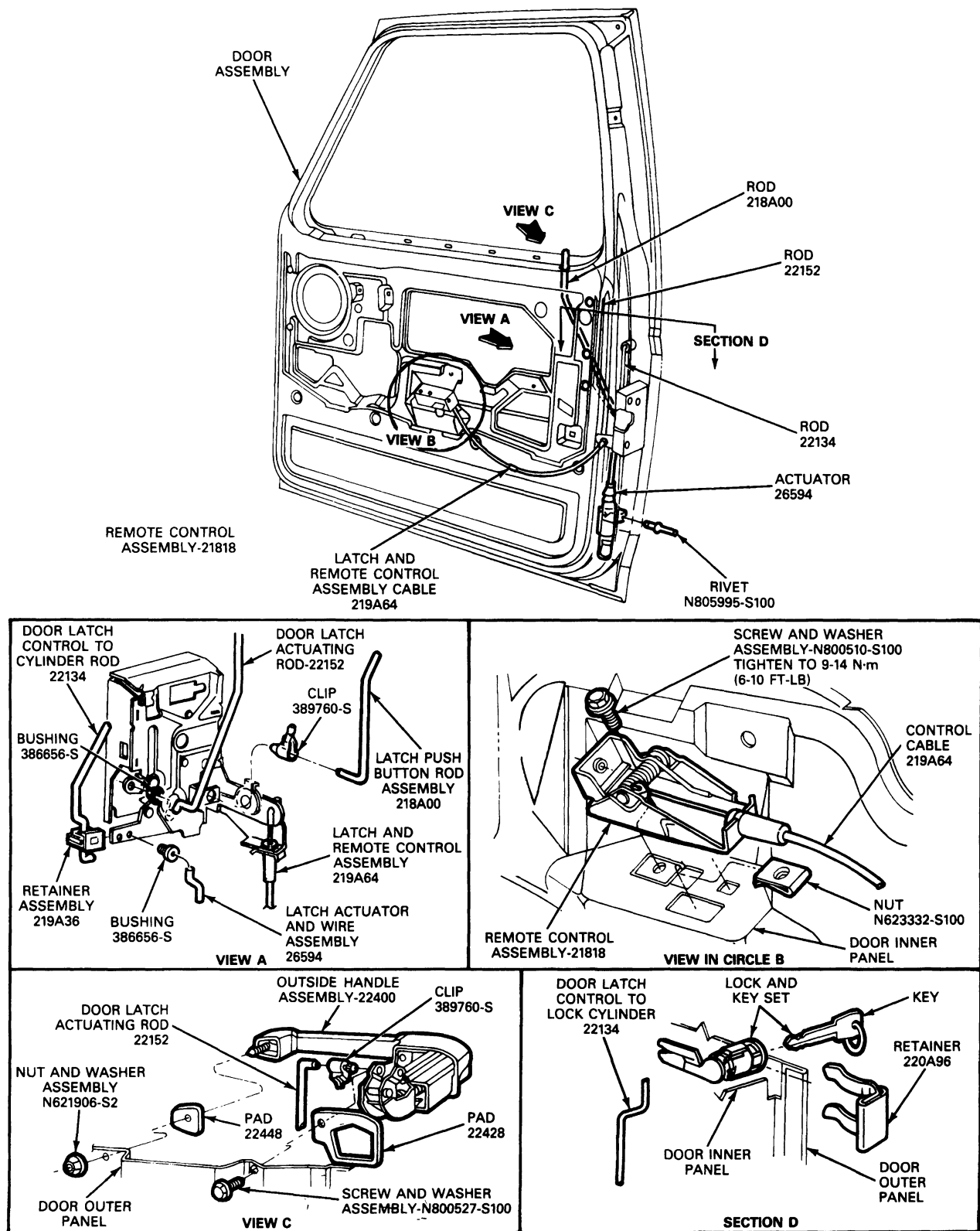
1. Remove the two screws retaining armrest to door inside panel. Remove the screw retaining window regulator handle to door.
2. Remove inside door handle trim cup.
3. Remove door trim panel and watershield, if equipped. Refer to Section 01-05A.

4. Push tabs on remote control assembly together and slide assembly forward.
5. Disconnect link rod from remote control assembly by rotating remote control clockwise. Remove remote control assembly from door.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Remote Control Assembly, Front Door, F-150-250-350 and Bronco



N4607-L

REMOVAL AND INSTALLATION (Continued)**Door Lock Switch, F-150-250-350**

NOTE: Door lock switches are located on the front door trim panel.

Removal and Installation

1. Insert a small thin-bladed screwdriver into spring tab slots, located at front and rear of switch housing.
2. Apply pressure on screwdriver to pop switch housing from door.
3. Remove three connector attaching screws from switch housing.
4. Remove switch, carefully pry switch from connector pins with a small screwdriver.

NOTE: The switch is keyed to connector and can only be installed one way.

For installation, follow removal procedures in reverse order.

1. Remove bezel retaining screws.
2. Lift bottom of bezel from door trim panel.
3. Remove switch and bezel.
4. Remove wiring connector retaining screw from back of bezel.
5. Using a thin-bladed screwdriver, carefully pry switch from connector.

For installation, follow removal procedures in reverse order.

Door Lock Module, with Power Door Locks / Sliding Door, Econoline**Removal and Installation**

1. Remove door lock control module from left quarter panel, using a hex nut driver.
2. Disconnect module from wiring connector by separating locking fingers.

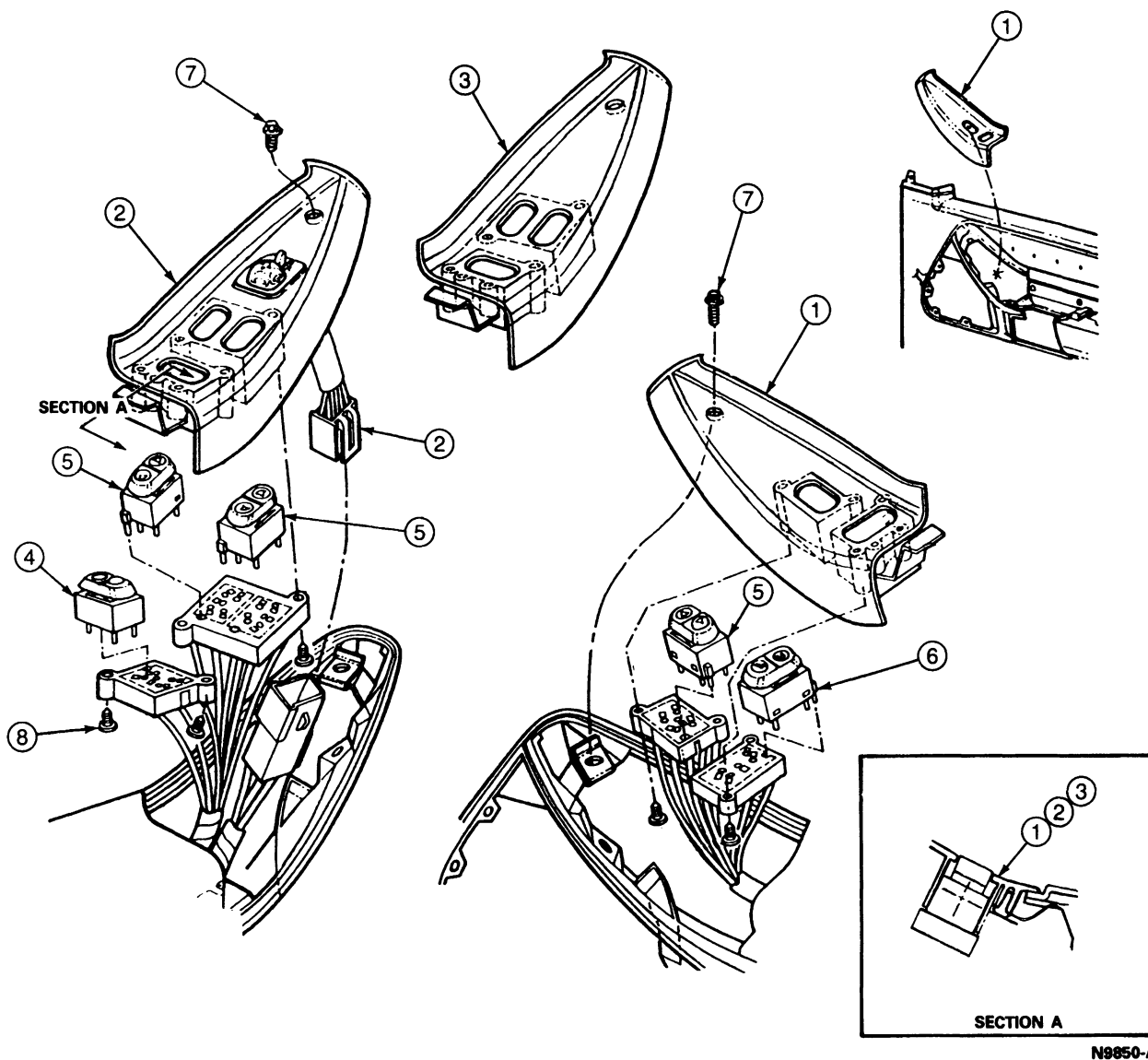
For installation, follow removal procedures in reverse order.

Door Lock Switch, Econoline**Removal and Installation**

NOTE: Power door lock switches are located on front door trim panel.

REMOVAL AND INSTALLATION (Continued)

Door Lock Control Switch, E-150-250-350



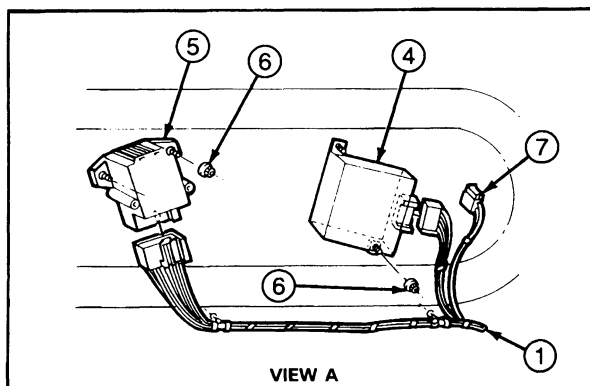
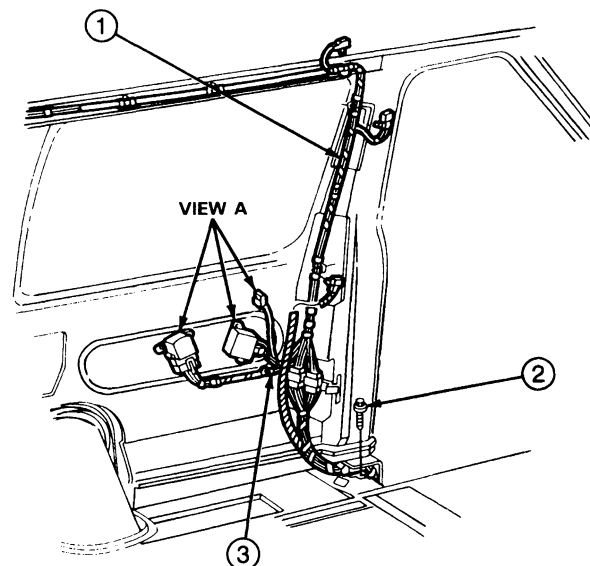
Item	Part Number	Description
1	14A563	Housing Assembly
2	14B133	Switch and Housing Assembly, Front Left Door Window Regulator with Power Mirrors
3	14A564	Housing Assembly, Front Left Door Switch Window Regulator without Power Mirrors

(Continued)

Item	Part Number	Description
4	14963	Left Door Lock Switch Assembly
5	14529	Single Window Regulator Control Switch Assembly
6	14017	Right Door Lock Switch Assembly
7	N610127-S58	Screw
8	56904	Screw

REMOVAL AND INSTALLATION (Continued)

Door Lock Module, E-Series



N9854-B

Item	Part Number	Description
1	14405	Wiring Assembly
2	N610956	Screw and Washer Assembly
3	Ref.	Locators
4	14A093	Memory Lock Module
5	13C718	Illuminated Entry Module
6	620391	Nut and Washers Assembly
7	Ref.	Wiring to Speaker

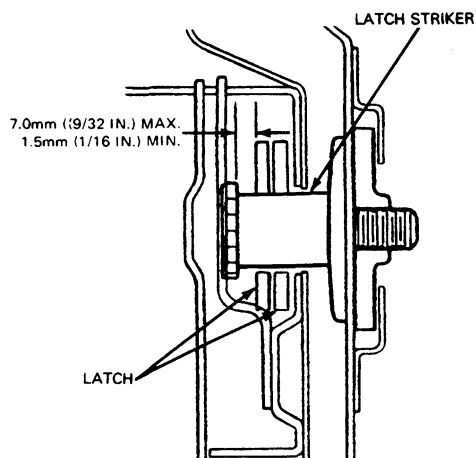
ADJUSTMENTS

Latch Striker Adjustment F-150-250-350, F-Super Duty and Bronco

CAUTION: Do not cover up a poor door alignment with a latch striker adjustment.

NOTE: The striker pin can be adjusted laterally and vertically as well as fore and aft. The latch striker should not be adjusted to correct door sag. The latch striker should be shimmed to get the clearance shown between the latch striker and the latch. To check this clearance:

1. Clean the latch jaws and the striker area.
2. Apply a thin layer of dark grease such as Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent to the latch striker.
3. As the door is closed and opened, a measurable pattern will result.
4. Move the striker assembly laterally to provide a flush fit with the door and body. Do not use more than two shims.
5. Using Torx® Drive Bit Set D79P-2100T or equivalent, tighten striker to 35-45 N·m (24-33 ft·lb).



P1169-1C

Latch Striker Adjustment, Econoline

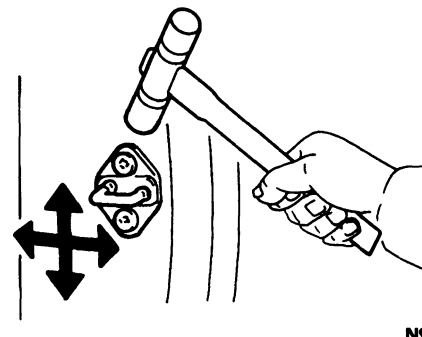
CAUTION: Do not cover up poor door alignment with a latch striker adjustment.

Use Torx® Drive Bit T-40 for M8 x 1.25 screws and T-20 for M6 x 1.0 screws, where required to loosen or tighten striker. The wire form striker can be adjusted laterally and vertically for front sliding and lower side cargo doors. These door strikers do not require shimming. The upper side cargo door can be adjusted fore and aft vertically and shimmed laterally. The upper rear cargo door striker can be adjusted fore and aft laterally and shimmed vertically. The lower rear cargo door striker can be adjusted laterally, vertically and shimmed fore and aft.

1. Check that the door fit is adjusted correctly. Do not use striker to adjust for door sag; instead adjust door hinge settings as outlined in Section 01-03.
2. Loosen the striker mounting screws to adjust.

ADJUSTMENTS (Continued)

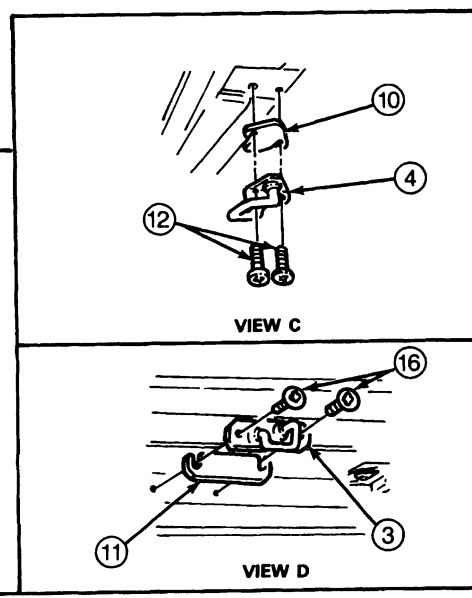
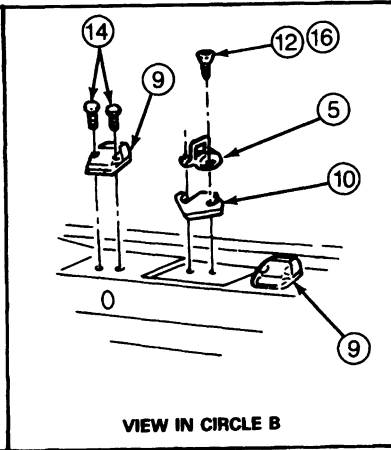
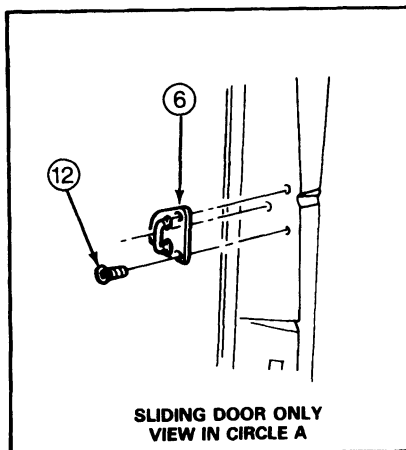
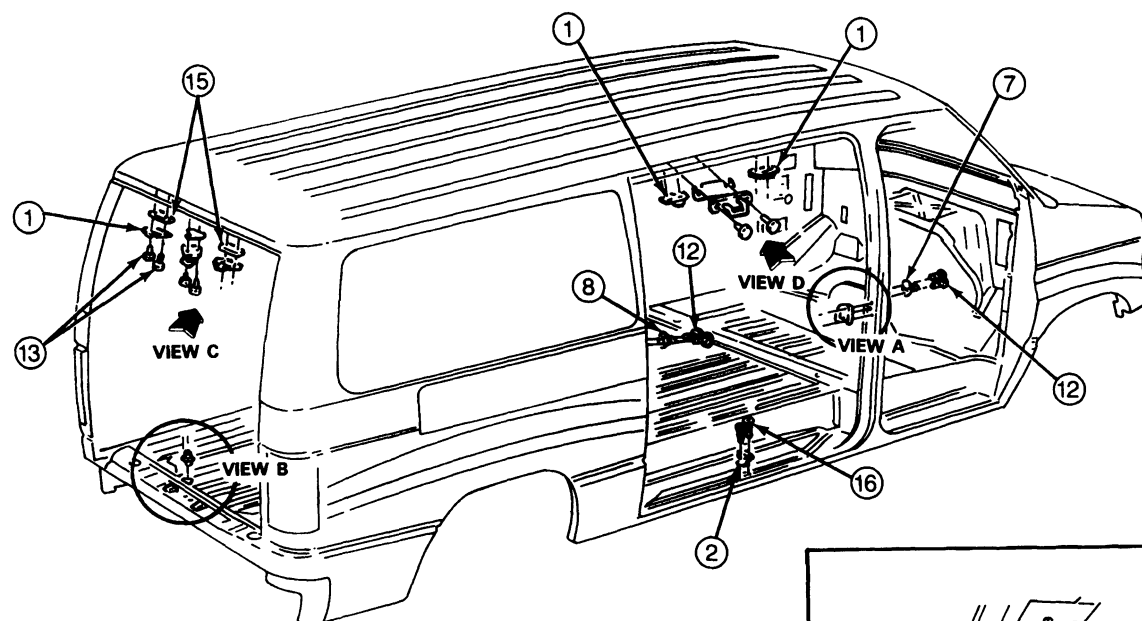
3. Adjust the striker with plastic hammer to provide a flush fit with adjacent panel.



N9829-A

4. Tighten striker mounting screws to 21-29 N·m (16-21 ft·lb).

Striker Assemblies, Econoline



N9830-B

ADJUSTMENTS (Continued)

Item	Part Number	Description
1	40060	Wedge and Plate Assembly
2	265A4	Striker — Body Side Door Latch, Lower
3	264A1	Striker — Body Side Door Latch, Upper
4	44162	Striker — Back Door Latch, Upper
5	264A1	Striker — Body Side Door Latch
6	265A0	Striker — Body Side Door Front Latch
7	21982	Striker — Front Door Latch
8	264A1	Striker — Body Side Door Latch (Sliding Door Vehicle Only)

(Continued)

Item	Part Number	Description
9	42656	Wedge — Back Door Scuff Plate
10	433A5	Spacer — Back Door Latch Striker
11	433A5	Spacer — Body Side Door Latch Striker
12	N806680-S100	Screw 21-29 N·m (15-21 Ft-Lb)
13	N802141-S36B	Screw 3-5 N·m (27-44 In-Lb)
14	N800876-S49	Screw 1.5-2.3 N·m (13-20 In-Lb)
15	40018	Shim — Back Door Wedge
16	N804230-S55	Screw 10-14 N·m (7-10 Ft-Lb)

Rear Latch Cable Adjustment, Sliding Door, Econoline

NOTE: This adjustment is for the condition where the outside or inside door handle does not have enough travel to release the latch and open the sliding door.

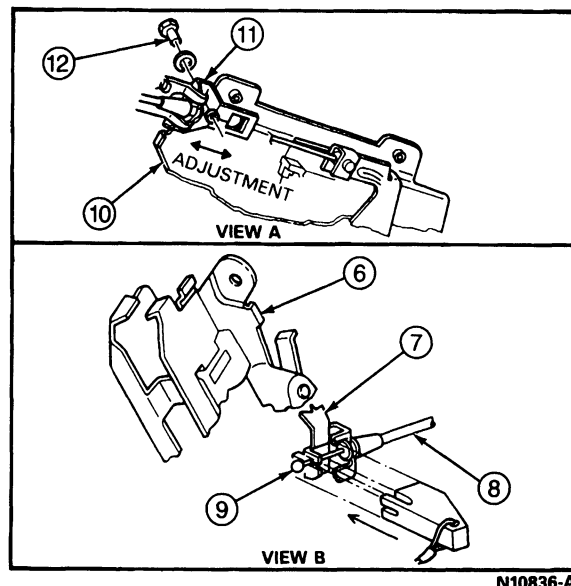
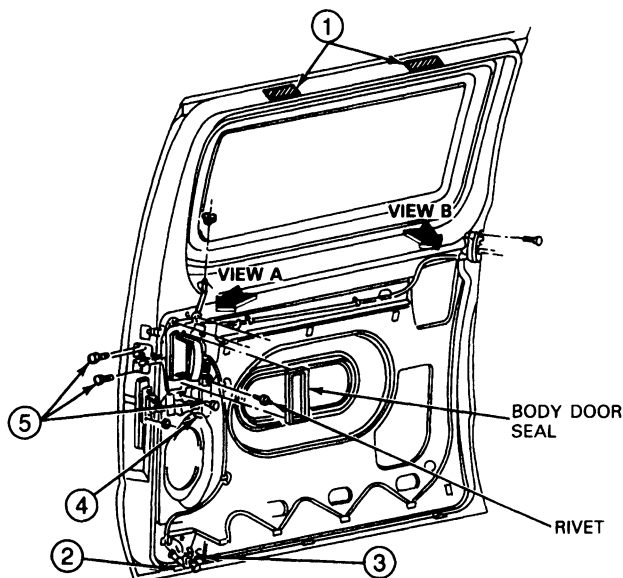
1. Remove door trim panel. Refer to Section 01-05B.
2. Loosen the lock cable adjusting bolt on the remote control assembly.
3. Insert spacer block (tool number not available at time of publication) in rear latch with the latch installed in the door, between the cable ferrule and the latch.

4. With door fully closed or open, with the rear latch manually latched into its primary latch position, lightly pull cable until snug and tighten the adjusting bolt to 8.5-12.5 N·m (6-9 ft-lb).

CAUTION: The spacer block is required for proper adjustment to assure that the latch lever is in its correct position. Any adjustment without the use of this spacer block is not recommended because the rear latch lever could be incorrectly positioned, which could cause a hazard during normal operation of the vehicle.

5. Check for proper latching operation from outside and inside handle by opening and closing door. Check that the door can be unlatched with 12.5 to 17.8mm (1/2 to 11/16 inch) of outside handle travel.

Rear Latch Cable Adjustment, Sliding Door, Econoline



N10836-A

ADJUSTMENTS (Continued)

Item	Part Number	Description
1	Ref.	Shields (2 Req'd)
2	264B46	Latch Assembly
3	N62 1905-S55	Latch Assembly Nuts 10-14 N·m(9-10 Ft-Lb)
4	Ref.	Door Actuator
5	N806679-S101	Screw(s) (9 Req'd) 9-12 N·m (7-9 Ft-Lb)
6	264A26	Rear Latch

(Continued)

Item	Part Number	Description
7	—	Rear Latch Release
8	—	Cable Assembly
9	—	Cable Ferrule (Part of Cable Assembly)
10	—	Remote Control Assembly
11	—	Lock Cable Adjusting Bracket
12	—	Adjusting Bolt 9-13 N·m (7-10 Ft-Lb)

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	Lb-Ft
Front Door Striker (F-Series)	35-45	25-33
Front Door Striker Mounting Screws (E-Series)	21-29	15-21
Sliding Door Upper Striker (E-Series)	10-14	7-10
Rear Door Striker(s) (E-Series)	21-29	15-21
Rear Door Striker Mounting Screws (E-Series)	21-29	15-21
Adjusting Bolt (E-Series)	9-13	7-9
Inside Handle Nut (E-Series)	1-2	9-18 In-Lb
Front Cargo Door Lower Wedge / Plate Screw(s) (E-Series)	3-5	27-44 In-Lb
Handle and Housing Assembly Screw / Washer Assemblies (E-Series)	1-2	9-18 In-Lb
Remote Control Assembly Screw / Washer Assemblies (F-Series)	9-14	7-10

(Continued)

TORQUE SPECIFICATIONS (Cont'd)

Description	N·m	Lb-Ft
Lower Rear Door Remote Assembly Screw	4-8	35-71 In-Lb
Front Door Latch (Front Side Cargo Door, Econoline)	10-14	7-10

SPECIAL SERVICE TOOLS / EQUIPMENT

Tool Number	Description
D79P-2100-T	Torx® Drive Bit Set
Not Available at Time of Publication	Spacer Block

ROTUNDA EQUIPMENT

Tool Number	Description
007-00001	Digital Volt-Ohmmeter
107-006000	Hydraulic Rivet Gun

SECTION 01-14B Remote Door Entry

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS.....	01-14B-17	DIAGNOSIS AND TESTING (Cont'd.)	
CLEANING AND MAINTENANCE		Power Locks.....	01-14B-11
Lubricate the Linkage.....	01-14B-16	Quick Test.....	01-14B-7
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
Remote Transmitter Operation.....	01-14B-2	Electronic Control Module/Receiver.....	01-14B-16
Transmitters.....	01-14B-2	Transmitter Battery Replacement.....	01-14B-16
DIAGNOSIS AND TESTING		SPECIAL SERVICE TOOLS/EQUIPMENT.....	01-14B-17
Pinpoint Tests.....	01-14B-9	VEHICLE APPLICATION.....	01-14B-1

VEHICLE APPLICATION

Econoline Vehicles

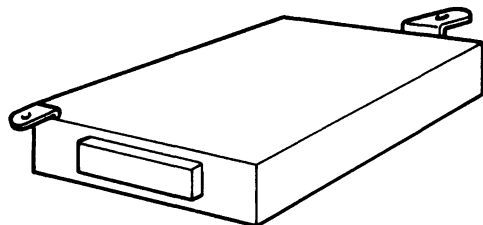
DESCRIPTION AND OPERATION

The remote entry system has two main components: the electronic control module with integral receiver, located behind the B-pillar on the driver's side, and the three-button (hand-held) transmitter.

KEYRING TRANSMITTER, TWO PER VEHICLE, 15K601



REMOTE ENTRY MODULE, ONE PER VEHICLE, 15K602



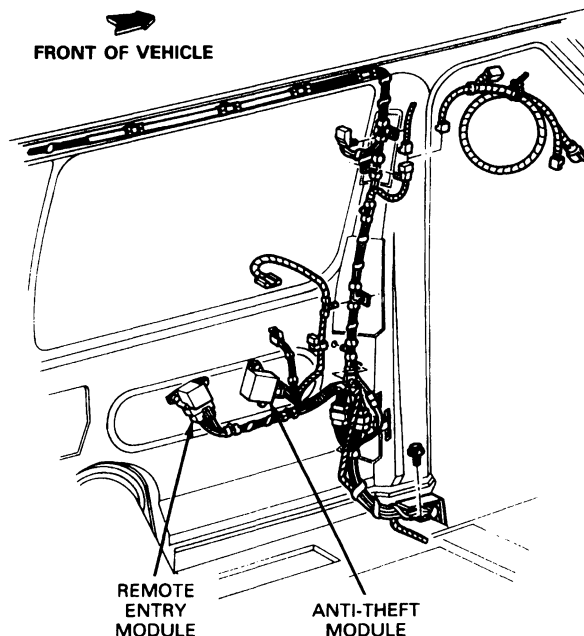
N9869-A

The electronic control module performs the following functions:

- Unlocking driver's door
- Unlocking all doors
- Sliding door memory lock
- Locking all doors

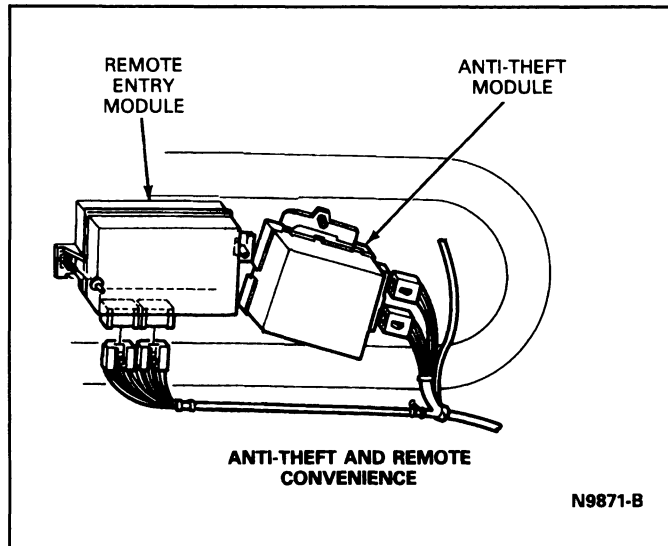
- Arming and disarming the factory-installed Ford anti-theft system
- Turning on interior lamps after either front door handle is lifted
- Turning on interior lamps when using the transmitter(s)
- Activating and deactivating a personal security feature which sounds the horn and flashes the exterior parking lamps and headlamps.

Remote Door Entry Module



N9870-B

DESCRIPTION AND OPERATION (Continued)



Transmitters

The remote entry system includes two three-button (hand-held) transmitters. The customer may purchase additional transmitters from the dealer. When troubleshooting the remote entry system, it is essential that the customer leave at least one transmitter with the vehicle. If the transmitter must be re-programmed into the control module, **all the customer's transmitters must be available for re-programming at the same time.**

The remote entry system receives inputs from the following:

- Front door handles
- Ignition switch
- Electric door lock / unlock switches
- Side door jamb switch
- Program Connector (J2)
- Transmitters

NOTE: The module can store up to four transmitters in its memory at one time.

The system distributes output to the following:

- Convenience lamps
- Door lock actuators / motors
- Interior lamps
- Factory-installed Ford anti-theft module

Remote Transmitter Operation

NOTE: The remote entry features will not function when the ignition switch is in the RUN or ACCESSORY positions.

To unlock the driver's door, press the UNLOCK button once on a transmitter which has been programmed into the module. This will also disarm the Ford anti-theft system.

To unlock all doors, press the UNLOCK button on a transmitter twice. The second depression must be within five seconds of the first. If more than five seconds have elapsed since the first depression of the UNLOCK button, pressing the UNLOCK button again will only unlock the driver's door.

To turn on the interior lamps, press either the UNLOCK or the PANIC button.

To lock all doors, press the LOCK button on a transmitter once. This will also arm the Ford anti-theft system. If the side door was open during the LOCK operation, the memory lock feature will activate to lock the side door after it is closed again.

To activate the personal security alarm, press the red PANIC button on a transmitter. The horn will beep and the parking lamps and headlamps will flash for a maximum of three minutes.

To deactivate the personal security alarm, press the red PANIC button on the same transmitter that was used to activate the alarm, or turn the ignition key on.

DIAGNOSIS AND TESTING

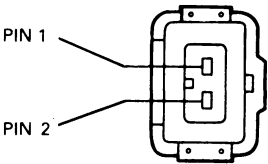
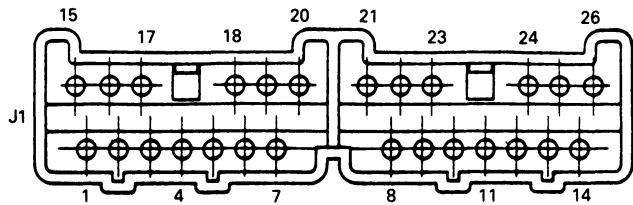
Before proceeding with diagnosis and service of the remote entry electrical operation, check for mechanical binds in the door locks. Operate all door locks several times and check lock operation. Also be sure the battery is fully charged. Refer to the following diagrams and charts for additional information when performing the diagnostic tests.

NOTE: Voltage and resistance readings can be obtained using Rotunda Digital Volt-Ohmmeter 014-00407 or Rotunda Inductive Dwell-Tach-Volts-Ohms Tester 059-00010 or equivalents.

DIAGNOSIS AND TESTING (Continued)

Remote / Keyless Entry Module Connectors

MODULE CONNECTOR PART NUMBER: E7EB-14A624-AA
MATING CONNECTOR PART NUMBERS: E6DB-14489-VA RIGHT HAND
E6DB-14489-UA LEFT HAND



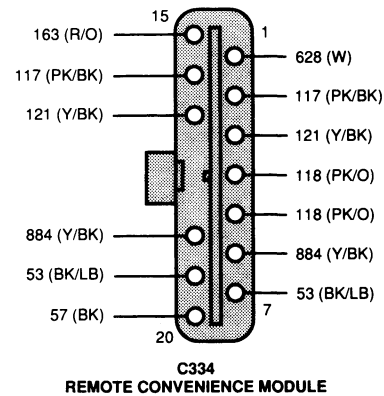
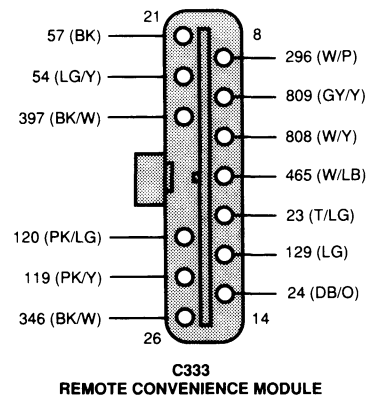
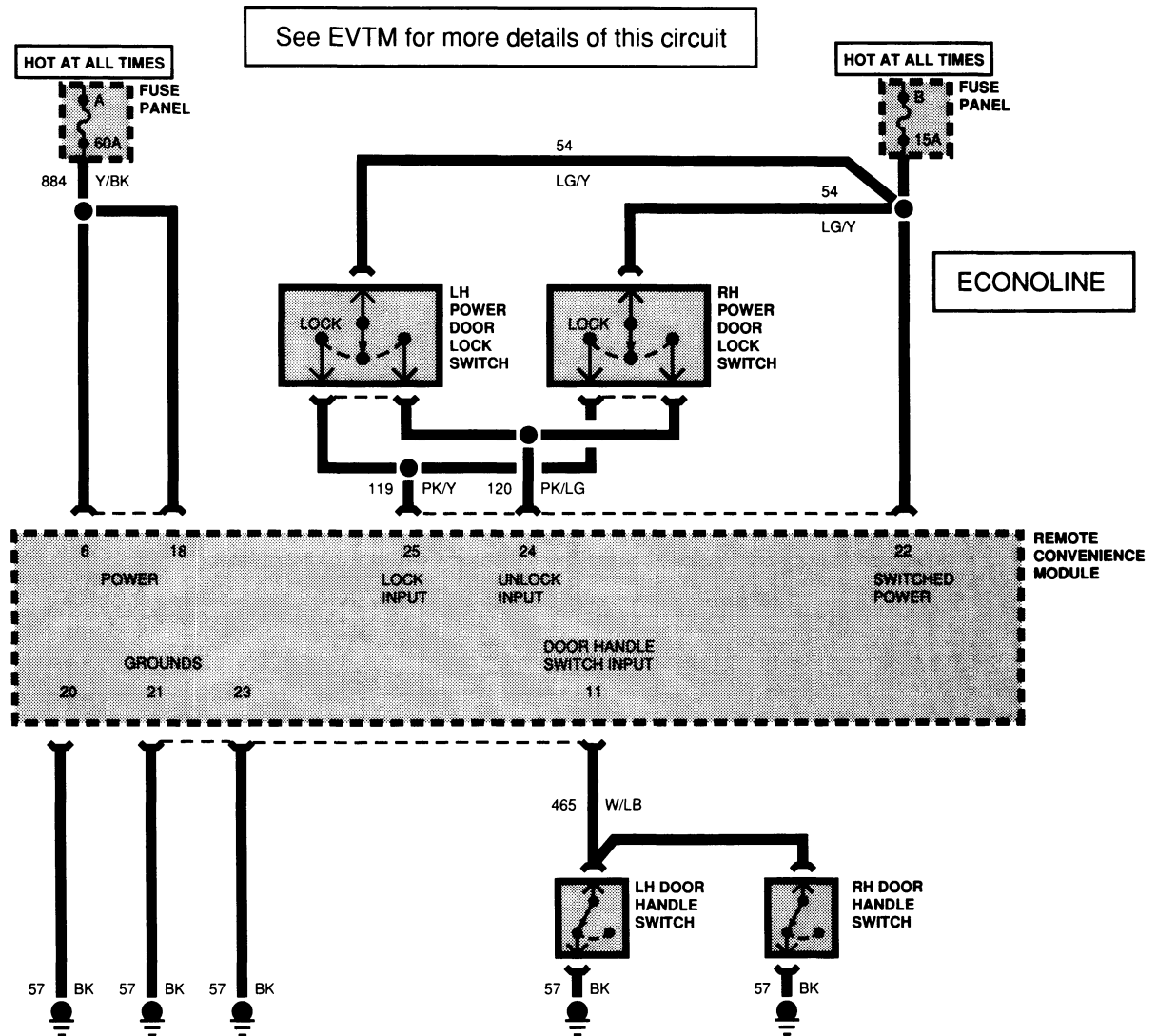
MODULE CONNECTOR DIAGRAM

			PIN OUT		
TERMINAL NUMBER	CIRCUIT NUMBER	CIRCUIT DESCRIPTION	TERMINAL NUMBER	CIRCUIT NUMBER	CIRCUIT DESCRIPTION
1	628	REAR DOOR UNLOCK (W)	15	163	DRIVERS' DOOR UNLOCK (R/O)
2	117	DOOR LOCK (PK/BK)	16	117	DOOR LOCK (PK/BK)
3	121	SIDE DOOR LOCK (Y/BK)	17	121	SIDE DOOR LOCK (Y/BK)
4	118	SIDE DOOR UNLOCK (PK/O)	18	884	POWER FEED (Y/BK)
5	118	SIDE DOOR UNLOCK (PK/O)	19	53	INTERIOR LAMPS (BK/LB)
6	884	POWER FEED (Y/BK)	20	57	POWER GROUND (BK)
7	53	INTERIOR LAMPS (BK/LB)	21	57	POWER GROUND (BK)
8	296	IGNITION (RUN/ACCY) (W/P)	22	54	SIGNAL FEED (DB/O)
9	809	PROGRAM B (GY/Y)	23	397	SIGNAL GROUND (BK/W)
10	808	PROGRAM A (R/W)	24	120	UNLOCK SWITCH INPUT (PK/LG)
11	465	DOOR LATCH SWITCHES (W/LB)	25	119	LOCK SWITCH INPUT (PK/Y)
12	23	PASSENGER DOOR DISARM SWITCH (T/LB)	26	346	SIDE DOOR JAMB SWITCH (BK/W)
13	129	TATS DATA LINK (LG)			
14	24	TATS ARM (DB/O)			

N9873-B

DIAGNOSIS AND TESTING (Continued)

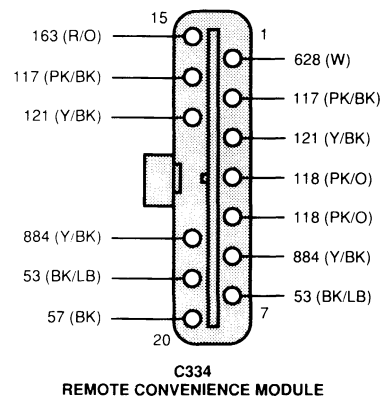
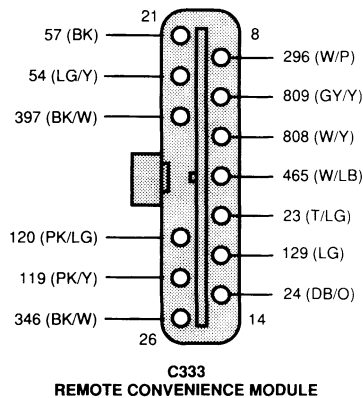
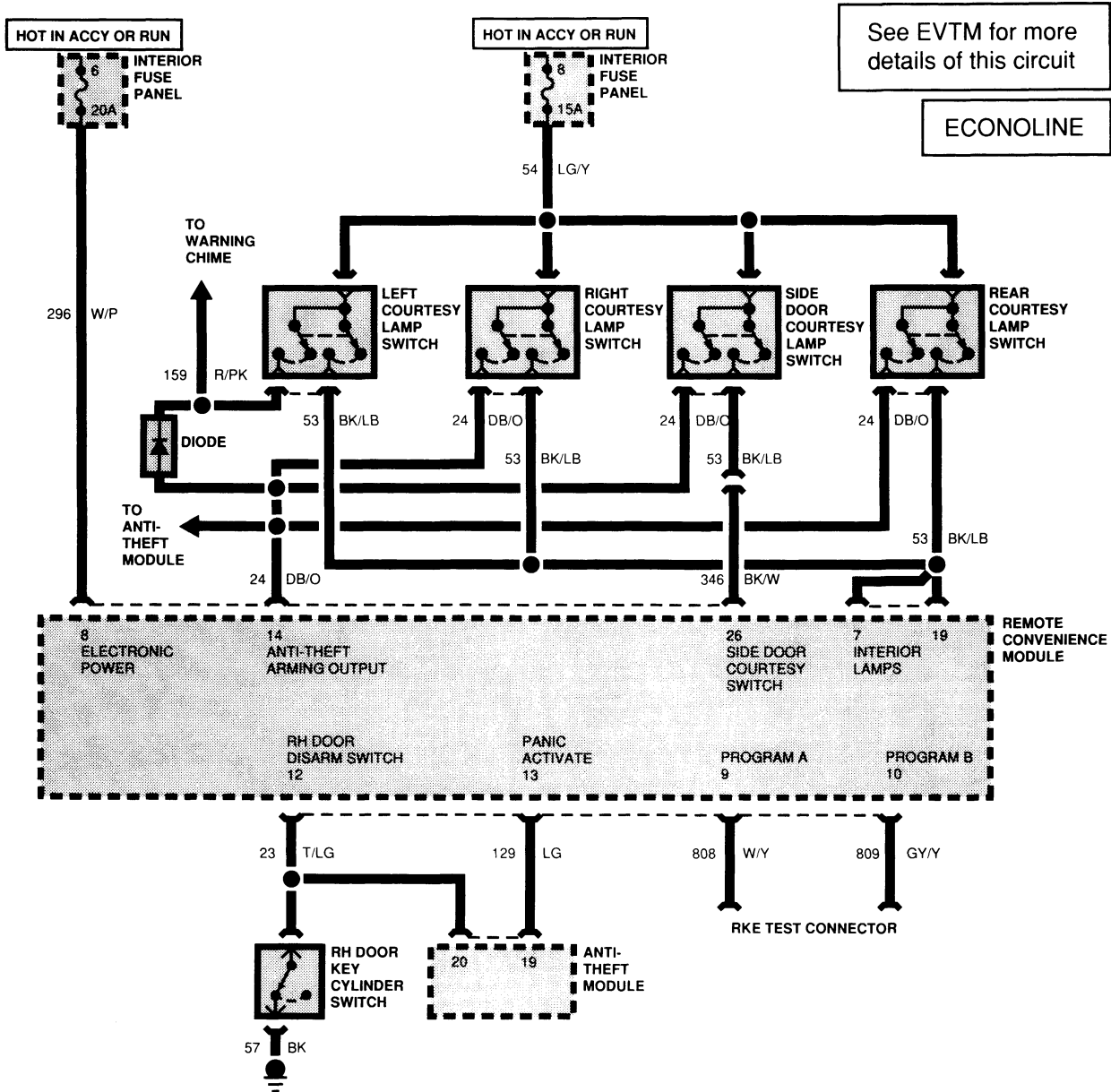
Remote/Keyless Entry Wiring Diagram, Econoline with Sliding or Hinged Side Door



N10292-A

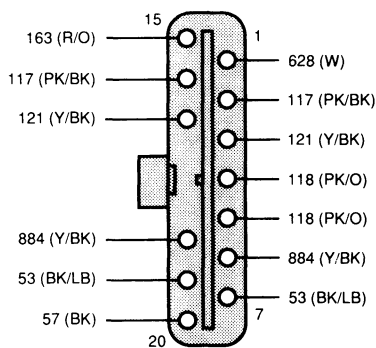
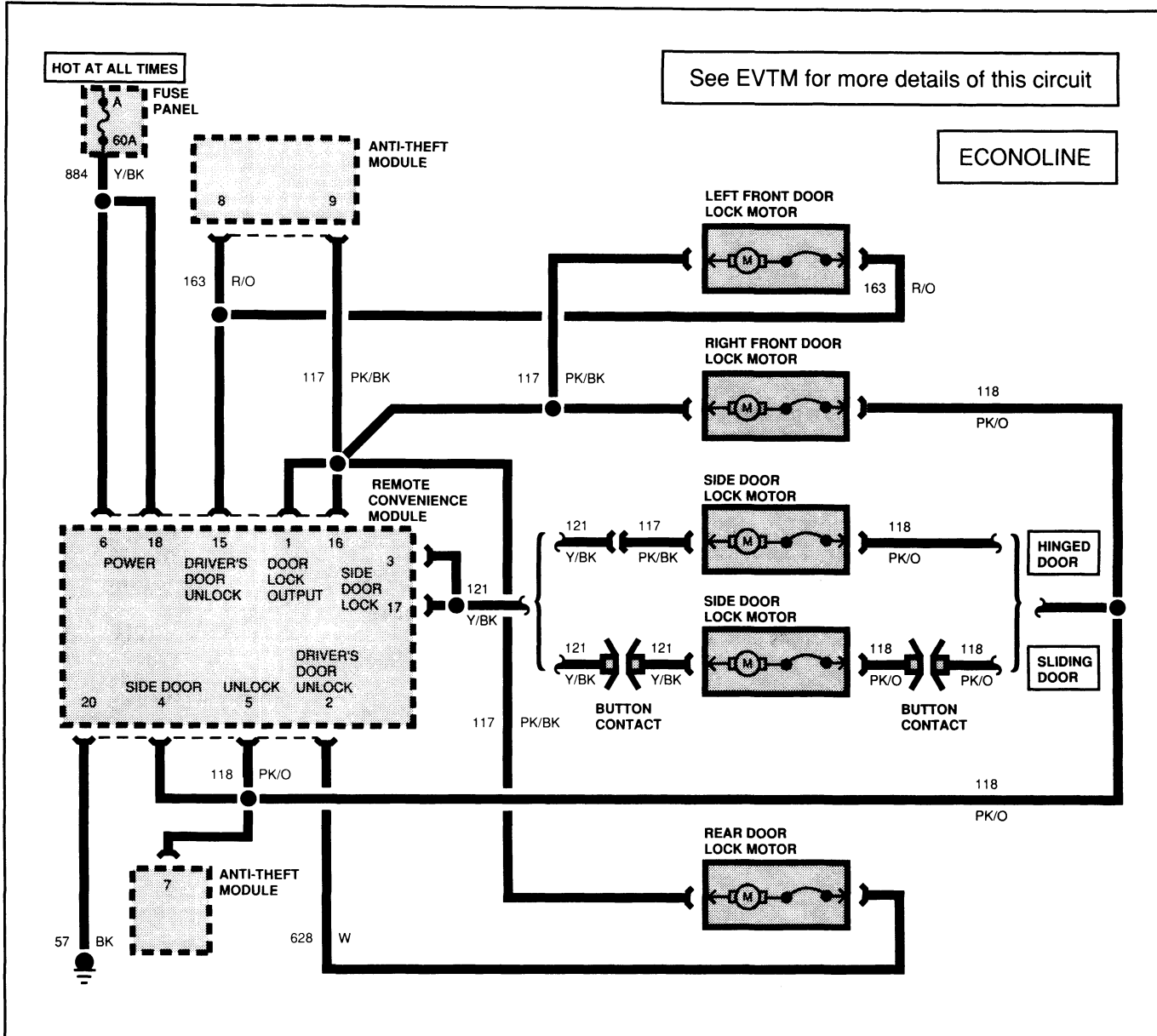
DIAGNOSIS AND TESTING (Continued)

Keyless Entry, Econoline



N10293-A

DIAGNOSIS AND TESTING (Continued)



N10294-A

DIAGNOSIS AND TESTING (Continued)**Quick Test****QUICK TEST STARTS HERE**

- CHECK THAT BATTERY IS FULLY CHARGED. (If not, it may be causing the problems.)
- DISCONNECT AND RECONNECT BATTERY TO MAKE SURE SYSTEM IS RESET.
- FOR THIS SPECIFIC COMPLAINT GO to
 - Manual Locks
 - Locks bind when manually operated PINPOINT TEST C
 - Locks do not operate in freezing weather C18
 - Locks only work when engine is running C19
 - Locks work intermittently C17
 - Illuminated Entry
 - Interior lamps do not turn on with any remote entry functions when ignition key OFF; they ONLY work when a door is opened PINPOINT TEST B
 - Interior lamps do not turn on ONLY when door is opened from inside the vehicle and ignition key OFF; the interior lamps do work with all other functions B8
 - Interior lamps do not turn on ONLY when either of the front door handles is lifted and ignition key OFF; they work with all other functions B4-B6
 - Remote Transmitter Entry
 - All doors lock, then unlock every time ignition key is turned to RUN/ACCY D2
 - Remote features will not work at all, but all other feature are OK D1
 - The Remote Entry system works, but the remote entry functions only work when the transmitter is held very close to the vehicle D1
 - Remote Entry functions do not operate in freezing or extremely hot weather, but all other module functions do operate properly D14

IF all of the above are OK, GO to A1.

IF ANY of above problems are found: service and test to see if problem is solved.

NOTE: Keep the driver's window rolled down during the QUICK TEST and the PINPOINT TESTS, to avoid being locked out of the vehicle.

CN9877-A

QUICK TEST — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	OPERATE LOCKS FROM DOOR SWITCHES		
	<ul style="list-style-type: none"> • For the door lock switch in each door: <ul style="list-style-type: none"> — LOCK and UNLOCK the doors several times using the switch. Check that all the doors lock/unlock properly. 	All doors lock/unlock properly from each switch Any problems	GO to A2. GO to Pinpoint Test C.
A2	LIFTING DOOR HANDLE TO TURN ON ILLUMINATED ENTRY		
	<ul style="list-style-type: none"> • Ignition key to OFF. — Doors closed and locked. • Lift either front door handle to open door. • Within 25 seconds, unlock door with key, get inside car and turn ignition ON. 	Interior lamps illuminated with door handle and go off when ignition is turned ON Interior lamps illuminate and do not go off when ignition is turned on Interior lamps do not illuminate	GO to A3. REPLACE module REPEAT Quick Test. GO to Pinpoint Test B.

DIAGNOSIS AND TESTING (Continued)**QUICK TEST — TEST A (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
A3	CHECK PROGRAM CONNECTOR		
	<ul style="list-style-type: none"> Ignition switch ON. Insert a shorting plug into program Connector J2 (located below the driver's side of the instrument panel at the base of the steering column). <p>NOTE: This shorting plug connects Program A input to Program B on the module.</p>	<p>All doors lock, then unlock</p> <p>No response from the door locks</p>	<p>▶ GO to A4.</p> <p>▶ GO to D2.</p>
A4	LOCK DOORS USING TRANSMITTER		
	<ul style="list-style-type: none"> Remove shorting plug from program Connector J2. Ignition key OFF. Close all doors. <ul style="list-style-type: none"> Doors should be unlocked. Press the LOCK button on any transmitter that has been programmed into the module. <p>NOTE: May have to press the button more than once.</p>	<p>All doors lock; interior lamps OFF; anti-theft indicator lamp OFF when doors closed, then ON for 30 seconds after doors lock</p> <p>No response from the door locks (even after three button pushes)</p>	<p>▶ GO to A5.</p> <p>▶ GO to D1.</p>
A5	UNLOCK DRIVER'S DOOR USING TRANSMITTER		
	<ul style="list-style-type: none"> Ignition switch OFF. Program Connector J2 NOT shorted. Doors closed and locked. Press the UNLOCK button on a transmitter. 	<p>Driver's door unlocks; interior lamps turn on; alarm does not sound when door is opened</p> <p>Driver's door fails to unlock or interior lamps do not turn on</p>	<p>▶ GO to A6.</p> <p>▶ GO to D1.</p>
A6	UNLOCK PASSENGER DOOR(S) USING TRANSMITTER		
	<ul style="list-style-type: none"> Press the UNLOCK button on a transmitter twice (the second press must be within 5 seconds of the first). -OR- If less than five seconds since Step A8, press the UNLOCK button on a transmitter once. <ul style="list-style-type: none"> Ignition switch OFF. Program Connector J2 NOT shorted. 	<p>Passenger's door(s) unlock</p> <p>Passenger's door(s) fail to unlock</p>	<p>▶ GO to A7.</p> <p>▶ GO to D1.</p>
A7	ACTIVATE THE PANIC ALARM USING TRANSMITTER		
	<ul style="list-style-type: none"> Press the (red) PANIC button on a transmitter. <ul style="list-style-type: none"> Ignition switch OFF. Program Connector J2 NOT shorted. 	<p>Horn beeps and parklamps and headlamps flash on and off continuously</p> <p>Any problems</p>	<p>▶ GO to A8.</p> <p>▶ GO to A12.</p>
A8	MAKE SURE PANIC ALARM DOES NOT SHUT OFF WITH DIFFERENT TRANSMITTER		
	<ul style="list-style-type: none"> If more than 3 minutes have elapsed since Step A11 (if the panic alarm has shut off), repeat Step A11. <ul style="list-style-type: none"> Ignition switch OFF. Program Connector J2 NOT shorted. If more than one transmitter is available, press the (red) PANIC button on a different transmitter than was used in Step A11. 	<p>Horn and parklamps and headlamps continue to beep and flash on and off</p> <p>Horn and parklamps and headlamps shut off</p>	<p>▶ GO to A9.</p> <p>▶ REPLACE module. REPEAT Quick Test.</p>

DIAGNOSIS AND TESTING (Continued)

QUICK TEST — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A9	DEACTIVATE PANIC ALARM USING SAME TRANSMITTER		
	<ul style="list-style-type: none"> If more than 3 minutes have elapsed since Step A11 (if the panic alarm has shut off), repeat Step A11. <ul style="list-style-type: none"> Ignition switch OFF. Program Connector J2 NOT shorted. Push the (red) PANIC button on the same transmitter that was used in Step A11. 	Horn and parklamps and headlamps shut off Horn and parklamps and headlamps do not shut off (even after three button pushes)	GO to A10. REPLACE module. REPEAT Quick Test.
A10	TURN OFF PANIC ALARM WITH IGNITION ON		
	<ul style="list-style-type: none"> Press the (red) PANIC button on any transmitter which has been programmed into the module. <ul style="list-style-type: none"> Program Connector J2 NOT shorted. Turn the ignition switch ON. 	Horn beeps and parklamps and headlamps flash ON and OFF, then all outputs shut off when ignition is turned ON Horn and parklamps and headlamps do not shut off when ignition is turned ON	GO to A11. REPLACE module. REPEAT Quick Test.
A11	NO TRANSMISSIONS RECEIVED WITH IGNITION ON		
	<ul style="list-style-type: none"> Ignition switch ON. <ul style="list-style-type: none"> All doors closed and unlocked. Trunk closed and latched. Press the UNLOCK button on any transmitter which has been programmed into the module. 	No doors unlock (even after three button pushes) Any doors unlock	End of Quick Test. Remote/keyless entry system is OK. REPLACE module. REPEAT Quick Test.
A12	ANTI-THEFT DATA LINK		
	<ul style="list-style-type: none"> Check voltage on anti-theft data link Circuit 129 (LG) between anti-theft module and remote entry module. 	If voltage is 10 volts or greater If voltage is less than 10 volts	CHECK for open in Circuit 129 (LG). GO to anti-theft Pinpoint Test C in Section 13-11. GO to Pinpoint Test D.

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Pinpoint Tests

When any pinpoint test service is completed, return to the Quick Test.

CAUTION: Do not replace parts unless test results say they should be replaced.

PINPOINT TEST	SUBJECT
B	Illuminated Entry
C	Power Locks
D	Remote Entry System

ILLUMINATED ENTRY — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK MODULE GROUND		
	<ul style="list-style-type: none"> Check continuity to ground at Pins 20, 21 and 23 of Connector J1. 	Continuity No continuity at 20 or 21 No continuity at 23	GO to B2. SERVICE open in Circuit 57. REPEAT Quick Test. SERVICE open in Circuit 397. REPEAT Quick Test.

DIAGNOSIS AND TESTING (Continued)

ILLUMINATED ENTRY — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B2	CHECK POWER TO MODULE		
	<ul style="list-style-type: none"> Check voltage at Pins 6 and 18 of Connector J1 to ground. 	VOM Reading: 10 volts or more Under 10 volts	GO to B3 . CHECK and REPLACE fuse. SERVICE open or short in Circuit 884. REPEAT Quick Test.
B3	CHECK IGNITION SWITCH INPUT TO MODULE		
	<ul style="list-style-type: none"> Check voltage at Pin 8 of Connector J1 with ignition key switch at RUN and OFF positions. 	VOM Reading: 10 volts or more at RUN Above 0 volts at OFF or below 10 volts at RUN	GO to B4 . SERVICE break or short in Circuit 296. REPEAT Quick Test.
B4	CHECK INPUT TO MODULE FROM DOOR HANDLE SWITCH		
	<ul style="list-style-type: none"> For each front door handle: Check continuity between Pin 11 of Connector J1 and ground when the door handle is lifted up, and when handle is in normal position. 	Continuity with handles lifted, and no continuity when handle is in normal position No continuity when either handle is lifted up Continuity with handle in normal position	GO to B7 . GO to B6 . GO to B5 .
B5	CHECK DOOR HANDLE CIRCUIT FOR SHORT-TO-GROUND		
	<ul style="list-style-type: none"> Disconnect module Connector J1 and both door handle switches. Check for short-to-ground between Pin 11 of Connector J1 and ground. 	No continuity Continuity	REPLACE door handle switch. REPEAT Quick Test. SERVICE short-to-ground in Circuit 465. REPEAT Quick Test.
B6	CHECK DOOR HANDLE CIRCUIT CONTINUITY		
	<ul style="list-style-type: none"> Check continuity between Pin 11 of Connector J1 and Circuit 465 connection to handle switch of the handle(s) which failed Step B4. 	Continuity Open circuit	SERVICE door handle switch. REPEAT Quick Test. SERVICE break in Circuit 465. REPEAT Quick Test.
B7	CHECK MODULE RESPONSE TO DOOR HANDLES		
	<ul style="list-style-type: none"> Reconnect module Connector J1. Ignition key to OFF. Check voltage between Pins 7, 19 of Connector J1 and ground when the door handle is lifted up. 	VOM Reading: 10 volts or more (may be delayed up to 15-30 seconds) Under 10 volts	GO to B8 . REPLACE module. REPEAT Quick Test.

DIAGNOSIS AND TESTING (Continued)**ILLUMINATED ENTRY — TEST B (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
B8	CHECK DOOR JAMB SWITCHES		
	<ul style="list-style-type: none"> For each door: <ul style="list-style-type: none"> Disconnect module Connector J1. Measure the continuity between Circuit 884 and Pins 7, 19 of Connector J1 with the door open, and then closed. 	Continuity with door open, and no continuity with door closed (for all doors)	GO to B9 .
		No continuity with door open (for one or more doors)	REPLACE faulty door jamb switch(es). REPEAT Quick Test.
		Continuity with door closed (for one or more doors)	SERVICE short in door jamb switch or circuitry. REPEAT Quick Test.
B9	TURN ON INTERIOR LAMPS WITH A JUMPER WIRE		
	<ul style="list-style-type: none"> Momentarily connect a jumper between Pins 6, 18 and Pins 7, 19 of Connector J1. 	Interior lamps go on	GO to B10 .
		Interior lamps do not go on	SERVICE short or open in Circuits 53 or 884. REPEAT Quick Test.
B10	CONNECTORS OK?		
	<ul style="list-style-type: none"> Inspect both connectors for loose or corroded pins. 	No loose or corroded pins	REPLACE module. REPEAT Quick Test.
		Loose or corroded pins	SERVICE as required. REPEAT Quick Test.

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Power Locks

For information on the power lock system, refer to Section 01-14A.

NOTE: Before performing any of the tests in this section, the battery must be fully charged.

POWER LOCKS — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	CHECK FOR OPEN CIRCUIT BREAKER		
	<ul style="list-style-type: none"> Check Fuse A and Fuse 8. 	Fuses OK	GO to C2 .
		Fuses not OK	REPLACE fuse.
C2	POWER TO MODULE		
	<ul style="list-style-type: none"> Disconnect module Connector J1 from the Module. Check the voltage between Pins 6, 18 of Connector J1 and ground. 	VOM Reading: 10 volts or more	GO to C3 .
		Under 10 volts at connector J1	SERVICE open or short in Circuit 884 or charge battery. REPEAT Quick Test.
C3	DOES CIRCUIT BREAKER BLOW WHEN SWITCH ACTIVATES?		
	<ul style="list-style-type: none"> Reconnect module Connector J1. Press and hold the lock and unlock switches for approximately 15 seconds each. Check Fuse A, located in the power distribution box. 	Fuse OK	GO to C4 .
		Fuse blown	CHECK for short-to-ground in Circuits 163, 118, 117, 121, 628 or shorted lock actuator. REPEAT Quick Test.

DIAGNOSIS AND TESTING (Continued)**POWER LOCKS — TEST C (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
C4	CHECK MODULE GROUNDS		
	<ul style="list-style-type: none"> Disconnect module Connector J1. Check continuity between Pins 20, 21 of Connector J1 and ground. Check continuity between Pin 23 of Connector J1 and ground 	Continuity No continuity at Pins 20, 21 No continuity at Pin 23	GO to C5. SERVICE open in Circuit 57. REPEAT Quick Test. SERVICE open in Circuit 397. REPEAT Quick Test.
C5	CHECK LOCK ACTUATORS		
	<ul style="list-style-type: none"> Manually lock all doors. Connect a jumper between ground and Pins 2, 16 and 3 of module Connector J1, with connector disconnected. With a second jumper, momentarily connect together Pins 6, 18 of Connector J1 and Pins 4, 5 and 1 of Connector J1. <ul style="list-style-type: none"> Only passenger doors should unlock. Momentarily connect together Pins 6, 18 of Connector J1 and Pin 15 of Connector J1. <ul style="list-style-type: none"> Driver's door should now unlock. 	All doors unlock Only driver's door unlocks Only passenger doors unlock	GO to C6. SERVICE Circuit(s) 117, 118, 628, passenger door or rear door lock actuator(s). REPEAT Quick Test. SERVICE Circuit(s) 163, 117 or driver's door lock actuator. REPEAT Quick Test.
C6	CHECK LOCK SWITCHES		
	<ul style="list-style-type: none"> Test for lock switch stuck in LOCK or UNLOCK position. NOTE: May be mechanically stuck; check switch using meter.	Switch stuck Switch not stuck	REPLACE switch. REPEAT Quick Test. GO to C7.
C7	SHORT BETWEEN LOCK AND UNLOCK CIRCUITS		
	<ul style="list-style-type: none"> Disconnect module Connector J1 Measure the continuity between Pin 25 of Connector J1 and Pin 24 of Connector J1. 	No continuity Continuity	GO to C8. SERVICE the short between Circuits 119 and 120.
C8	CHECK LOCK SWITCHES FOR SHORT-TO-GROUND		
	<ul style="list-style-type: none"> Disconnect module Connector J1 Check for short-to-ground between Pin 25 of Connector J1 and ground. Check for short-to-ground between Pin 24 of Connector J1 and ground. 	No short Short (resistance less than 100 K-ohms)	REPLACE Module. REPEAT Quick Test. SERVICE short-to-ground in Circuit 119 or 120. REPEAT Quick Test.
C9	MECHANICAL FUNCTION OK?		
	<ul style="list-style-type: none"> Manually cycle the faulty lock actuator several times to check for latch or linkage binding. 	Lock not binding Lock binding	GO to C10. LUBRICATE lock and linkage.
C10	POWER TO ACTUATOR WITH DOOR SWITCH LOCK		
	<ul style="list-style-type: none"> Remove trim panel on the door. Check voltage between the faulty lock actuator and ground while pressing the lock of the door switch. 	VOM Reading: 10 volts or more Under 10 volts	GO to C12. GO to C11.

DIAGNOSIS AND TESTING (Continued)

POWER LOCKS — TEST C (Continued)

TEST STEP		RESULT	ACTION TO TAKE
C11	CHECK MODULE OUTPUTS		
	<ul style="list-style-type: none"> With Connector J1 connected, depress lock button and measure voltage at Pins 2, 16 and 3 of Connector J1 to ground. Also measure the voltage at Pins 4, 5, 1 and 15 of Connector J1, while the lock button is depressed. 	<p>VOM Reading:</p> <p>9 volts or more at Pins 2, 16 and 3 when depressed and less than 0.1 volts when released.</p> <p>Under 9 volts at Pins 2, 16 and 3 when depressed</p> <p>More than 9 volts on any Pin (4, 5, 1 and 15 or 2, 16 and 3) when not depressed</p>	<p>SERVICE Circuit 163, 117, 118 or 119 for open or short.</p> <p>REPLACE module. REPEAT Quick Test.</p> <p>REPLACE module. REPEAT Quick Test.</p>
C12	POWER TO ACTUATOR WITH DOOR SWITCH UNLOCK		
	<ul style="list-style-type: none"> Check voltage between the lock actuator Circuit 118 and ground while pressing the UNLOCK position of the door switch. 	<p>VOM Reading:</p> <p>10 volts or more</p> <p>Under 10 volts</p>	<p>REPLACE actuator (refer to Section 01-14A). REPEAT Quick Test.</p> <p>SERVICE open or short in Circuit 120, 118 or 117. REPEAT Quick Test.</p>
C13	ONE OR MORE SWITCHES DO NOT WORK, CHECK CIRCUIT CONTINUITY		
	<ul style="list-style-type: none"> Ignition key OFF. Disconnect module Connector J1. Remove trim panel of the door with the faulty switch. Check continuity between Pin 25 of Connector J1 and lock position terminal of the door switch (locking Circuit 119). Check continuity between Pin 24 of Connector J1 and unlock position terminal of the door switch (unlocking Circuit 120). Check continuity between ground terminal of the door switch and ground (Circuit 57). 	<p>Continuity all circuits</p> <p>No continuity any circuits</p>	<p>REPLACE door switch (refer to Section 01-14A). REPEAT Quick Test.</p> <p>SERVICE open in Circuit(s) 119, 120 and/or 57. REPEAT Quick Test.</p>
C14	CHECK INPUT CIRCUIT		
	<ul style="list-style-type: none"> Ignition key OFF. Disconnect module Connector J1. Check Circuit 57, ground to switches. Check continuity between Pin 25 (Pin 24 if doors won't unlock) of Connector J1 and ground while pressing the lock (unlock) position of one of the door switches. 	<p>Continuity</p> <p>Open circuit from Pin 4 (or 5) to ground only</p> <p>Open circuit for 57</p>	<p>GO to C15.</p> <p>GO to C16.</p> <p>SERVICE open in wire 57. REPEAT Quick Test.</p>
C15	CHECK OUTPUT FROM MODULE		
	<ul style="list-style-type: none"> Check voltage between Pins 2, 16 of Connector J1 (Pins 4, 5, 1 and 15 for unlock) and ground while pressing the lock (unlock) position of one of the door switches. 	<p>VOM Reading:</p> <p>10 volts or more</p> <p>Under 10 volts</p>	<p>SERVICE open or short in Circuit 117 (118 or 163 or 628 for unlock). REPEAT Quick Test.</p> <p>REPLACE module. REPEAT Quick Test.</p>
C16	CHECK DOOR SWITCH FUNCTION		
	<ul style="list-style-type: none"> Check continuity between ground and circuit 119 for lock (120 for unlock) connection to door locking switch while pressing the lock (unlock) position of the switch. 	<p>Continuity</p> <p>No continuity</p>	<p>SERVICE break in Circuit 119 (120 for unlock problem). REPEAT Quick Test.</p> <p>SERVICE door switch (refer to Section 01-14A). REPEAT Quick Test.</p>

DIAGNOSIS AND TESTING (Continued)**POWER LOCKS — TEST C (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
C17	LOCKS WORK INTERMITTENTLY, CHECK GROUND TO MODULE		
	<ul style="list-style-type: none"> Ignition key OFF. Disconnect Connector J1. Check continuity to ground at Pins 20, 21 of Connector J1. 	Continuity	CHECK and SERVICE loose connections. REPEAT Quick Test.
		No continuity at Connector J1	SERVICE Circuit 57. REPEAT Quick Test.
C18	LOCKS DO NOT WORK IN FREEZING WEATHER		
	<ul style="list-style-type: none"> Bring vehicle into heated garage to thaw. Lubricate locks as directed at the beginning of this section. 		GO to Quick Test to identify further problems.
C19	LOCKS ONLY WORK WITH ENGINE RUNNING		
	<ul style="list-style-type: none"> Double check the following: <ul style="list-style-type: none"> Battery fully charged. Any latch or linkage binding (see Quick Test). Loose or corroded connections to actuators, switches, Remote Entry module connectors. 		GO to Quick Test to check for other problems.

TCN9866A

Remote Entry System

NOTE: Before performing any of the tests in this section, the battery must be fully charged.

REMOTE ENTRY SYSTEM — TEST D

TEST STEP		RESULT	ACTION TO TAKE
D1	TRY ANOTHER TRANSMITTER		
	<ul style="list-style-type: none"> If more than one transmitter is available, test the response of all the other transmitters that the customer brought in with the vehicle. If no other transmitters are available, go directly to D3. 	All other transmitters operate properly	REPLACE faulty transmitter. REPEAT Quick Test.
		None of the other transmitters work	GO to D10.
D2	CHECK FOR SHORTING PLUG		
	<ul style="list-style-type: none"> Make sure that the shorting plug is not inserted into Connector J2. 	OK	GO to D3.
		Not OK	REMOVE shorting plug from Connector J2. REPEAT Quick Test.
D3	CHECK PROGRAM "A" SHORT TO GROUND		
	<ul style="list-style-type: none"> Disconnect module Connector J1. Test for continuity between Pin 1 of Connector J2 and ground. 	Continuity	SERVICE short-to-ground in Circuit 808. REPEAT Quick Test.
		No continuity	GO to D4.
D4	CHECK PROGRAM "A" SHORT TO BATTERY		
	<ul style="list-style-type: none"> Test for continuity between Pin 1 of Connector J2 and battery. <ul style="list-style-type: none"> Module Connector J1 disconnected. 	Continuity	SERVICE short to battery in Circuit 808. REPEAT Quick Test.
		No continuity	GO to D5.
D5	CHECK PROGRAM "B" SHORT TO GROUND		
	<ul style="list-style-type: none"> Test for continuity between Pin 2 of Connector J2 and ground. <ul style="list-style-type: none"> Module Connector J1 disconnected. 	Continuity	SERVICE short to ground in Circuit 809. REPEAT Quick Test.
		No continuity	GO to D6.

DIAGNOSIS AND TESTING (Continued)

REMOTE ENTRY SYSTEM — TEST D (Continued)

TEST STEP		RESULT	ACTION TO TAKE
D6	CHECK PROGRAM "B" SHORT TO BATTERY		
	<ul style="list-style-type: none"> Test for continuity between Pin 2 of Connector J2 and battery. — Module Connector J1 disconnected. 	Continuity	SERVICE short to battery in Circuit 809. REPEAT Quick Test.
		No continuity	GO to D7.
D7	CHECK MODULE PROGRAM "A" INPUT		
	<ul style="list-style-type: none"> Disconnect module Connector J1. Measure the voltage between Pin 10 of Connector J1 and ground. 	Between 4 volts and 6 volts	GO to D8.
		Less than 4 volts or more than 6 volts	REPLACE module. REPEAT Quick Test.
D8	CHECK MODULE PROGRAM "B" INPUT		
	<ul style="list-style-type: none"> Disconnect module Connector J1. Measure the continuity between Pin 9 of Connector J1 and ground. 	Continuity	GO to D9.
		No continuity	REPLACE module. REPEAT Quick Test.
D9	CHECK CONTINUITY OF PROGRAM "A" CIRCUIT		
	<ul style="list-style-type: none"> Reconnect module Connector J1. Measure the voltage between Pin 1 of Connector J2 and ground. 	Between 4 volts and 6 volts	GO to D10.
		Less than 4 volts	SERVICE open in Circuit 808. REPEAT Quick Test.
D10	CHECK CONTINUITY OF PROGRAM "B" CIRCUIT		
	<ul style="list-style-type: none"> Reconnect module Connector J1. Measure the continuity between Pin 2 of Connector J2 and ground. 	Continuity	GO to D11.
		No continuity	SERVICE open in Circuit 809. REPEAT Quick Test.
D11	ENTER TRANSMITTER PROGRAM MODE		
	NOTE: Perform this step ONLY after trying D1.		
	<ul style="list-style-type: none"> Ignition switch ON. Insert a shorting plug into program Connector J2 (located below the driver's side of the instrument panel at the base of the steering column). — This shorting plug connects Program "A" input to Program "B" on the module. 	All doors lock then unlock	GO to D12.
		No response from the door locks	GO to D2.
D12	STORE TRANSMITTER(S) INTO MODULE MEMORY		
	<ul style="list-style-type: none"> Ignition switch still ON. Press any button on the transmitter. <p>NOTE: May have to push the button more than once.</p> <ul style="list-style-type: none"> Repeat this sequence for each of the owner's transmitters (up to four total). 	For each transmitter stored:	
		All doors lock, then unlock	GO to D13.
		No response from the door locks (even after three button presses)	GO to D1. If D1 has already been done, REPLACE transmitter batteries and REPEAT D12. If still no response, REPLACE module. REPEAT Quick Test.
D13	EXIT TRANSMITTER PROGRAM MODE		
	<ul style="list-style-type: none"> Ignition switch OFF. Make sure that shorting plug has been removed from program Connector J2. 	All doors lock, then unlock	REPEAT Quick Test, only Steps A3 through the end.
		No response from the door locks	REPLACE module. REPEAT Quick Test.

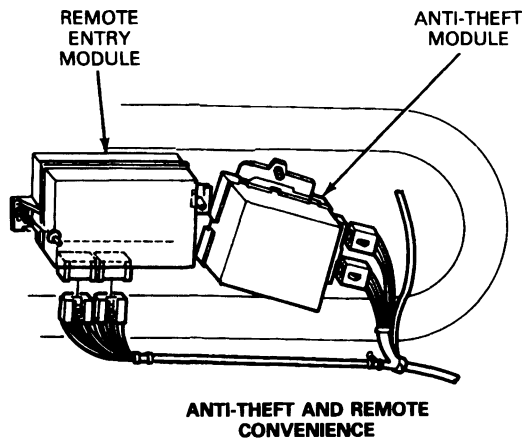
DIAGNOSIS AND TESTING (Continued)**REMOTE ENTRY SYSTEM — TEST D (Continued)**

	TEST STEP	RESULT	ACTION TO TAKE
D 14	REMOTE FUNCTIONS DO NOT WORK IN EXTREME WEATHER		
	<ul style="list-style-type: none"> Bring vehicle to room temperature and perform the Quick Test. 	Module passes Quick Test Module fails a Quick Test step.	REPLACE module. REPEAT Quick Test. SERVICE the remote entry system as required. REPEAT Quick Test.

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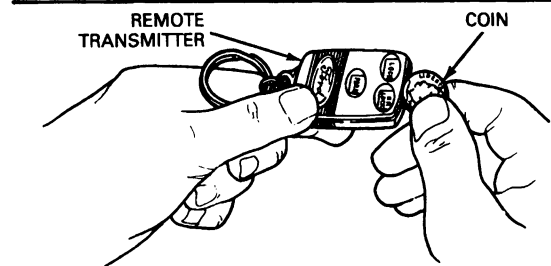
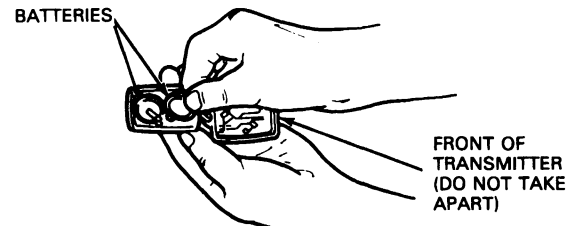
REMOVAL AND INSTALLATION**Electronic Control Module/Receiver****Removal and Installation**

1. Remove two nuts on retaining screws.
2. Disconnect the connector.
3. To install, reverse Steps 1 and 2.



N9871-B

4. Carefully swing the contacts back onto the top of the batteries.
5. Snap the two halves back together.



N9878-A

Transmitter Battery Replacement

NOTE: The remote entry transmitter is powered by two coin-type 3-volt lithium 2016 batteries.

1. To replace the batteries, the transmitter can be snapped apart by twisting a thin coin between the two halves of the transmitter.

NOTE: Do not take the front half of the transmitter apart.

2. Carefully swing the contacts off the batteries and remove the old batteries.
3. When installing the new batteries, be sure to place the positive (+) side down as marked.

CLEANING AND MAINTENANCE**Lubricate the Linkage**

- Use Multi-Purpose Grease Spray D7AZ-19584-AA (ESR-M1C159-A and ESB-M1C106-B) or equivalent.
- Spray into latch opening; it may be necessary to remove the door trim panel to lubricate the entire latch and linkage system. Refer to Section 01-05B.
- Manually cycle the lock 10 times. Check for interference around night latch and all linkages.

ADJUSTMENTS**Lost or New Transmitter(s)**

When the customer has purchased additional transmitters, or has lost a transmitter, the customer must bring all of the transmitters for their vehicle to the dealer. The dealer must then re-program all of the transmitters **at the same time**. The remote entry module erases **all** previous transmitters from memory when the transmitters are programmed or re-programmed.

NOTE: The remote entry module can store up to four transmitters in memory.

Programming Transmitter(s)

To program (or re-program) transmitter(s) into the remote entry module, perform the following steps:

1. Turn the ignition switch to the ON or ON / ACCY position and short the two terminals of the program connector (J2), a two-pin connector located below the driver's side of the instrument panel at the base of the steering column. All doors should lock and then unlock.
2. Press any button on a transmitter. All doors should lock and then unlock. If the door locks do not respond, press the button again (up to three times maximum with the same transmitter). If the door locks still fail to respond, go to PINPOINT TEST D.

3. Repeat Step 2 to program additional transmitters into the control module (up to four transmitters maximum).
4. Turn ignition off. All doors should lock and then unlock.
5. Make sure that the short has been removed from the Program Connector (J2).

SPECIAL SERVICE TOOLS /EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
014-00407	Digital Volt-Ohmmeter
059-00010	Inductive Dwell-Tach-Volts-Ohms Tester

SECTION 01-16A Windshield Wipers

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DIAGNOSIS AND TESTING (Cont'd.)	
Blade Replacement	01-16A-14	Park Switch Test.....	01-16A-8
Element Replacement	01-16A-14	Wiper Motor Current Draw	01-16A-9
Wiper Arm	01-16A-15	Wiper Switch	01-16A-4
Wiper Arm and Blade Assembly.....	01-16A-15	Wiper Switch Continuity Test	01-16A-10
CLEANING AND INSPECTION		REMOVAL AND INSTALLATION	
Windshield Wiper Blade Replacement.....	01-16A-13	Wiper Control Module (WCM)	01-16A-10
Windshield Wiper Blades, All Vehicles Except		Wiper Control Module, Econoline RV and	
E-350 RV and Commercial Chassis	01-16A-13	Commercial Chassis.....	01-16A-10
DESCRIPTION AND OPERATION		Wiper Control Switch.....	01-16A-10
Windshield Wiper System	01-16A-1	Wiper Motor Linkage and Pivot Shaft	01-16A-11
DIAGNOSIS AND TESTING		E-150-250-350 (Except E-350 RV and	
Circuit Breaker Test, F-150-250-350, F-Super		Commercial Chassis)	01-16A-12
Duty Chassis Cab and Bronco Only	01-16A-9	F-150-250-350, F-Super Duty Chassis Cab	
Diagnosis Guides	01-16A-4	and Bronco	01-16A-11
Interval Windshield Wiper System "E" Motor		SPECIAL SERVICE TOOLS/EQUIPMENT	01-16A-15
Test	01-16A-9	SPECIFICATIONS	01-16A-15
Multi-Function Switch	01-16A-4	VEHICLE APPLICATION	01-16A-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab and Bronco Vehicles

DESCRIPTION AND OPERATION

Windshield Wiper System

The two-speed, permanent magnet, three-brush "E" electric windshield wiper motor has a brush rigging that permits selection of low or high speed.

An interval wiper system features a rotary actuated wiper switch, and a push-type washer switch. Both switches are part of the turn signal lever of the multi-function switch.

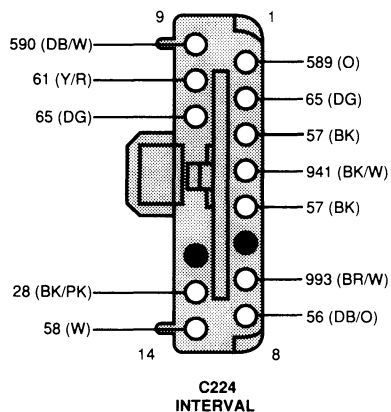
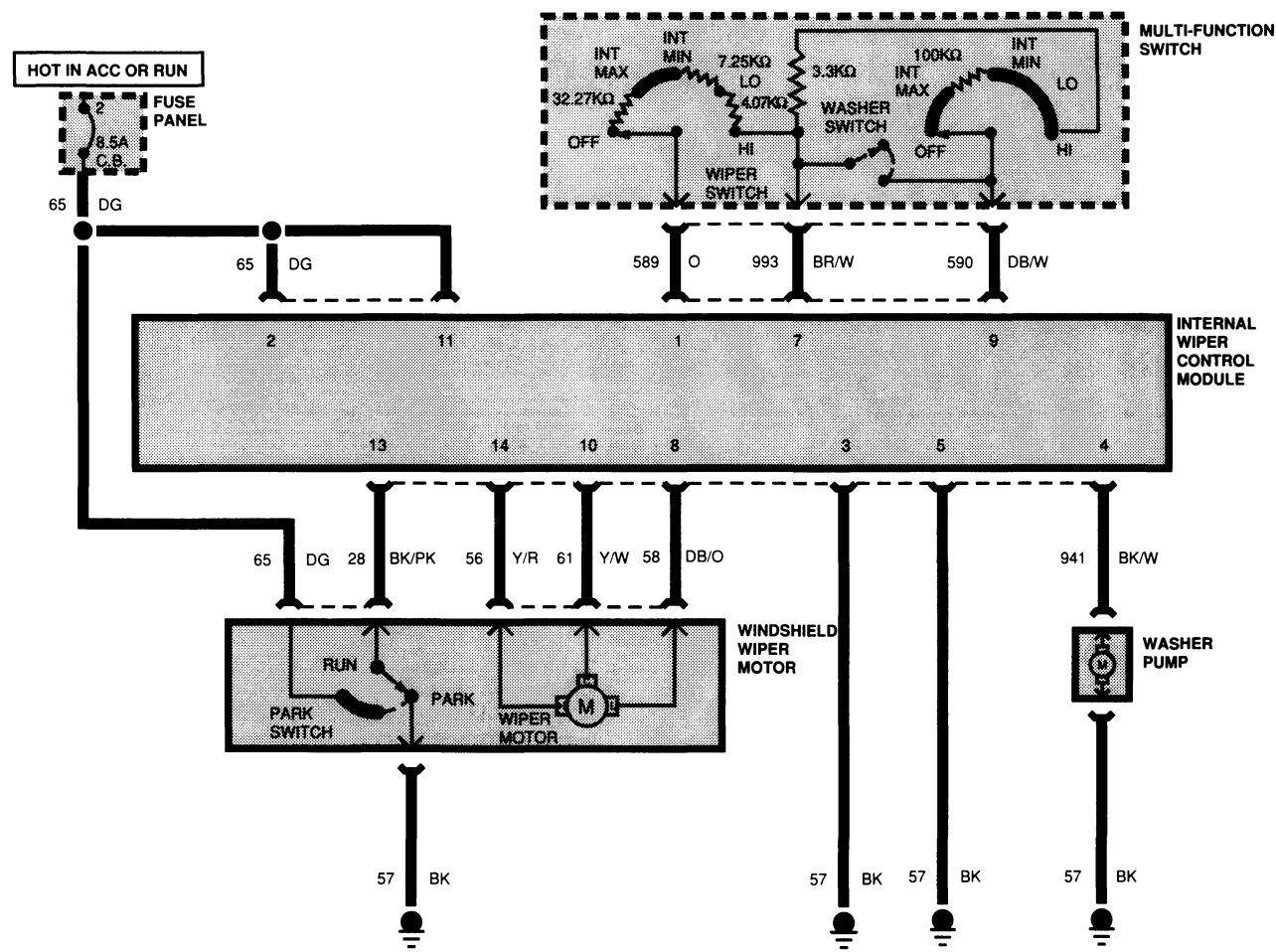
Interval wipers are standard equipment on Econoline vehicles and are available as an option on F-150-250-350, F-Super Duty Chassis Cab and Bronco vehicles.

DESCRIPTION AND OPERATION (Continued)

Wiper Circuit, F-Series and Bronco

F-SERIES
AND
BRONCO

See EVTM for more details of this circuit



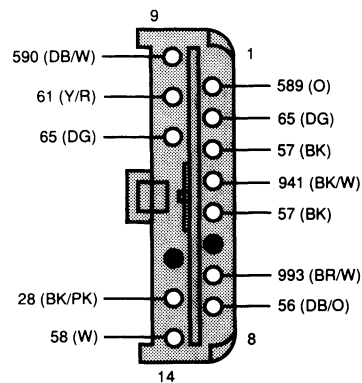
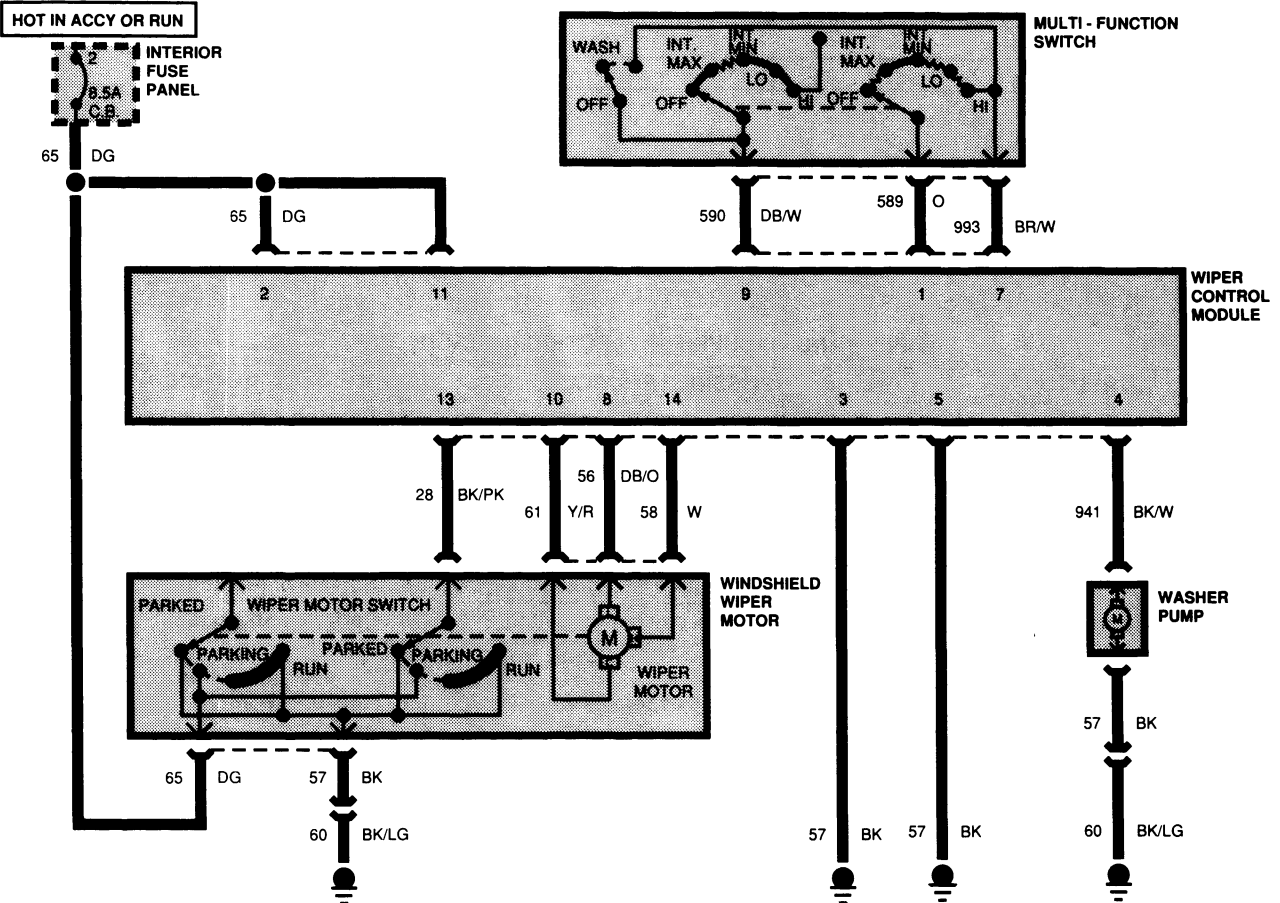
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DESCRIPTION AND OPERATION (Continued)

Wiper Circuit, Econoline

See EVTm for more details of this circuit

ECONOLINE

C222
WIPER CONTROL MODULE

K19009-A

DIAGNOSIS AND TESTING**Wiper Switch****Econoline RV and Commercial Chassis**

For diagnosis and testing of the wiper control switch or electronic WCM, refer to the appropriate diagnosis and testing procedure. For diagnosis and testing of wiper motors, arms, or blade assemblies consult the appropriate RV dealer or Commercial body builder.

Multi-Function Switch

Refer to Section 11-05 for Diagnosis and Testing.

Diagnosis Guides**WIPERS AND WASHERS — ELECTRICAL DIAGNOSIS**

CONDITION	POSSIBLE SOURCE	ACTION
Windshield wipers do not operate.	<ul style="list-style-type: none"> ● Open circuit breaker. ● Poor ground at wiper motor. ● Switch. ● Bent or damaged linkage. 	<ul style="list-style-type: none"> ● Replace circuit breaker. If it goes again, check for short circuit. ● Jumper motor ground terminal to vehicle body. If motor operates, service ground. ● Perform switch test. Service as required. ● Service or replace.
Wipers will not park in OFF or will not pause in INTERVAL mode.	<ul style="list-style-type: none"> ● Worn or damaged motor, switch, wiring or WCM assembly. 	<ul style="list-style-type: none"> ● Perform parking test.
In INTERVAL mode no wipe(s) after wash.	<ul style="list-style-type: none"> ● Circuit 941 open. ● Wiper module assembly inoperative. 	<ul style="list-style-type: none"> ● Service as required. ● Replace WCM.
Inoperative WCM on Intermittent Wiper System; inoperative Wiper Control Module.	<ul style="list-style-type: none"> ● Motor. ● Open in wiring. ● Poor ground to WCM assembly. 	<ul style="list-style-type: none"> ● Perform motor test. Service as required. ● Service as required. ● Replace WCM.

TK17822B

DIAGNOSTIC PINPOINT TEST INDEX

Description	Test
Wipers Inoperative at High Speed	A
Wipers Inoperative at Low Speed	B
Wipers Inoperative at Low Speed Interval	C

(Continued)

DIAGNOSTIC PINPOINT TEST INDEX (Cont'd)

Description	Test
Wipers Inoperative	D
No Wipe After Wash	E
Windshield Wipers Do Not Park	F

DIAGNOSIS AND TESTING (Continued)**WIPERS INOPERATIVE AT HIGH SPEED — TEST A**

TEST STEP		RESULT	ACTION TO TAKE
A1	VOLTAGE CHECK		
	<ul style="list-style-type: none"> Turn ignition on. Turn wiper switch to high. Unplug wiper motor. Check for battery voltage at Circuits 65 (DG) & 56 (DB/O). Does voltage check OK at both circuits? 	Yes No, voltage at Circuit 65 is OK. Voltage at Circuit 56 is not OK. No, voltage at both circuits not OK.	GO to A4. GO to A2. CHECK for: <ul style="list-style-type: none"> Open circuit breaker in fuse panel. Open connector. Open wire Circuit 65 (DG). SERVICE or REPAIR as necessary.
A2	CONTINUITY CHECK		
	<ul style="list-style-type: none"> Disconnect connector from Wiper Control Module (WCM). Check for continuity between Circuits 993 (BR/W) and 589 (O). Is there continuity? 	Yes No, any value other than closed circuit.	GO to A3. CHECK for: <ul style="list-style-type: none"> Open wire between wiper switch and WCM. Defective Wiper Switch.
A3	VOLTAGE CHECK, CIRCUIT 56		
	<ul style="list-style-type: none"> Plug WCM connector into WCM. Check for battery voltage at Circuit 56 (DB/O) of the WCM connector. Does voltage check OK? 	No Yes	REPLACE WCM. CHECK for open wire between WCM and wiper motor and SERVICE as required.
A4	CHECK WIPER GROUND WIRE		
	<ul style="list-style-type: none"> Ground wiper motor case to body ground. Does motor run? 	Yes No	REPAIR motor ground. GO to A5. GO to A5.
A5	CHECK WIPER MOTOR CURRENT DRAW		
	<ul style="list-style-type: none"> Perform wiper motor current draw test as described in this section. Is current draw OK? 	No Yes	SERVICE or REPAIR as required. CHECK linkage.

WIPERS INOPERATIVE AT LOW SPEED — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	VOLTAGE CHECK		
	<ul style="list-style-type: none"> Turn ignition on. Turn wiper switch to low. Unplug wiper motor. Check for battery voltage at Circuits 65 (DG) & 58 (W). Does voltage check OK at both circuits? 	Yes No, voltage at Circuit 65 is OK. Voltage at Circuit 58 is not OK. No, voltage at both Circuits not OK.	GO to A4. GO to A2. CHECK for: <ul style="list-style-type: none"> Open circuit breaker in fuse panel. Open connector. Open wire Circuit 65 (DG). SERVICE or REPAIR as necessary.
B2	CONTINUITY CHECK		
	<ul style="list-style-type: none"> Disconnect connector from Wiper Control Module (WCM). Measure resistance between Circuits 993 (BR/W) and 589 (O). Is the measured resistance 4.08K ohms $\pm 20\%$? 	Yes No, any value other than 4.08K ohms.	GO to A3. CHECK for: <ul style="list-style-type: none"> Open wire between wiper switch and WCM. Defective wiper switch.

DIAGNOSIS AND TESTING (Continued)

WIPERS INOPERATIVE AT LOW SPEED — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B3	VOLTAGE CHECK, CIRCUIT 58		
	<ul style="list-style-type: none"> ● Plug WCM connector into WCM. ● Check for battery voltage at Circuit 58 (W) of the WCM connector. ● Does voltage check OK? 	No Yes	REPLACE WCM. CHECK for open wire between WCM and wiper motor and SERVICE as required.
B4	CHECK WIPER GROUND WIRE		
	<ul style="list-style-type: none"> ● Ground wiper motor case to body ground. ● Does motor run? 	Yes No	REPAIR motor ground. GO to A5. GO to A5.
B5	CHECK WIPER MOTOR CURRENT DRAW		
	<ul style="list-style-type: none"> ● Perform wiper motor current draw test as described in this section. ● Is current draw OK? 	No Yes	SERVICE or REPAIR as required. CHECK linkage.

WIPERS INOPERATIVE AT LOW SPEED INTERVAL — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	VOLTAGE CHECK		
	<ul style="list-style-type: none"> ● Turn ignition on. ● Turn wiper switch to interval. ● Unplug wiper motor. ● Check for battery voltage at Circuits 65 (DG) & 58 (W). ● Is there battery voltage at Circuit 65 (DG) and does the voltage at Circuit 58 (W) switch from ground to battery voltage? 	Yes No, voltage at Circuit 65 (DG) is OK. Voltage at Circuit 58 (W) is not OK (does not switch between battery voltage and ground). No, voltage at Circuits 65 is not OK.	GO to C5. GO to C2. CHECK for: ● Open circuit breaker in fuse panel. ● Open connector. ● Open wire Circuit 65 (DG). SERVICE or REPAIR as necessary.
C2	RESISTANCE CHECK		
	<ul style="list-style-type: none"> ● Disconnect connector from Wiper Control Module (WCM). ● Measure resistance between Circuits 993 (BR / W) and 589 (O). ● Is measured resistance 11.3K ohms? 	Yes No, any value other than 11.3K.	GO to C3. CHECK for: ● Open wire between wiper switch and WCM. ● Defective wiper switch.
C3	RESISTANCE CHECK, CIRCUITS 590 (DB / W) AND 993 (BR / W)		
	<ul style="list-style-type: none"> ● Measure resistance between Circuits 590 (DB / W) and 993 (BR / W) ● Is the resistance measured between 0 to 100K ohms? 	Yes No, greater than 100K ohms.	GO to C4. CHECK for: ● Open wire between wiper switch and WCM. ● Defective wiper switch.
C4	VOLTAGE CHECK, CIRCUIT 58		
	<ul style="list-style-type: none"> ● Plug WCM connector into WCM. ● Check for battery voltage at Circuit 58 (W) of the WCM connector. ● Does voltage check OK? 	No Yes	REPLACE WCM. CHECK for open wire between WCM and wiper motor and SERVICE as required.

DIAGNOSIS AND TESTING (Continued)**WIPERS INOPERATIVE AT LOW SPEED INTERVAL — TEST C (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
C5	CHECK WIPER GROUND WIRE		
	<ul style="list-style-type: none"> Ground wiper motor case to body ground. Does motor run? 	Yes	REPAIR motor ground. GO to C6 .
		No	GO to C6 .
C6	CHECK WIPER MOTOR CURRENT DRAW		
	<ul style="list-style-type: none"> Perform wiper motor current draw test as described in this section. Is current draw OK? 	No	SERVICE or REPAIR as required.
		Yes	CHECK linkage.

WASHERS INOPERATIVE — TEST D

TEST STEP		RESULT	ACTION TO TAKE
D1	VOLTAGE CHECK		
	<ul style="list-style-type: none"> Turn ignition on. Unplug washer motor. Depress washer switch. Check for battery voltage at Circuit 941 (BK / W). Does voltage check OK? 	Yes	WCM is OK. CHECK washer pump. GO to D2 .
		No	GO to D3 .
D2	VOLTAGE CHECK, CIRCUIT 65 (DG)		
	<ul style="list-style-type: none"> Check for battery voltage at Circuit 65 (DG) of WCM (J1-1). Does voltage check OK? 	Yes	GO to D3 .
		No	CHECK for: <ul style="list-style-type: none"> Open circuit breaker in fuse panel. Open connector. Open wire Circuit 65 (DG). SERVICE or REPAIR as necessary.
D3	RESISTANCE CHECK		
	<ul style="list-style-type: none"> Disconnect connector from Wiper Control Module (WCM). Depress washer switch. Check for continuity between Circuits 993 (BR / W) and 590 (O). Is there continuity? 	Yes	WCM OK, CHECK for wiring concerns between WCM and washer pump.
		No, any value other than closed circuit.	CHECK for: <ul style="list-style-type: none"> Open wire between wiper switch and WCM. Defective wiper switch.
D4	VOLTAGE CHECK, CIRCUIT 941		
	<ul style="list-style-type: none"> Depress wiper switch. Check for battery voltage at Circuit 941 at WCM connector. Does voltage check OK? 	Yes	CHECK for open in circuit between WCM and washer pump.
		No	REPLACE WCM.

NO WIPE AFTER WASH (AEROSTAR) — TEST E

TEST STEP		RESULT	ACTION TO TAKE
E1	VOLTAGE CHECK		
	<ul style="list-style-type: none"> Turn ignition on. Unplug wiper motor. Depress and release washer switch. Check for battery voltage at Circuits 65 (DG) and 58 (W). Is there battery voltage at both circuits? 	Yes	GO to A4 .
		No, voltage at circuit 65 (DG) is OK. Voltage at circuit 58 (W) is not OK.	GO to E2 .
		No, voltage at both circuits is not OK.	CHECK for: <ul style="list-style-type: none"> Open circuit breaker in fuse panel. Open connector. Open wire Circuit 65 (DG). SERVICE or REPAIR as necessary.

DIAGNOSIS AND TESTING (Continued)

NO WIPE AFTER WASH (AEROSTAR) — TEST E (Continued)

TEST STEP		RESULT	ACTION TO TAKE
E2	RESISTANCE CHECK		
	<ul style="list-style-type: none"> Disconnect connector from Wiper Control Module (WCM). Turn wiper switch to off position. Depress washer switch. Check for continuity between Circuits 590 (DB/W) and 993 (BR/W). Is there continuity? 	Yes No, any value other than closed circuit.	GO to E3 . CHECK for: <ul style="list-style-type: none"> Open wire between WCM and wiper switch. Defective wiper switch.
E3	VOLTAGE CHECK		
	<ul style="list-style-type: none"> Plug WCM connector into WCM. Turn wiper switch to off. Depress washer switch. Measure voltage at Circuit 58 (W) at WCM connector. Is there battery voltage present? 	No Yes	REPLACE WCM. WCM is OK, CHECK for open wire between WCM and wiper motor.

WINDSHIELD WIPERS DO NOT PARK — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	PERFORM MOTOR PARKING SWITCH TEST		
	<ul style="list-style-type: none"> Perform motor parking switch test as described in this section. Is parking switch OK? 	Yes No	REMOVE wiper motor from the vehicle and REPAIR parking switch as required. GO to F2 .
F2	RESISTANCE CHECK		
	<ul style="list-style-type: none"> Turn wiper switch on stalk to OFF. Measure resistance between Circuits 589 and 593. Is resistance approximately 47.6K ohms \pm 20%? 	Yes No	GO to F3 . CHECK wiper switch and wiring between WCM and wiper switch.
F3	CHECK WCM CONTINUITY		
	<ul style="list-style-type: none"> Switch WCM to OFF. Measure continuity between Circuits 28 and 58 (J-13, J-8) at WCM. Is continuity OK? 	Yes No	CHECK wiring of Circuits 28 and 58 between WCM and motor. REPAIR as required. REPLACE WCM.

TK5335C

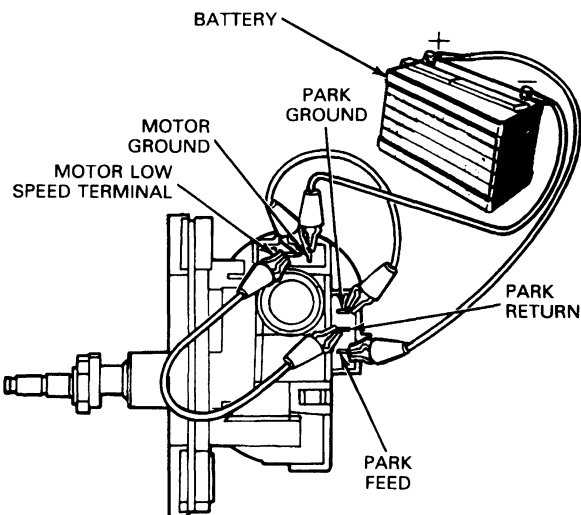
Park Switch Test

1. Connect a jumper lead from low speed terminal of motor connector to park return terminal of park switch connector.

2. Jumper both motor and park switch ground terminals to battery negative terminal.

DIAGNOSIS AND TESTING (Continued)

3. Connect a jumper lead from battery positive terminal to park feed terminal. (Motor should cycle once, then stop in park position.)



K10515-C

Interval Windshield Wiper System "E" Motor Test

Quick Check

1. If wipers operate in high speed only and wipers hesitate when going through PARK position, connect jumper wire from windshield wiper switch case to ground.
2. If wipers now work in low speed, repair switch ground.
3. If wipers do not work in low speed with switch case grounded, replace Wiper Control Module.

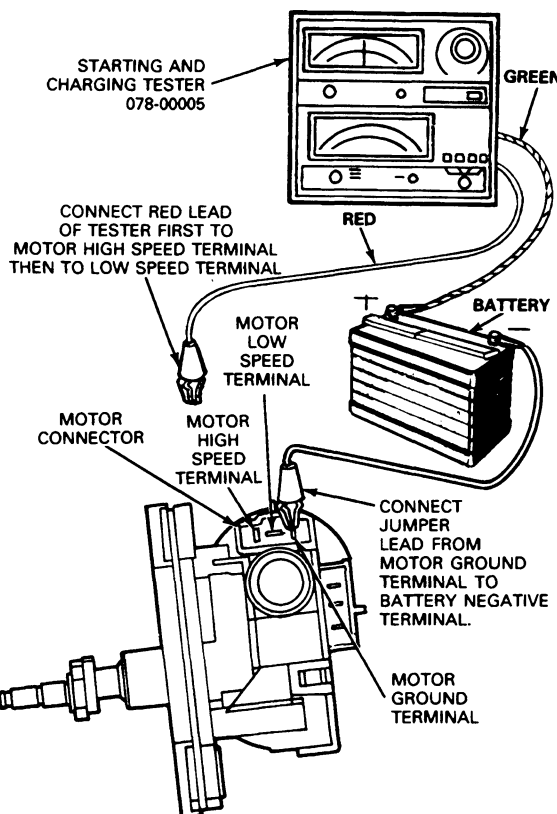
Wiper Motor Current Draw

CAUTION: Electric wiper motors contain permanent magnets made of ceramic. This is a hard glass-like material that can shatter or crack if the motor receives a severe physical shock. Do not handle any windshield wiper motor abusively when diagnosing wiper operations, because it will damage the magnets and make the motor inoperative. Rough handling of new replacement motors may also damage the magnets.

The windshield wiper motor tests can be performed with the wiper motor installed in the vehicle (linkage disconnected), or on the bench.

1. Disconnect positive cable from battery.
2. Disconnect wiper linkage from wiper motor.
3. Disconnect electrical plug to test motor on vehicle.

4. Connect the green lead from the tester to the battery positive post.
5. Connect the positive (red) lead from the Rotunda Starting and Charging Tester 078-00005 or equivalent, first to the low-speed connection and then to the high-speed connection at the connector plug. In either case, the current draw should not exceed 3.5 amperes.



K10514-1C

Circuit Breaker Test, F-150-250-350, F-Super Duty Chassis Cab and Bronco Only

The circuit breaker is rated at 8.25 amps and is located in the wiper control switch on all rotary switches.

Two separate tests are necessary to check for correct circuit breaker operation when circuit breaker is part of wiper switch.

Test 1

1. Before connecting the switch to the Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, short the tester leads together and adjust the current draw until it equals the circuit breaker rating.

DIAGNOSIS AND TESTING (Continued)

2. Connect the switch to the tester. Leave the switch connected to the tester for ten minutes. Hold the current reading on the ammeter at the rated current. If the circuit breaker opens during the ten minutes, replace the wiper switch assembly.

Test 2

1. Short the tester leads together and adjust the current draw until it is twice the rated current.
2. Connect the switch. Hold the current reading on the ammeter at twice rated current. The current reading on the ammeter should drop to zero within 20 seconds. If it takes longer than 20 seconds for the circuit breaker to open (current reading drops to zero), replace the wiper switch assembly.

Wiper Switch Continuity Test

Check for continuity between the switch terminals. Either a self-powered test lamp or an ohmmeter can be used to test standard two-speed switch. An ohmmeter must be used to test switch used with the interval wiper system.

To detect marginal operation of the switch, rotate or slide the switch control knob while each reading is being taken.

If the switch does not exhibit continuity, or if poor continuity exists in any switch position, replace the switch.

REMOVAL AND INSTALLATION**Wiper Control Switch**

NOTE: The switch handle is an integral part of the switch and cannot be removed separately.

Removal and Installation

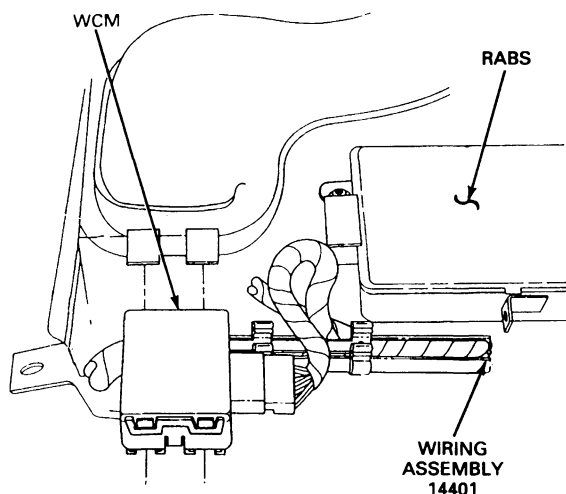
Refer to Section 11-05 for removal and installation procedures.

Wiper Control Module (WCM)**Removal and Installation**

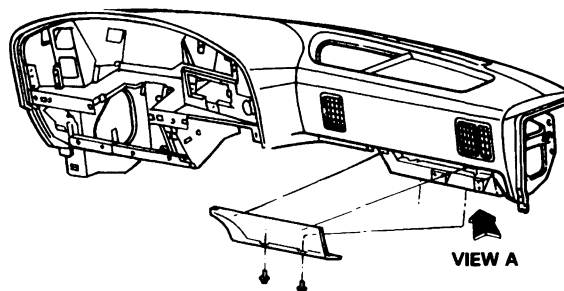
1. Disconnect battery negative cable.
2. Remove glove box.
3. Remove WCM from bracket.
4. Disconnect WCM electrical connector.

For installation, follow removal procedures in reverse order.

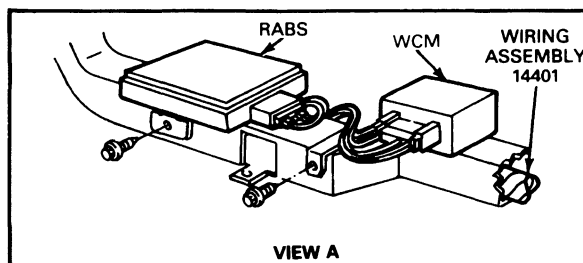
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Wiper Control Module, F-150-250-350 and Bronco

K17859-B

Wiper Control Module, Econoline

VIEW A



VIEW A

K17858-B

Wiper Control Module, Econoline RV and Commercial Chassis**Removal and Installation**

1. Make sure ignition switch is off.
2. Remove right lower trim panel.

REMOVAL AND INSTALLATION (Continued)

3. Disconnect electrical connector from WCM.
4. Remove WCM attaching screw and remove the WCM.

Wiper Motor Linkage and Pivot Shaft

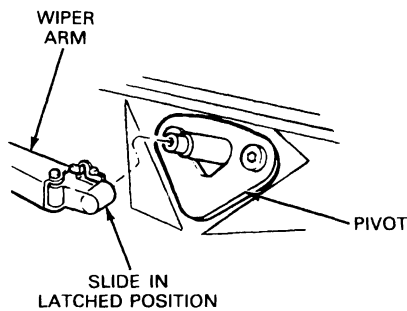
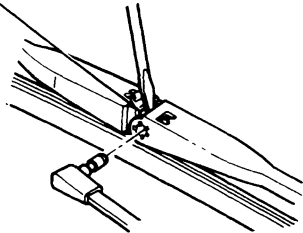
F-150-250-350, F-Super Duty Chassis Cab and Bronco

Removal and Installation

NOTE: The wiper motor is not serviceable. Replace as a complete assembly.

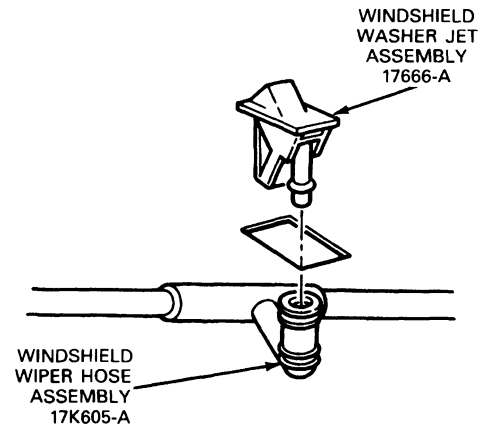
1. Disconnect the battery ground cable.
2. Remove both wiper arm and blade assemblies, disconnect the antenna cable.

PRESS DOWN ON SPRING
WITH SCREWDRIVER TO
RELEASE BLADE.



K19606-A

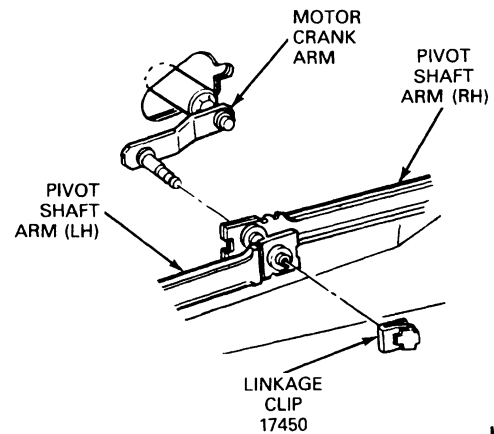
3. Open hood and disconnect the washer jet assemblies.



BRONCO SHOWN

K19607-A

4. Remove the cowl grille attaching screws and cowl grille. Refer to Section 01-11.
5. Remove the wiper linkage clip from the motor output arm. Pull linkage from output arm, if removing linkage and pivot shaft.

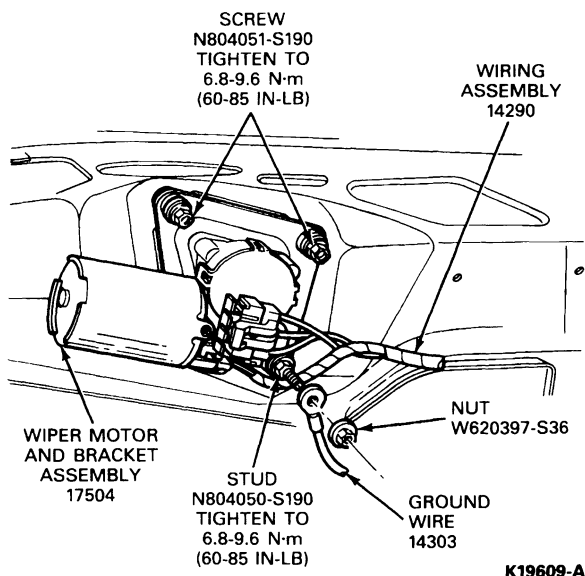


K19608-A

6. Disconnect the wiper motor wiring connector.

REMOVAL AND INSTALLATION (Continued)

7. Remove the wiper motor's three attaching screws and motor.



8. If removing the linkage and pivot shaft, remove the pivot body-to-cowl screws. Remove the linkage and pivot shaft assembly (three screws on each side).

NOTE: Left and right pivots are independent and can be serviced separately.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM processor relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

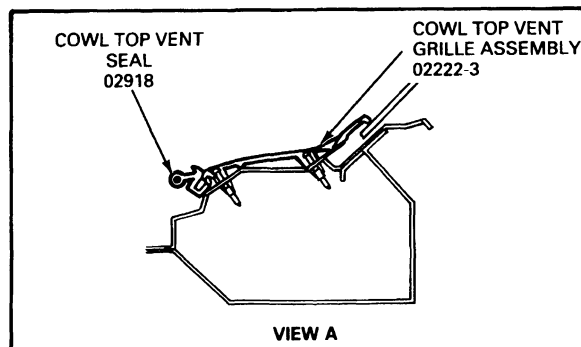
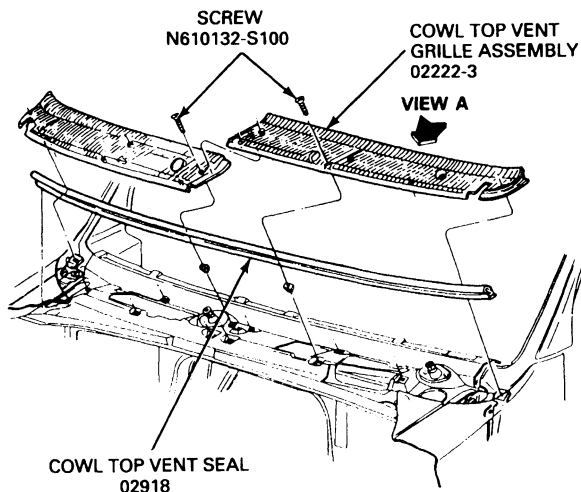
For installation, follow removal procedures in reverse order. Tighten wiper motor attaching screws to 6.8-9.6 N·m (60-85 in·lb).

E-150-250-350 (Except E-350 RV and Commercial Chassis)

Removal and Installation

1. Disconnect battery ground cable.

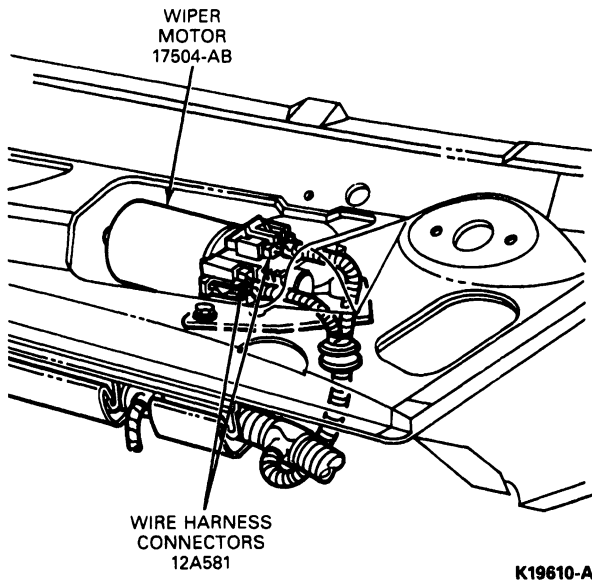
2. Remove the wiper arm and blade assemblies from the pivot shaft.
3. Remove the hood-to-cowl vent grille seal.



4. Remove the washer jets from the right and left cowl vent grilles by pressing the latch tab at outlet of jet.
5. Disconnect wiper motor wiring harness connectors at the motor.

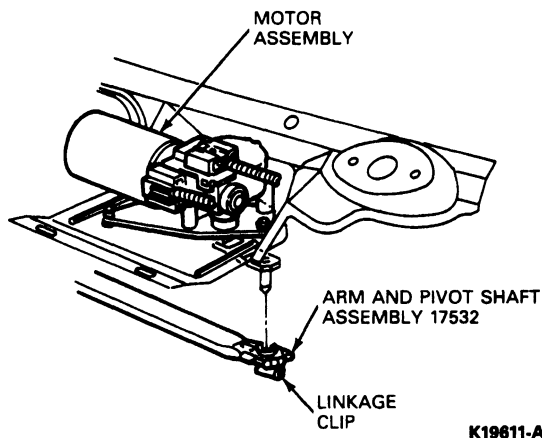
REMOVAL AND INSTALLATION (Continued)

6. Remove the wiper motor attaching bolts.



7. Remove the clip retaining the motor drive arm to the linkage mounting arm and pivot shaft assembly.
 8. Remove motor.
 9. Remove the four bolts attaching the linkage to the sheet metal.
 10. Remove the linkage from vehicle.

NOTE: To install, linkage must be positioned 165 degrees from park; otherwise, it will be difficult to install linkage to motor.



For installation, follow removal procedures in reverse order. Tighten linkage bolts and wiper motor bolts to 6.7-9.5 N·m (60-85 in-lb).

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

CLEANING AND INSPECTION

1. Clean all old grease from gear housing. Do not allow any cleaning fluid to contact the armature shaft and output shaft bearings.
2. Wipe all other parts with a clean cloth.
3. Inspect the gear housing for cracks or distortion. Replace a cracked or distorted housing.
4. Check all shafts, bushings, and gears for scored surfaces. Replace damaged parts, and add new grease to the housing and gears.

Windshield Wiper Blades, All Vehicles Except E-350 RV and Commercial Chassis

To maintain maximum wiper effectiveness the windshield and wiper blades must be kept clean. Foreign matter on the windshield or wiper blades may cause streaking, chattering or smearing. If blades do not clean properly, wash the wiper blades with a clean towel and complete windshield area with undiluted Ford Ultra-Clear Windshield Washer Concentrate C9AZ-19550-AA or BA (ESR-M17P5-A) or equivalent. Wash thoroughly and repetitively until all the foreign matter and contamination is removed. Rinse with water while rubbing with a clean cloth. Lift the blades off the windshield to clean them.

If streaking, chattering or smearing persists, repeat the above procedure.

CAUTION: Do not allow wiper blade rubber elements to come in contact with oil, gasoline, kerosene, paint thinner or similar solvents. The elements are damaged by these solvents and must be replaced.

Windshield Wiper Blade Replacement

Wiper blade replacement intervals will vary with the amount of use, type of weather, chemical reaction from road tars or salts and the age of the blades. Be sure that the windshield glass surface is not contaminated with oil, car wash "hot wax", tree sap or other substance which cannot be easily rubbed off.

Generally, if the wiper pattern across the glass is uneven and streaks over clean glass, the blades should be cleaned.

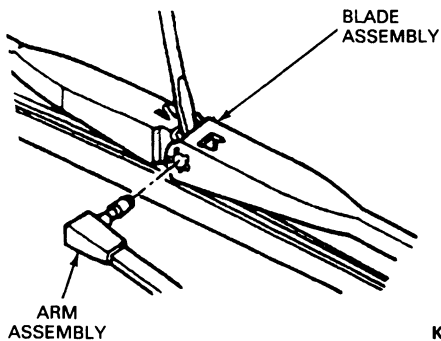
CLEANING AND INSPECTION (Continued)

If cracks, significant wear or breaks are found in the rubber, replace wiper blade element, as outlined in this section.

ADJUSTMENTS**Blade Replacement**

1. Cycle arm and blade assembly to up position on the windshield where removal of blade assembly can be performed without difficulty. Turn ignition key off at desired position.
2. To remove blade assembly, insert screwdriver in slot, push down on spring lock and pull blade assembly from pin.
3. To install, push the blade assembly on the pin so that the spring lock engages the pin (View A). Be sure the blade assembly is securely attached to pin.

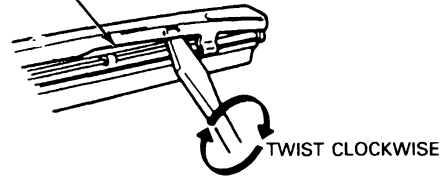
PRESS DOWN ON SPRING
WITH SCREWDRIVER TO
RELEASE BLADE

**Element Replacement**

1. Insert screwdriver between the edge of the superstructure and the blade backing drip (View B). Twist screwdriver slowly until element clears one side of the superstructure claw.
2. Slide the element into the superstructure claws.

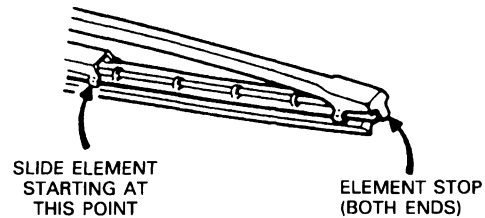
NOTE: Insert screwdriver 3.2mm (1/8 inch) or less past this edge.

NOTE: INSERT SCREWDRIVER
3.2 MM (1/8") OR LESS PAST
THIS EDGE



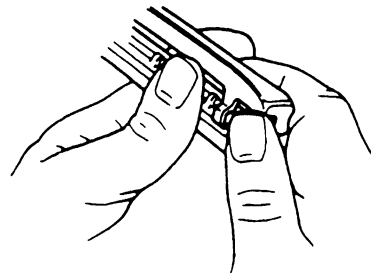
K19612-A

3. Slide the element into the superstructure claws, starting with second set from either end (View C) and continue to slide the blade element into all the superstructure claws to the element stop.



K19613-A

4. Insert element into one side of the end claws (View D) and with a rocking motion push element upward until it snaps in.



K19614-A

ADJUSTMENTS (Continued)**Wiper Arm****Removal and Installation**

1. Raise blade end off the windshield and slide latch away from pivot shaft, to unlock wiper arm from the shaft.
2. Remove wiper arm.

NOTE: Wiper arm can be removed and installed without the aid of any tools.

For installation follow the removal procedure in reverse order.

NOTE: If blade does not touch windshield, then slide latch is not completely in place.

Wiper Arm and Blade Assembly**E-350 RV and Commercial Chassis**

For wiper arm and blade assembly adjustment procedures for Econoline RV and Commercial chassis, consult the appropriate RV dealer or commercial body builder.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	In-Lb
Wiper Motor Screws or Bolts (E-Series)	6.8-9.6	60-85
Linkage to Sheet Metal Bolts	6.7-9.7	60-85

ELECTRIC WINDSHIELD WIPER MOTOR AND SWITCH TEST CURRENT LIMITS

Motor Type	Motor Current Draw Test	Circuit Breaker / Switch Low Current Pass Test	Circuit Breaker / Switch High Current Pass Test
System "E" — F-Series and Bronco	3.5 Amperes	7 Amperes	14 Amperes

Motor maximum current when operated without linkage attached.

SPECIAL SERVICE TOOLS / EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
007-00001	Digital Volt-Ohmmeter
078-00005	Starting and Charging Tester

SECTION 01-16B Windshield Washers

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Econoline RV and Commercial Chassis	01-16B-1	F-150-250-350, F-Super Duty and	
Washer System, Electric	01-16B-1	Bronco	01-16B-6
DIAGNOSIS AND TESTING		Motor, Seal and Impeller Assembly,	
Econoline RV and Commercial Chassis	01-16B-2	F-150-250-350, F-Super Duty Chassis Cab and	
Fluidic Washer System	01-16B-2	Bronco	01-16B-5
Washer Pump Current Draw Test	01-16B-2	Pump And Seal Assembly,	
Washer Switch	01-16B-2	E-150-250-350	01-16B-6
Washer System	01-16B-2	Washer Pump And Reservoir Assembly, Front,	
DIAGNOSIS GUIDES	01-16B-3	E-150-250-350	01-16B-4
REMOVAL AND INSTALLATION		Windshield Washer Reservoir And Motor	
Jets	01-16B-6	Assembly, F-150-250-350, F-Super Duty	
E-150-250-350	01-16B-6	Chassis Cab and Bronco	01-16B-4
Econoline RV and Commercial Chassis	01-16B-7	SPECIAL SERVICE TOOLS/EQUIPMENT	01-16B-7
		VEHICLE APPLICATION	01-16B-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab and Bronco Vehicles

DESCRIPTION AND OPERATION

Washer System, Electric

The electric windshield washer system consists of a control switch, integral with the wiper control switch, reservoir and motor assembly, and the necessary hoses, preset nozzles and attaching parts.

Econoline RV and Commercial Chassis

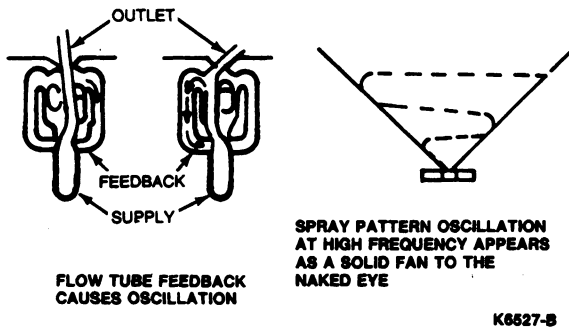
Ford Motor Company supplies only the control circuitry for the windshield washer system. The motor and pump assembly, reservoir, hoses, nozzles, and attaching parts are supplied by the RV manufacturer or commercial body builder. The Commercial Chassis uses the same stalk-mounted control switch as the E-350. For information on the other windshield washer components, contact the appropriate RV dealer or commercial body builder.

DIAGNOSIS AND TESTING

Before performing any of the following tests, check the washer reservoir for fluid, make sure the washer nozzle is not plugged, and make sure the fuse is not blown.

DIAGNOSIS AND TESTING (Continued)**Fluidic Washer System**

The front fluidic system nozzle expels what appears to be a wide fan-like spray pattern of large droplets of fluid on the windshield. However, it is actually a single oscillating jet stream. Care should be taken to only actuate the system momentarily because of the greater volume of fluid that is dispersed with this system.

**Washer Switch**

The windshield washer switch is an integral part of the windshield wiper switch. Refer to Section 01-16A for windshield wiper / washer switch testing.

Washer System

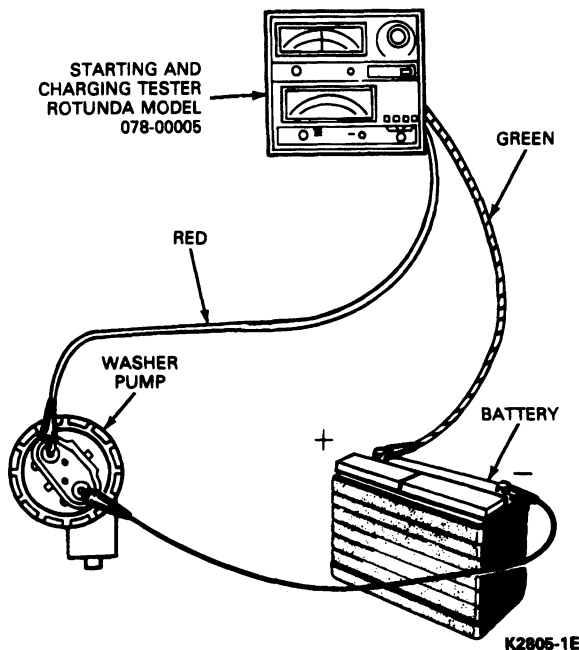
Refer to the diagnosis guide to isolate problems in the windshield washer system.

Econoline RV and Commercial Chassis

Ford Motor Company supplies only the control circuitry for the windshield washer system. The motor and pump assembly, reservoir, hoses, nozzles, and attaching parts are supplied by the RV manufacturer or commercial body builder. The Commercial Chassis uses the same stalk-mounted control switch as the E-350. For information on the other windshield washer components, contact the appropriate RV dealer or commercial body builder.

Washer Pump Current Draw Test

Attach the leads of the Digital Volt-Ohmmeter 014-00407 as shown in the illustration. The current draw should not exceed 4 amps nor be less than 1.7 amps while the washer pump is pumping fluid.



DIAGNOSIS GUIDES

WINDSHIELD WASHER DOES NOT WORK — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK FLUID LEVEL		
	<ul style="list-style-type: none"> Check fluid level of washer. 	No fluid Fluid level OK	FILL washer reservoir and CHECK operation of washers. GO to A2.
A2	CHECK WIPER OPERATION		
	<ul style="list-style-type: none"> Check operation of windshield wiper. 	Wipers do not work Wipers work	GO to A3. GO to A4.
A3	CHECK HEATER BLOWER AND RADIO		
	<ul style="list-style-type: none"> Check operation of heater blower and radio. 	Heater blower and radio do not work Heater blower and radio work	GO to A5. GO to A6.
A4	CHECK WASHER JET AND HOSE		
	<ul style="list-style-type: none"> Inspect washer jet for blockage. Inspect washer hose for blockage or kinks. 	Blocked jet or blocked or kinked hose	CLEAN or REPLACE washer jet or washer hose.
A5	CHECK FOR POWER AT IGNITION SWITCH		
	<ul style="list-style-type: none"> At accessory terminal check for power at ignition switch. 	No power Power OK at switch	REPAIR or REPLACE ignition switch. GO to A10.
A6	CHECK POWER AT WIPER-WASHER SWITCH		
	<ul style="list-style-type: none"> Check for power to wiper-washer switch. 	Power not OK Power OK	REPAIR accessory circuit to wiper-washer switch. GO to A7.
A7	CHECK FOR POWER AT WASHER PUMP		
	<ul style="list-style-type: none"> Using a voltmeter, actuate the washer switch and check for power at washer pump. 	No power at pump Power at pump	GO to A8. GO to A9.
A8	CHECK POWER AT PUMP TERMINAL		
	<ul style="list-style-type: none"> Check for power at pump terminal of washer switch. 	Power not OK Power OK	REPAIR or REPLACE washer switch. REPAIR circuit in wiring or connector to pump.
A9	CHECK GROUND		
	<ul style="list-style-type: none"> Check ground at pump connector. 	Ground not OK Ground OK	REPAIR ground. GO to A10.
A10	CHECK PUMP OUTLET		
	<ul style="list-style-type: none"> Inspect washer pump outlet for blockage. 	Blocked No blockage	REMOVE and CLEAN washer pump. REPLACE pump.
A11	CHECK FOR POWER AT ACCESSORY RELAY		
	<ul style="list-style-type: none"> Check for power to accessory relay, if so equipped, or check wiring to accessories. 	No power to relay or wiring damaged Power OK	REPAIR circuit between ignition switch and accessory relay, if so equipped, or REPAIR wiring to accessories. REPLACE accessory relay, if so equipped.

TCK5336E

REMOVAL AND INSTALLATION**Windshield Washer Reservoir And Motor Assembly, F-150-250-350, F-Super Duty Chassis Cab and Bronco**

To remove the assembly from the vehicle, disconnect the motor electrical connector (use a small screwdriver to unlock tabs) and hose, remove the retaining screws or nuts and lift the assembly from the fender apron (or radiator support or air cleaner bracket). Disconnecting the hose will drain the reservoir. The washer reservoir and cover assembly are not serviced separately. The motor retaining ring, seal and pump impeller assembly are serviced separately.

CAUTION: Do not make electrical connection prior to filling reservoir. Do not operate reservoir pump prior to filling reservoir.

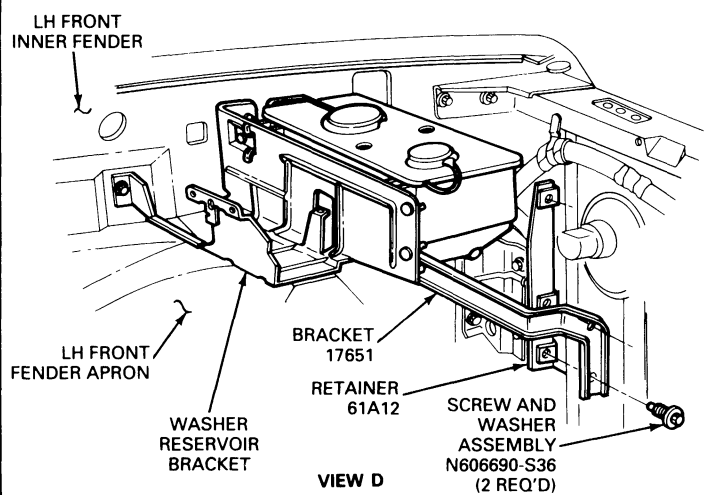
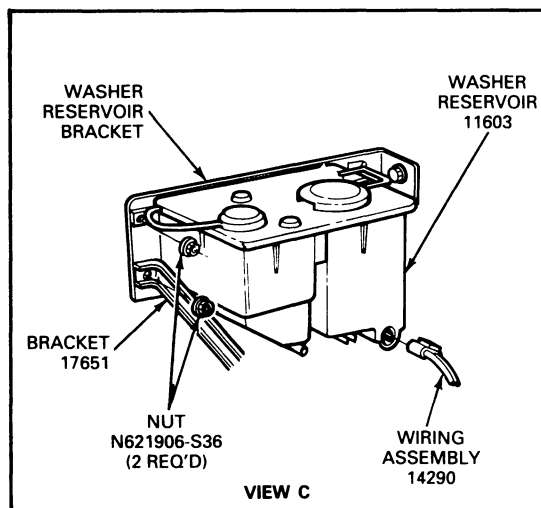
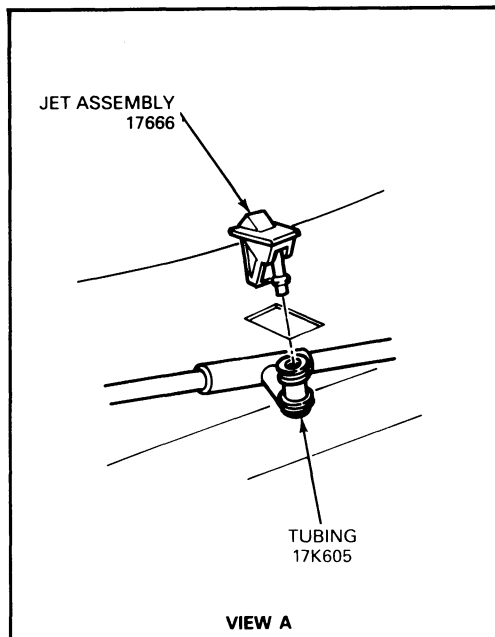
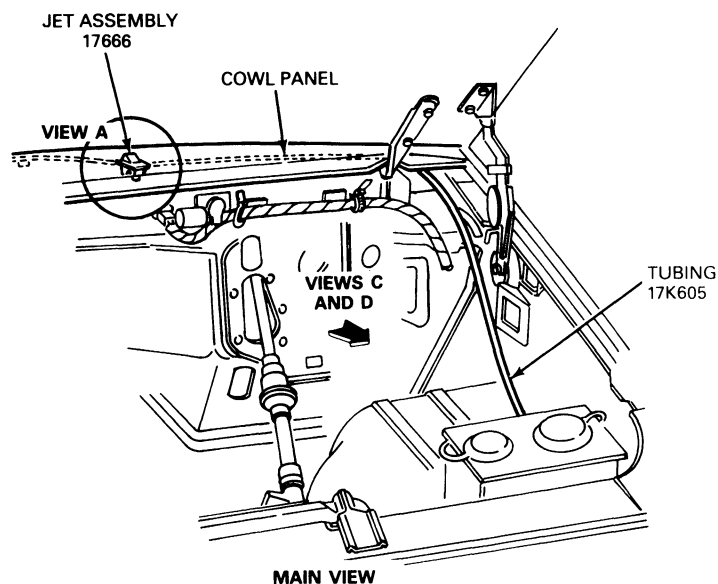
Washer Pump And Reservoir Assembly, Front, E-150-250-350**Removal**

1. Open hood.
2. Disconnect electrical connectors.
3. Remove air cleaner intake tube assembly.
4. Remove the reservoir retaining nuts and bolts.
5. Remove reservoir and hose from vehicle.

NOTE: Reservoir will drain with hose disconnected.

REMOVAL AND INSTALLATION (Continued)

Washer Pump, Reservoir and Jet Installation, F-Series and Bronco



K4889-J

Installation

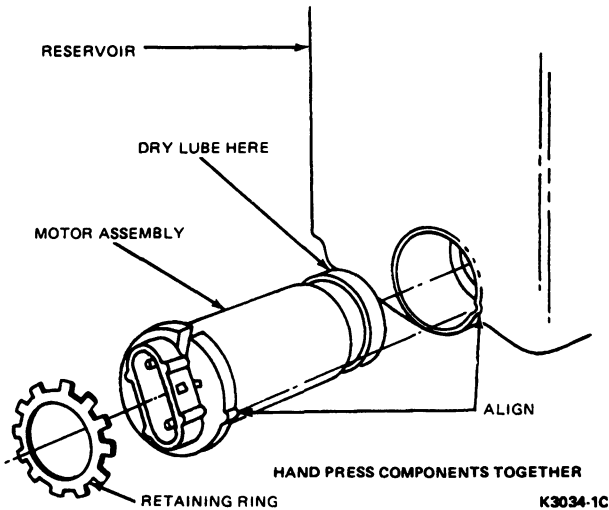
1. Install reservoir and hose.
2. Install reservoir retaining nuts and bolts.
3. Install air cleaner intake tube assembly.
4. Fill reservoir with fluid.
5. Connect electrical connector.

Motor, Seal and Impeller Assembly, F-150-250-350, F-Super Duty Chassis Cab and Bronco

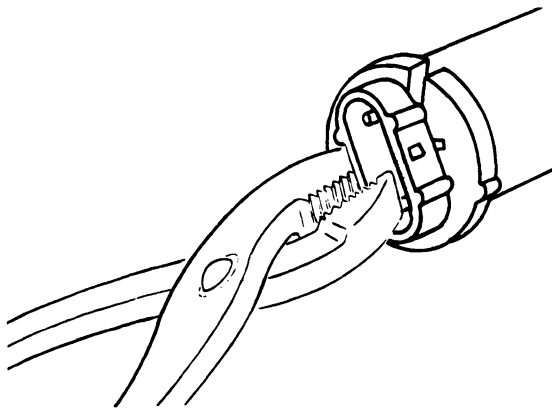
1. Remove reservoir assembly from vehicle. Disconnect electrical plug and hose.

REMOVAL AND INSTALLATION (Continued)

2. Using a small-bladed screwdriver, pry out retaining ring.



3. Using pliers to grip one wall around the electrical terminals, pull out the motor, seal and impeller assembly. If the impeller and seal come off when the motor is pulled, they can be reassembled. Make certain the reservoir pump chamber is free of foreign material prior to installing the old assembly in the new reservoir.



4. Before installing the assembly, lubricate the outside diameter of the seal with a dry lubricant such as powdered graphite. This will prevent the seal from sticking to the wall of the reservoir motor cavity and make assembly easier.
5. Align small projection on the motor end cap with the slot in the reservoir and assemble so that the seal seats against the bottom of the motor cavity.
6. Using a 25.4mm (1-inch) socket (preferably 12 point), hand press retaining ring securely against motor end plate.
7. Connect electrical plug and hose and replace the reservoir assembly in the vehicle.
8. Fill the reservoir and operate the washer system.

9. Check for leaks and align the cowl-mounted jets if necessary.

CAUTION: Do not operate pump until fluid is added to the reservoir.

Pump And Seal Assembly, E-150-250-350**Removal**

1. Remove reservoir assembly from vehicle. Disconnect electrical connector and hoses.
2. Using a small-blade screwdriver, pry out pump, being careful not to damage plastic housing.
3. Remove one-piece seal / filter and inspect for damage or debris.

Installation

1. Insert seal.
2. Lubricate inside diameter of seal with soapy solution and insert pump into bottle pump cavity until it is firmly seated in the seal.
3. Connect electrical plugs and hoses and replace reservoir assembly in vehicle.
4. Fill reservoir slowly and operate washer system.
5. Check for leaks.

CAUTION: Do not operate pump until fluid is added to reservoir.

Jets**F-150-250-350, F-Super Duty and Bronco****Removal**

1. Disconnect the washer nozzle hose using a long-blade screwdriver.
2. Squeeze the nozzle housing locking tabs and push the nozzle assembly up through the cowl grille.

Installation

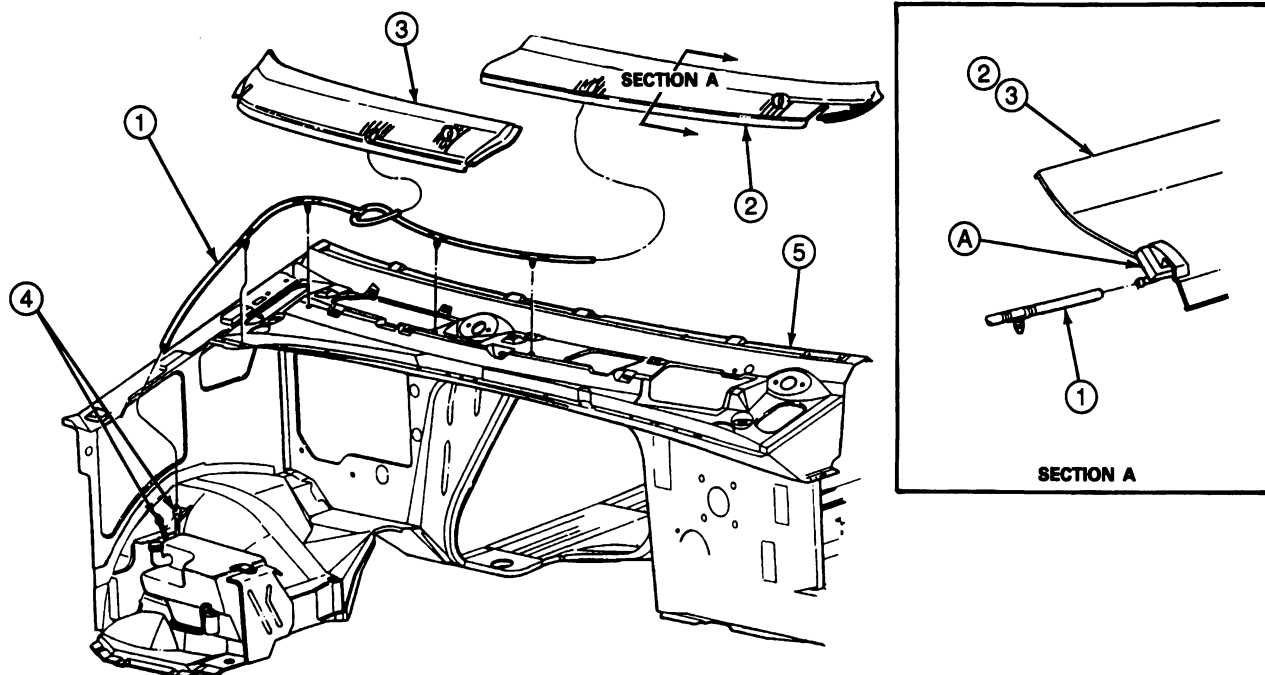
Reverse the removal procedure making sure the wiper motor is in PARK and the wiper arm and blade is set to Dimension X, as shown in Section 01-16A.

E-150-250-350

Refer to the following illustrations.

Removal and Installation

1. Remove the right and left wiper arm and blade assembly.
2. Remove the hood-to-cowl seal.
3. Remove the right and left cowl grilles and disconnect the washer hoses.
4. Remove the washer jet from the cowl grille.
5. Hook the end of the windshield washer hose shield under the lip in the head and pivot into position.

REMOVAL AND INSTALLATION (Continued)**Windshield Washer Nozzle Installation, E-150-250-350**

K17891-A

Item	Part Number	Description
1	17K605	Hose Assembly
2	—	Cowl Vent (Left)

(Continued)

Item	Part Number	Description
3	—	Cowl Vent (Right)
4	—	Washer Bottle
5	—	Cowl Sheet Metal
A	17666	Jet Assembly

Econoline RV and Commercial Chassis

Ford Motor Company supplies only the control circuitry for the windshield washer system. The motor and pump assembly, reservoir, hoses, nozzles, and attaching parts are supplied by the RV manufacturer or commercial body builder. For removal and installation instructions for washer systems components, contact the appropriate RV dealer or commercial body builder.

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
014-00407	Digital Volt-Ohmmeter
078-00005	Starting and Charging Tester

SECTION 01-18 Body Stripes (Tape) and Vinyl Films

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	01-18-1	SPECIAL SERVICE TOOLS/EQUIPMENT	01-18-4
REMOVAL AND INSTALLATION	01-18-1	VEHICLE APPLICATION	01-18-1
REPAIR	01-18-1		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350 and Bronco

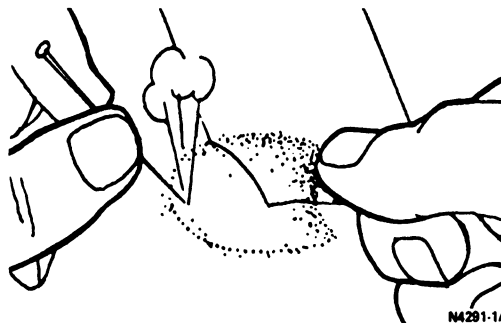
DESCRIPTION

Tape stripes are made from a tough, durable, weather-resistant, solid vinyl with a pressure-sensitive adhesive back. The pressure-sensitive adhesive back is protected by a liner paper which is easily peeled away during installation. During shipment and storage, the face is protected with an easy-release pre-mask paper.

REPAIR

Repair small nicks or scratches using touch-up paints mixed to blend with the affected area.

Repair blisters or air bubbles by piercing them with a sharp needle or pin at one end. Work the trapped air out through the pin hole with the thumb moving toward the pin hole and press the tape stripe firmly against the panel. It may be necessary to preheat the panel slightly to soften the adhesive. Heat also may be used to remove small wrinkles or irregularities. If bunching occurs around curves, spread bunching over as large an area as possible, then remove wrinkles.



REMOVAL AND INSTALLATION

Removal

1. Clean repair surfaces, adjacent panels, and openings as required.
2. Remove any parts mounted on or overlapping tape stripe from affected panel(s).
3. Remove tape stripe by starting at one edge and peeling it from painted surface. Apply heat to tape stripe to facilitate removal.

NOTE: Removal can also be assisted by using 3M® Woodgrain and Stripe Remover 08907 or equivalent. Avoid using pointed or sharp tools as they may damage the painted surface.

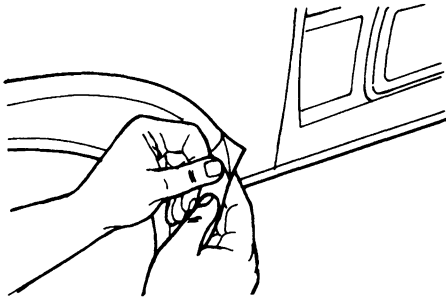
4. Remove adhesive from painted surfaces using a cloth saturated with 3M® Adhesive Remover 08908 or equivalent. Then, scrape with a squeegee.

NOTE: Exercise care when using solvents to avoid possible damage to painted surfaces. To determine if solvent is harmful to body paint, test it on a hidden area of the vehicle.

5. Rinse thoroughly with clean water and/or solvent as required.

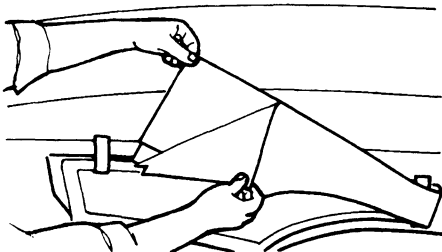
REMOVAL AND INSTALLATION (Continued)**Installation, Dry Method (Small or Thin Stripes)**

1. Clean painted surface (including wrap-around flanges on door openings) with Silicone and Wax Remover DL60-327 1-A or equivalent. Wipe surface with a clean cloth and allow to dry.
NOTE: Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause tape stripe to blister.
2. Position carrier edge or locating darts on tape stripe to body opening character lines on vehicle. Leading edge of tape stripe has a 2.5mm (1 / 10-inch) tape and liner extension. The rear edge has no extension. This will help determine which edge is forward and which edge is rearward.
3. Using masking tape, tape striping into place. Use particular care when matching tape stripe to character lines.
NOTE: If tape stripe overlaps occur, make sure forward piece overlaps rear piece.
4. Remove liner paper by sharply bending edge of striping toward face with flick of fingernail.



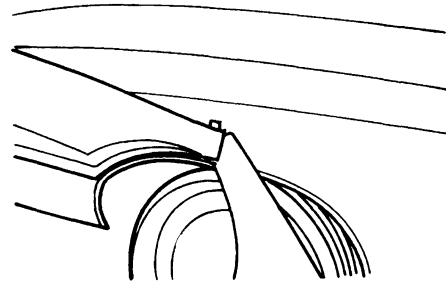
N10726-A

5. Peel liner paper from striping.



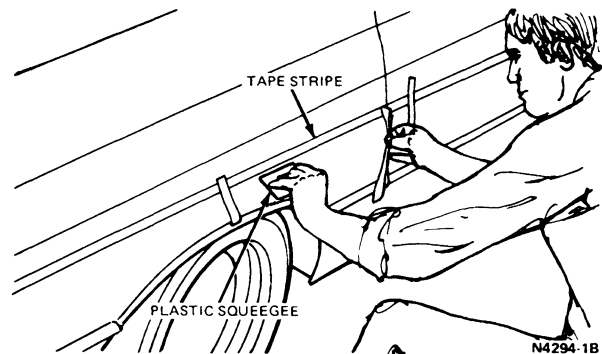
N10727-A

6. Rip liner paper off at approximately midpoint of panel.



N10728-A

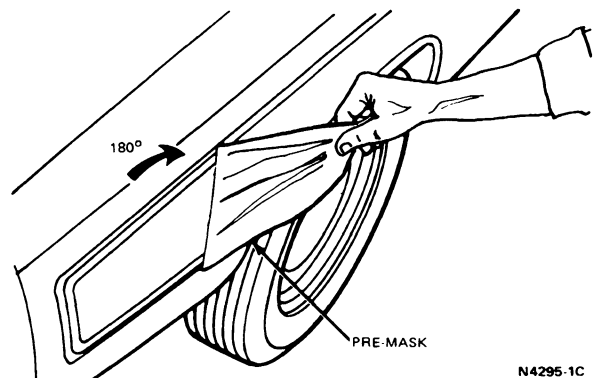
7. Stretch striping into desired location but away from the sheet metal. Using a plastic squeegee, start from center of panel and press striping into position moving toward the end of the panel.



N4294-1B

CAUTION: Do not use hands or fingers to smooth out the striping. Use of hands will result in creases and air bubbles in striping.

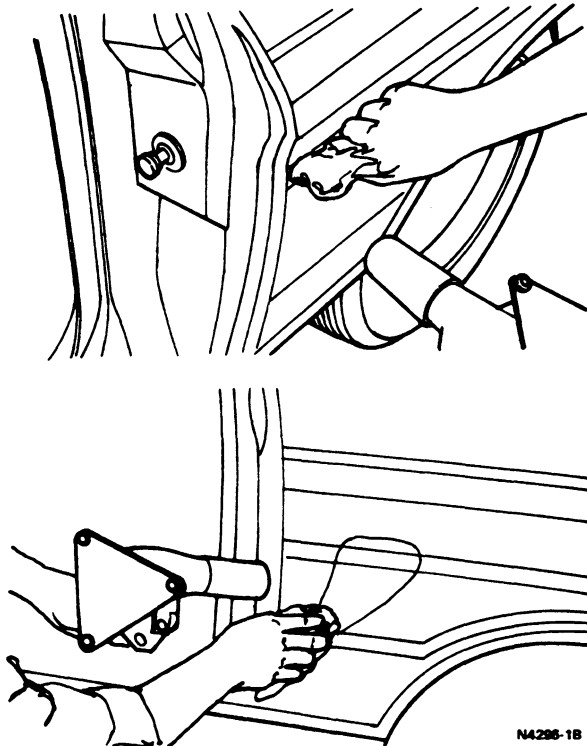
8. Peel off the remainder of liner paper and press striping into position using plastic squeegee.
NOTE: A 3M® SA-3 Low Friction Sleeve or equivalent should be placed over squeegee when installing large letters to prevent stretching and distortion of applique.
9. Remove pre-mask by pulling at 180-degree angle (knuckles against body panel) away from stripe. After removal of pre-mask, inspect for bubbles. Remove bubbles as described in this section.



N4295-1C

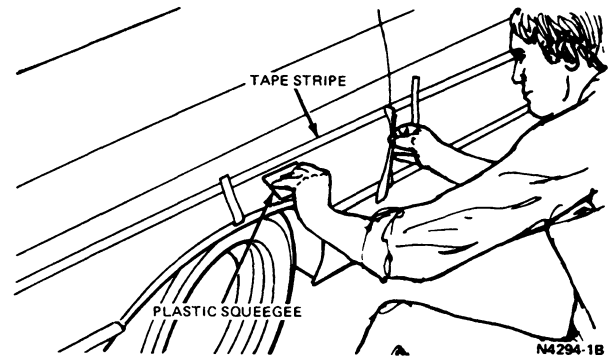
REMOVAL AND INSTALLATION (Continued)

10. Mold recessed areas into place using Rotunda Heat Gun 107-00301 or equivalent and a soft, clean cloth.

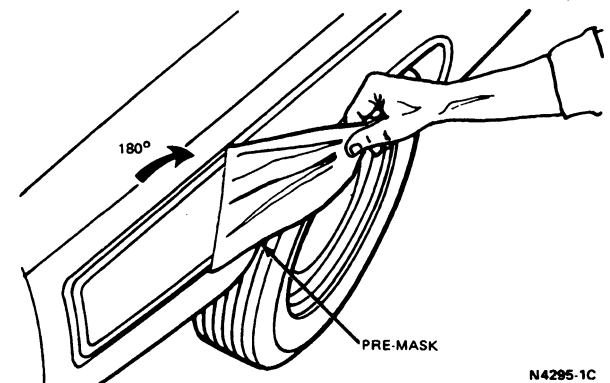
**Installation, Wet Method (Large Areas, Decal)**

1. Mix a teaspoon of standard dishwashing detergent in four liters (one gallon) of water. Fill a spray bottle with the solution.
2. Remove liner paper from tape stripe as described in Step 4 of Dry Method Installation, or as required.
3. Wet pressure-sensitive side of tape stripe and panel to be striped with detergent solution.
4. Position tape stripe on vehicle as described in Step 2 of Dry Method Installation.

5. Using squeegee and firm overlapping pressure, begin from center of tape stripe and squeegee toward the sides and then toward the front. The tape stripe can be easily lifted and reapplied if air bubbles are present.

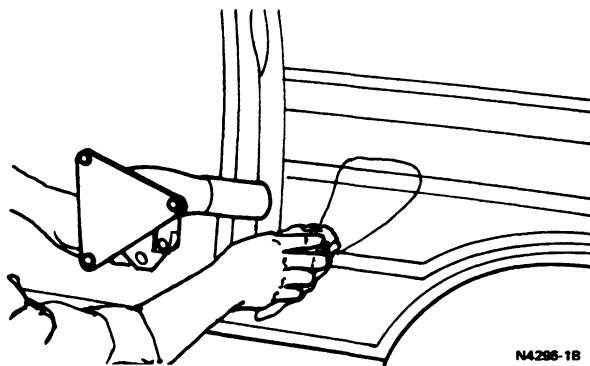
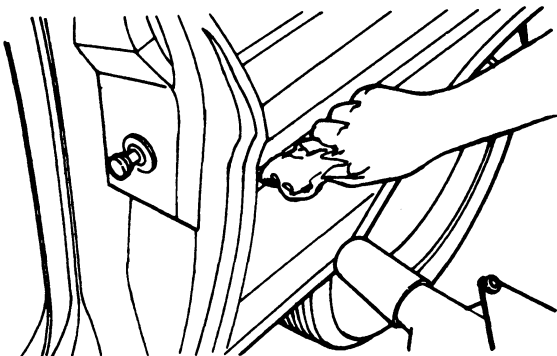


6. After the tape stripe is fully installed and squeegeed, remove pre-mask. An assistant can be very helpful in removing pre-mask from large areas. Wetting pre-mask on large decals may facilitate removal.



REMOVAL AND INSTALLATION (Continued)

7. Use Rotunda Heat Gun 107-00301 or equivalent as in Dry Method Installation, to mold decal into recessed areas and dry moisture as required.



N4286-1B

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT/EQUIPMENT**

Tool Number	Description
107-00301	Heat Gun

SECTION 01-19 Bumpers

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION		REMOVAL AND INSTALLATION (Cont'd.)	
Air Deflector (Front), E-150-250-350 and Club Wagon, Low Series	01-19-5	License Plate Bracket, Front.....	01-19-5
Air Deflector, E-350 Commercial Chassis	01-19-5	Outboard Mounting Bracket.....	01-19-3
Arm, Rear, Bumper-to-Frame	01-19-9	Rear Bumper Cover, E-150-250-350	01-19-8
Bumper Bar, Front	01-19-3	Rear Bumper Cover, Flareside, F-Series	01-19-8
Bumper Bar, Rear, Flareside.....	01-19-9	Rear Bumper License Plate Lamps, F-150-250-350, E-150 and Bronco	01-19-8
Center Plate, Rear, Flareside	01-19-9	Rear Bumper, E-150-250-350 and Club Wagon.....	01-19-7
Front Bumper Cover, E-150-250-350.....	01-19-4	Rear Bumper, F-150-250-350 and Bronco.....	01-19-5
Front Bumper, E-150-250-350 and Club Wagon.....	01-19-3	Rear Bumper, Flareside, F-Series	01-19-6
Front Bumper, F-150-250-350, F-Super Duty Chassis Cab and Bronco.....	01-19-1	Rear Bumper, Reinforcement	01-19-8
Front Valance Panel.....	01-19-4	Rubstrip, F-150-250-350, Super Duty and Bronco.....	01-19-4
Hitchplate, Rear, Flareside.....	01-19-9	SPECIFICATIONS	01-19-9
Inboard Mounting Bracket	01-19-3	VEHICLE APPLICATION	01-19-1

VEHICLE APPLICATION

All E-150-250-350, F-150-250-350, Bronco and F-Super Duty Series Vehicles

REMOVAL AND INSTALLATION

Front Bumper, F-150-250-350, F-Super Duty Chassis Cab and Bronco

Removal

1. Remove bumper assembly retaining nuts to frame rail.
2. Place bumper assembly on a protective surface for servicing.
3. If replacing bumper bar, remove rubstrips, valance panel brackets or license plate as described in this section.

Installation

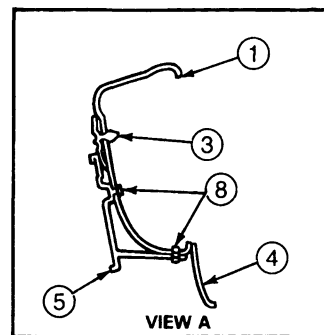
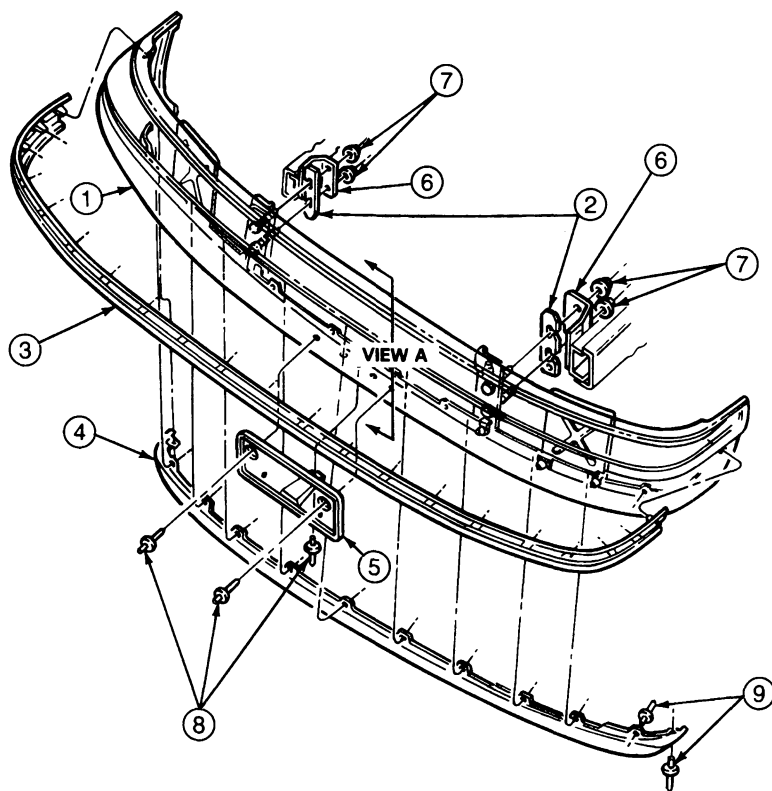
1. Align bumper assembly-to-frame mounting brackets and position bumper studs into place with tennerman nuts.
2. Insert studs through slot in frame brackets. Loosely assemble nuts to hold bumper to frame.
3. Align bumper to fenders and sheet metal stone deflector maintaining a one-inch (25.4mm) margin + / - 6mm and parallel.

NOTE: If rotation is an issue, use shim as required.

4. After bumper is aligned, tighten nuts to 87-118 N-m (65-85 ft-lb).

REMOVAL AND INSTALLATION (Continued)

Front Bumper, F-150-250-350, F-Super Duty Chassis Cab and Bronco

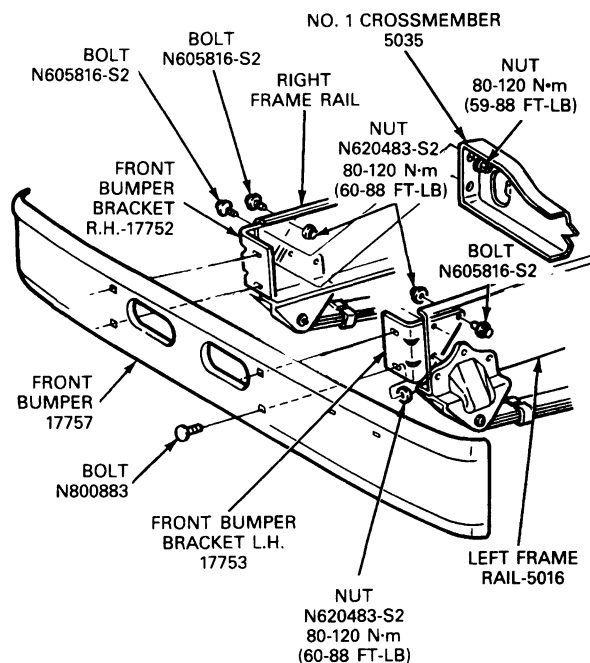


N9782-A

Item	Part Number	Description
1	17757	Front Bumper
2	17D899 or 17A923	Front Bumper Spacer
3	17C881	Front Bumper Pad
4	17626	Front Valance Panel

(Continued)

Item	Part Number	Description
5	17A385	Front License Plate Mounting Bracket
6	Ref.	Frame
7	N804525-S59	Nut 88-118 N-m (65-87 Ft-Lb)
8	N803043-S	Rivet (3 Req'd)
9	388442-S54	Rivet (12 Req'd)

REMOVAL AND INSTALLATION (Continued)**Front Bumper, F-Super Duty Commercial Chassis****Bumper Bar, Front**

Bumper assemblies are equipped with PIA frame mounting bracket and outboard reinforcements.

Inboard Mounting Bracket**Removal and Installation**

1. Remove bumper from vehicle as described in this section.
2. Remove rubstrip, valence panel and license plate bracket, if equipped, as described in this section.
3. Remove two bolts from two clips and discard. Use new bolts and U-clips for installation.
4. Remove inboard mounting bracket.
5. Inspect inboard mounting bracket and replace if necessary.

For installation, follow removal procedures in reverse order. Align bracket with bumper flange and tighten bolts to 25-34 N·m (19-25 ft-lb).

NOTE: Locating tabs on each arm must mate with bumper hole on top of flange.

Front Bumper, E-150-250-350 and Club Wagon**Removal**

1. Remove license plate bracket, if replacing bumper, as described in this section.
2. Remove four bumper retaining nuts. Carefully remove bumper.

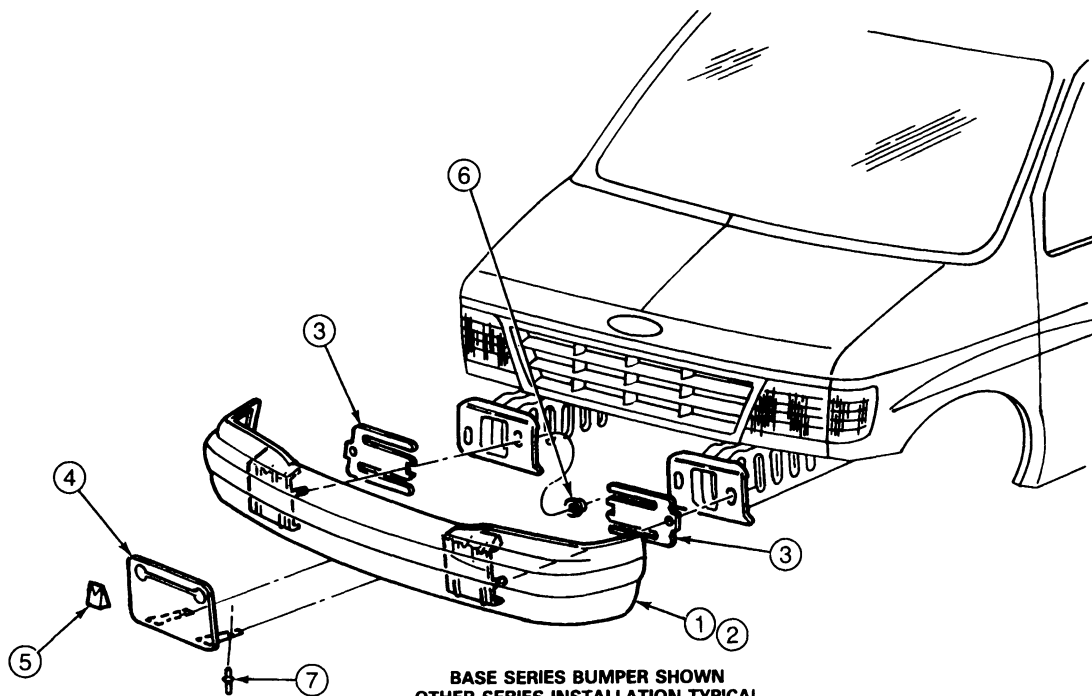
Installation

1. Loosely fit the four nuts retaining the bumper. Make sure proper bumper position and body-to-bumper clearance and that the spacers are in position. Refer to the following illustration.
2. Tighten attaching nuts to 88-118 N·m (65-87 ft-lb).
3. Install license plate bracket as outlined in this section.

Outboard Mounting Bracket**Removal and Installation**

1. Remove bumper from vehicle as described in this section.
2. Remove rubstrip, valence panel, and license plate bracket, if equipped, as described in this section.
3. Remove four bolts from U-clips and discard. Use new bolts and U-clips for installation.
4. Remove the outboard bracket.

For installation, follow removal procedures in reverse order. Align outboard bracket with bumper flange and tighten bolts to 25-34 N·m (19-25 ft-lb).

REMOVAL AND INSTALLATION (Continued)**Front Bumper, E-150-250-350, Club Wagon and Commercial Chassis**

N9785-A

Item	Part Number	Description
1	17750	Front Bumper Assembly
2	17C965	Front Bumper and Cover Assembly
3	17D899	Front Bumper Spacer (Optional)

(Continued)

Item	Part Number	Description
4	17A385	Front License Plate Bracket
5	17A386	License Plate Hardware Container
6	N801641-S57	Nut 88-118 N-m (65-87 Ft-Lb)
7	N803043-S	Rivet (4 Req'd)

Rubstrip, F-150-250-350, Super Duty and Bronco**Removal**

1. Remove bumper assembly as described in this section.
2. Place bumper on a protective surface for servicing.
3. Using pliers, carefully compress the retaining barb and pull rubstrip from bumper.

Installation

1. Locate center barb into center hole in bumper.
2. Working from center of rubstrip and using a rubber mallet, fully insert barbs into bumper.
3. After installation, inspect for tight fit. If gapping occurs or barb is damaged, a 3/16-inch screw can be inserted into barb to improve gapping condition.

Front Valance Panel**Removal and Installation**

1. Drill out twelve rivets from lower edge of valence.
2. Remove valence panel.

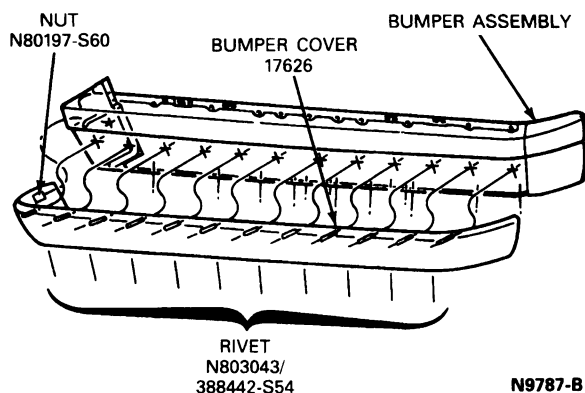
For installation, follow the removal procedures in reverse order.

Front Bumper Cover, E-150-250-350**Removal**

1. Remove bumper from vehicle as outlined in this section.
2. Drill out four rivets on bottom of bumper
3. Remove two nuts, one each end, retaining cover to bumper.
4. Using a pair of pliers carefully compress the cover retaining barbs and pull cover from bumper as it is released.

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Find the center of the cover and mark with chalk.
2. Find the center of bumper and align with center of cover.
3. Press a small area at center of cover into place.
4. Stretch the cover and work the barbs into the bumper starting at the center working toward the ends back and forth from right of center to left of center. Use a small rubber mallet to aid in installing the barbs.
5. Install the two nuts (one each end).
6. If equipped with front license plate bracket, position bracket on bumper. Install two rivets retaining bracket to front of bumper.
7. Install two rivets attaching cover to bottom of bumper.
8. Install bumper on vehicle as outlined in this section.

Typical Bumper Cover Installation, E-150-250-350**License Plate Bracket, Front****Removal and Installation**

1. Drill out attaching rivets.
2. Remove license plate bracket.

For installation, follow removal procedures in reverse order.

Air Deflector (Front), E-150-250-350 and Club Wagon, Low Series**Removal and Installation**

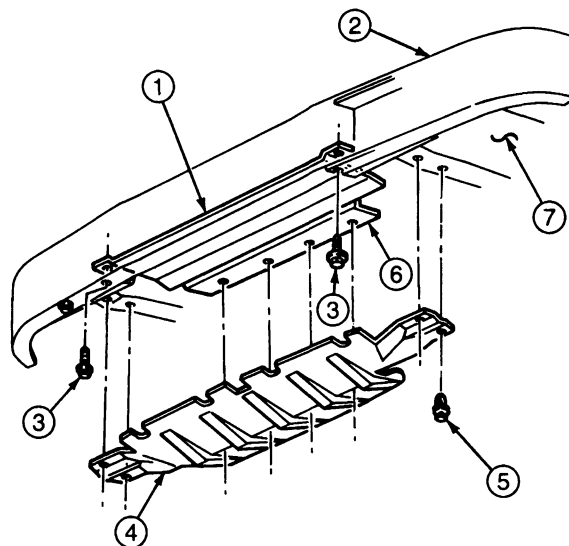
Remove six rivets holding the air deflector in place. Remove the air deflector and license plate bracket from the vehicle. For installation, follow removal procedures in reverse order.

Air Deflector, E-350 Commercial Chassis**Removal and Installation**

1. Remove eight rivets attaching the air deflector to the air conditioning condenser lower bracket.
2. Remove the two bolts attaching the air deflector bracket to the front bumper assembly.

For installation, follow removal procedures in reverse order. Tighten bolts to 35-55 N-m (26-41 ft-lb).

NOTE: Rivet plungers must be completely depressed to properly seat rivets.

Air Deflector, E-350 Commercial Chassis

Item	Part Number	Description
1	19E526	Air Deflector Bracket Assembly
2	17757	Front Bumper
3	N605920	Bolt 35-55 N-m (26-40 Ft-Lb)
4	19E667	A / C Condenser Air Lower Deflector
5	N806903	Rivet
6	19736	A / C Condenser Mounting Lower Bracket
7	17757	Front Bumper

Rear Bumper, F-150-250-350 and Bronco**Removal and Installation**

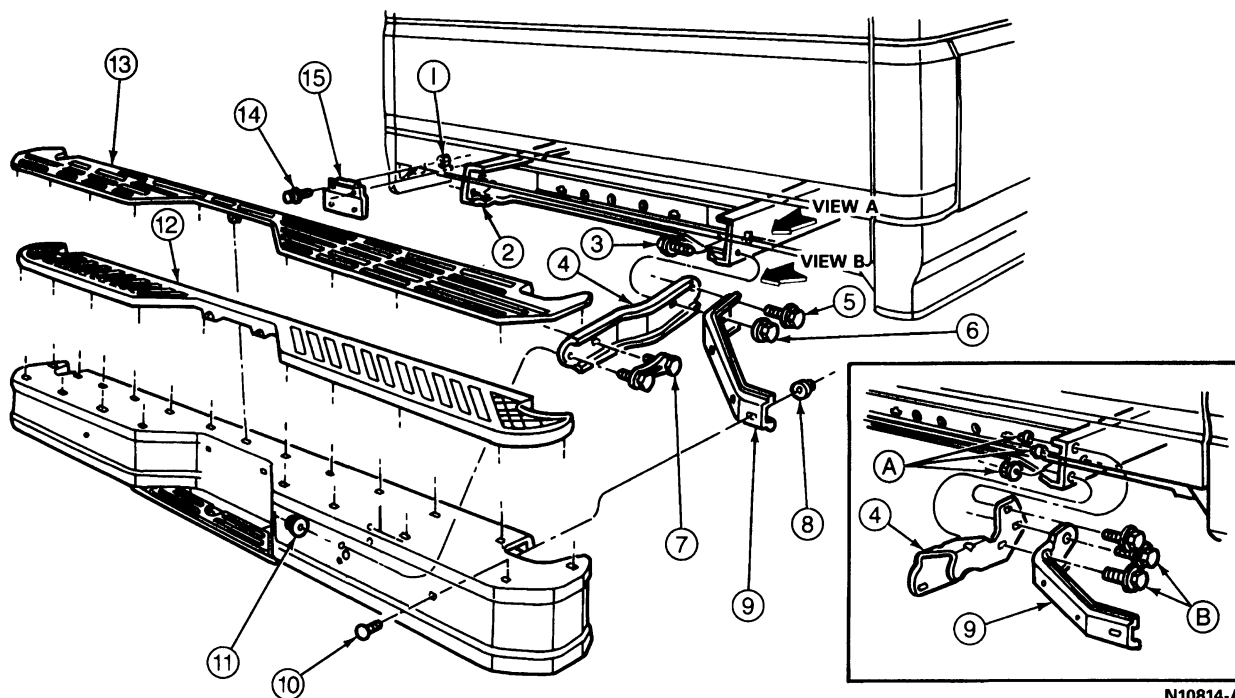
The rear bumper installation for all models is shown in the following illustration.

1. To remove the bumper, remove the bumper bracket-to-frame attaching bolts and remove the bumper and brackets.

REMOVAL AND INSTALLATION (Continued)

2. Remove the brackets from the bumper.

For installation, follow removal procedures in reverse order.

Rear Bumper, F-150-250-350 and Bronco

N10814-A

Item	Part Number	Description
1	W620397-S36	Nut and Washer (2 Req'd), LH Side Only
2	Ref.	Frame Assembly
3	N807422-S60	Bolt (1 Req'd Each Side), F-Series
4	17787-8	Arm, Rear Bumper Inner
5	N807254-S60	Bolt (1 Req'd Each Side), F-Series 98-132 N·m (72-105 Ft·Lb)
6	N620484-S60	Nut (1 Req'd Each Side), F-Series 98-132 N·m (72-105 Ft·Lb)
7	N806694-S100	Bolt and Retainer Assembly (1 Req'd Each Side)
8	N621945-S54	Nut and Washer Assembly (1 Req'd Each Side) 22-29 N·m (16-21 Ft·Lb)

(Continued)

Item	Part Number	Description
9	17795-6	Arm, Rear Bumper, Outer
10	N804926-S104	Bolt (Req'd Each Side), Argent and Chrome
10	N800883-S105	Bolt, "Nite"
11	N620484-S2	Nut and Washer (2 Req'd Each Side) 98-132 N·m (72-105 Ft·Lb)
12	170781	Cover, Rear Bumper (Hi-Series, Chrome or "Nite")
13	170781	Cover, Rear Bumper (Argent Bumper)
14	N8021118-S55M	Screw and Washer (2 Req'd) LH Side Only
15	13406-A	Bracket, Rear License (1 Req'd), LH Side When Rear Bumper Is Not Used

Rear Bumper, Flareside, F-Series**Removal and Installation**

1. Disconnect license plate wiring.
2. Support bumper and remove four attaching bolts (two each side).

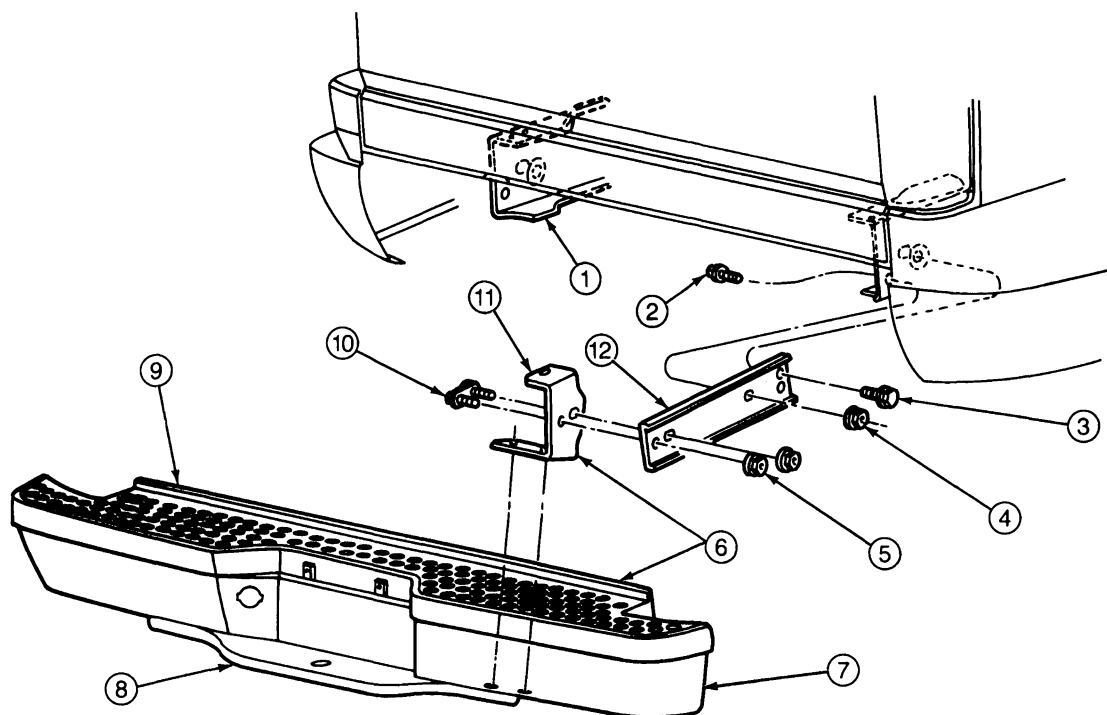
3. Remove nuts, one each side, attaching bumper to frame rail.
4. Remove bumper and place on protective surface.

REMOVAL AND INSTALLATION (Continued)

5. If replacing any components on bumper, refer to appropriate procedure in this section.

For installation, follow removal procedures in reverse order. Tighten bolts to 97-133 N·m (72-98 Ft-Lb).

Rear Bumper, Flareside



N10815-A

Item	Part Number	Description
1	Ref.	Frame Assembly
2	N807422-S60	Bolt (1 Req'd Each Side)
3	N807254-S60	Bolt (1 Req'd Each Side)
4	N620484-S60	Nut and Retainer Assembly (1 Req'd Each Side)
5	N620484-S60	Nut (2 Req'd Each Side)

(Continued)

Item	Part Number	Description
6	F2TB-17775C	Bumper Assembly, Chrome
6	F2TB-17775E	Bumper Assembly, Black
7	17906	Bumper
8	Ref.	Hitchplate
9	170781	Cover
10	N807255-S	Bolt and Retainer Assembly (1 Req'd Each Side)
11	17912-3	Reinforcement, Rear Bumper
12	—	Arm, Bumper, RR Inner

Rear Bumper, E-150-250-350 and Club Wagon

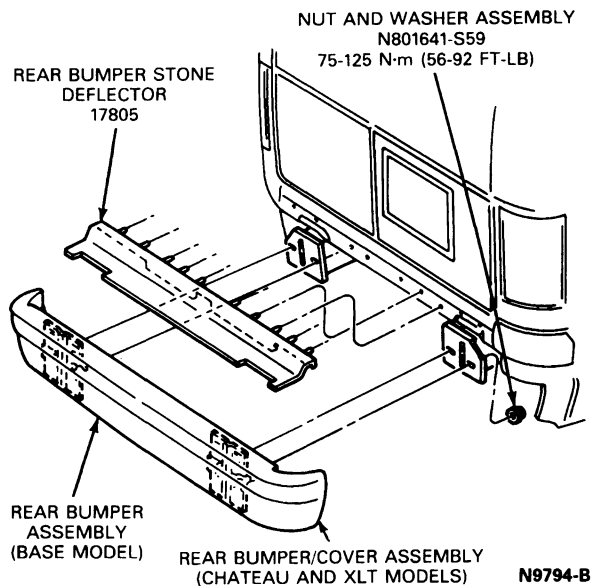
Removal and Installation

1. Remove four nuts attaching the bumper to frame mounting brackets.

2. Remove bumper.

For installation, follow removal procedures in reverse order. Tighten attaching nuts to 88-118 N·m (65-87 ft-lb).

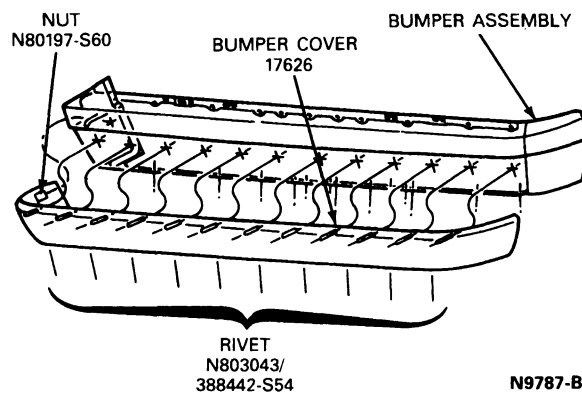
NOTE: Make sure body-to-bumper clearance and spacers are in position.

REMOVAL AND INSTALLATION (Continued)**Rear Bumper, E-150-250-350 and Club Wagon****Rear Bumper Cover, E-150-250-350****Removal**

1. Remove bumper from vehicle.
2. Remove the pushpins retaining cover to bottom of bumper.
3. Remove two nuts (one each end) retaining cover to bumper.
4. Using a pair of pliers carefully compress the cover retaining barbs and pull cover from bumper as it is released.

Installation

1. Find the center of the cover and mark with chalk.
2. Find the center of the bumper and align with the center of the cover.
3. Press a small area at the center of the cover into place.
4. Stretch the cover and work the barbs into the bumper starting at the center working towards the ends back and forth from right of center to left of center. Use a small rubber mallet to aid in installing the barbs.
5. Install the two nuts (one at each end).
6. Install the pushpins attaching the cover to the bottom of the bumper.
7. Install bumper on vehicle as outlined in this section.

Rear Bumper Cover, E-150-250-350**Rear Bumper, Reinforcement****Removal and Installation**

1. Remove rear bumper assembly as described in this section.
2. Remove arm-to-rear bumper assembly as described in this section.
3. Remove rear bumper cover as described in this section.
4. Remove reinforcement top attaching bolts and nuts to bumper bar.
5. Remove bottom reinforcement bolts and nuts to bumper bar.
6. Remove reinforcement.

For installation, follow removal procedures in reverse order. Tighten bolts and nuts to 46.7-63.3 N·m (35-47 ft-lb).

Rear Bumper Cover, Flareside, F-Series**Removal**

1. Remove bumper assembly as described in this section.
2. Using pliers, squeeze cover retaining barbs, one at a time, and pull cover from bumper.

Installation

1. Starting in center of bumper, align cover barbs with holes in bumper and press barbs into holes.
2. Install bumper as described in this section.

Rear Bumper License Plate Lamps, F-150-250-350, E-150 and Bronco

Refer to Section 18-01, for rear bumper license plate lamp installation.

REMOVAL AND INSTALLATION (Continued)**Arm, Rear, Bumper-to-Frame****Removal**

1. Remove bumper as described in this section.
2. Remove retainer nut and bolt assemblies, one each side of bumper.
3. Remove arm-to-bumper assembly.
NOTE: Inspect arm for damage; if damaged replace.

Installation

1. Align arm with holes in bumper assembly bracket.
2. Install bolts and retainer assembly.
3. Install nuts and tighten to 97-133 N-m (72-98 ft-lb).
4. Install bumper as described in this section.

2. Remove all components from bumper as described in this section.
3. Inspect components for damage, replace if necessary.

For installation, follow removal procedures in reverse order.

SPECIFICATIONS**Torque Specifications**

Description	N-m	Lb-Ft
Front Bumper Nuts, F-Series, Super Duty Chassis and Bronco	87-118	65-85
Inboard Mounting Bracket Bolt	25-34	19-25
Outboard Mounting Bracket Bolt	25-34	19-25
Frame Nuts	88-118	65-87
F-Series, Super Duty Chassis and Bronco Bumper Retaining Nuts	88-118	65-87
E-Series and Club Wagon Air Deflector Mounting Bracket to Bumper Flange Bolts	35-55	26-40
E-350 Commercial Chassis Rear Bumper To Frame Mounting Bracket Nuts	88-118	65-87
F-Series and Bronco Rear Bumper Nut and Washer Assembly	75-125	56-92
E-Series Bumper Assembly to Body Bolts and Nuts	97-133	72-98
Arm to Bumper Assembly Nuts	97-133	72-98
Reinforcement Bolts and Nuts	46.7-63.3	35-47
Hitchplate Attaching Bolts and Nuts	46.7-63.3	35-47
Arm to Rear Bumper Inner Nut	98-113	72-98
Hitchplate Attaching Nuts and Bolts	46.7-63.3	35-47
Center Plate Attaching Screws	17-23	13-17

Hitchplate, Rear, Flareside**Removal and Installation**

CAUTION: Support the hitchplate before removing the bolts and nuts.

1. Remove hitchplate six attaching bolts and nut to rear bumper assembly.
2. Remove hitchplate.

For installation, follow removal procedures in reverse order. Tighten attaching nuts and bolts to 46.7-63.3 N-m (35-47 ft-lb).

Center Plate, Rear, Flareside**Removal and Installation**

1. Remove four center plate attaching screws.
2. Remove center plate.

For installation, follow removal procedures in reverse order. Tighten attaching screws to 17-23 N-m (13-17 ft-lb).

Bumper Bar, Rear, Flareside**Removal and Installation**

1. Remove rear bumper bar from frame as described in this section.

SECTION 01-20A Seat/Shoulder Belts

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DIAGNOSIS AND TESTING (Cont'd.)	
Child Seat Locking Clip.....	01-20A-24	Diagnosis Guides	01-20A-3
Safety Belt	01-20A-25	Retractor Does Not Lock, Crew Cab.....	01-20A-5
Seat Belt Extension Assembly	01-20A-25	Webbing Cannot Be Pulled from Retractor	01-20A-5
Slow Or Lazy Retraction At D-Ring, F-Series, F-Super Duty and Bronco	01-20A-30	REMOVAL AND INSTALLATION	
CLEANING AND INSPECTION		Child Safety Seat Tether Anchor Kit Installation.....	01-20A-17
Cleaning Belt Webbing	01-20A-30	Detachable Rear Shoulder Belt, E-150-250-350	01-20A-10
Inspection Procedure After An Accident	01-20A-30	Seat and Shoulder Harness Belt Bolt with Damaged Anchor Plate Threads	01-20A-24
DESCRIPTION AND OPERATION		Seat Belt Bolt Without Damaged Anchor Plate Threads	01-20A-23
Center Lap Belts.....	01-20A-2	Seat Belts, E-150-250-350 Front and Rear Seats, F-350 Crew Cab Rear Seat	01-20A-9
Continuous-Loop System, Front Outboard and Forward Facing Seats, SuperCab and Bronco.....	01-20A-2	Seat Belts, Front and Rear Outboard Position	01-20A-6
Occupant Restraint System	01-20A-2	Seat Belts, Front Seats, F-Series and Bronco.....	01-20A-5
Seat Belt Extension Assembly	01-20A-2	Seat Belts, Rear Seat and Front Center Position	01-20A-6
Seat Belt Maintenance.....	01-20A-2	SPECIAL SERVICE TOOLS	01-20A-31
Seat Belt Warning System.....	01-20A-2	SPECIFICATIONS	01-20A-30
Seat Belts and Shoulder Belts	01-20A-1	VEHICLE APPLICATION	01-20A-1
Unfastening Seat Belts	01-20A-2		
DIAGNOSIS AND TESTING			
Continuous-Loop Shoulder/Lap Belt Test, System with Movable Tongue and One Retractor	01-20A-4		
Damaged Anchor Plate Threads Functional Test	01-20A-4		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350 and Bronco Vehicles

DESCRIPTION AND OPERATION

Seat Belts and Shoulder Belts

The seat belts and shoulder belts are factory-installed in their proper locations. If the seat belts or shoulder belts are removed for any reason, they should be installed as shown in this section. Sealer should be placed around all seat belt anchor bolt holes in the floorpan. Tighten the anchor bolts to 35 ± 5.3 N·m (26 ft-lb \pm 47 in-lb).

When replacing safety belt buckles and/or retractor assemblies, use only the replacement parts specified in the Ford Parts and Service Division Master Parts and Accessories Catalog for the vehicles serviced.

WARNING: ALL SAFETY BELT ASSEMBLIES INCLUDING RETRACTORS AND ATTACHING HARDWARE SHOULD BE INSPECTED AFTER ANY COLLISION. FORD RECOMMENDS THAT ALL SAFETY BELT ASSEMBLIES IN USE DURING A COLLISION BE REPLACED UNLESS THE COLLISION WAS MINOR AND A QUALIFIED TECHNICIAN FINDS THAT THE BELTS SHOW NO DAMAGE AND CONTINUE TO OPERATE PROPERLY. SAFETY BELT ASSEMBLIES NOT IN USE DURING A COLLISION SHOULD ALSO BE INSPECTED AND REPLACED IF EITHER DAMAGE OR IMPROPER OPERATION IS NOTED.

DESCRIPTION AND OPERATION (Continued)**Seat Belt Extension Assembly**

A seat belt assembly that is too short, even when fully extended over the lap of a vehicle occupant, can be lengthened approximately 203mm (8 inches) with a seat belt extension assembly which can be obtained through local Ford Dealers. The seat belt extension assembly is only available with black webbing and standard buckle and must be of the same manufacture as the belt system to which it is attached.

Occupant Restraint System

The continuous-loop system can be identified by the movable tongue on the front outboard lap / shoulder belt and only one retractor. (This is a combination lap / shoulder belt retractor.)

Seat Belt Warning System

Continuous-loop system units incorporate a buzzer and lamp warning system. The seat belt warning lamp will illuminate for approximately eight seconds after the ignition switch is turned to the RUN position, regardless of seat belt usage. The seat belt warning buzzer is grounded by a switch in the left inboard buckle, on the continuous loop systems. The seat belt warning buzzer will sound for approximately eight seconds unless the driver's belt is used.

Continuous-Loop System, Front Outboard and Forward Facing Seats, SuperCab and Bronco

The occupant restraint system for front and rear outboard passengers is a continuous-loop system. The outboard combination lap and shoulder belt uses a common sliding tongue. On F-Series SuperCab, Crew Cab, Bronco and Econoline vehicles, the 2nd, 3rd, 4th and 5th row outboard seating positions also have continuous-loop three point restraint systems.

On F-150-250-350 and Bronco, the webbing for the lap belt is anchored near the inboard side of the sill **without a retractor**.

On F-Series SuperCab, Crew Cab and Bronco rear seats, adjust lap belt snugly across the hips, **NEVER ACROSS THE WAIST**, allowing the slack to return to retractor.

The shoulder harness retractor is designed to let the webbing freely move in or out at all times, except during vehicle hard braking, hard cornering or impact of 8 km / h (5 mph) or more, when it is automatically locked by a mechanically actuated inertia sensor.

On bench seat installations, the inboard belt with the buckle passes through the seat before being anchored to the floor, except for Econoline bench seats where all inboard buckles are attached to the seat. On Econoline bucket seats and captain's chairs, the inboard buckles are attached to the floor. Attaching the tongue and buckle secures the occupant with both lower and upper restraints. This tongue and buckle attachment can be accomplished by a single continuous movement.

After entering the vehicle, adjust the front seat to obtain the best position for driving comfort and visibility. Then, use the following procedure for adjusting belts for front seat occupants and Econoline rear outboard seating positions.

To fasten the belt, pull the lap / shoulder belt from the retractor so that the shoulder portion of the belt crosses your shoulder and chest. Insert the belt tongue into the proper buckle until you hear a snap and feel it latch.

WARNING: USE THE SHOULDER BELT ONLY ON THE SHOULDER THAT IS CLOSEST TO THE VEHICLE DOOR. NEVER SWING IT AROUND YOUR NECK OVER THE INSIDE SHOULDER. IF YOU DO NOT USE THE SHOULDER BELT PROPERLY, THE CHANCES OF YOUR BEING INJURED IN A COLLISION GREATLY INCREASE.

To tighten the lap portion of the belt, pull up on the shoulder belt until it fits you snugly. The belt should rest as low on your hips as possible. The belt must always be worn snug against the body. After unbuckling the belt, it is recommended that you guide the tongue during retraction to prevent it from striking you or the vehicle.

Center Lap Belts

The center seat belts do not have retractors. To lengthen the belt, tip the tongue at a right angle to the belt, and pull the tongue until the ends can be joined over the lap.

To fasten the belt, insert the tongue into the open end of the buckle until a snap is heard. To shorten the belt, pull on the loose end of the webbing. **The lap belt should be snug across the hips, NEVER ACROSS THE WAIST.**

Unfastening Seat Belts

Push the release button in the buckle and allow the front and rear outboard belts to retract to the fully stowed position.

Seat Belt Maintenance

Seat belt assemblies are maintenance-free; however, they should be periodically inspected to make sure that they have not become damaged and that they remain in proper operating condition.

DIAGNOSIS AND TESTING

Diagnosis Guides

The following Diagnosis Guides provide information to isolate malfunctions in the seat belt warning system used on three-point and continuous-loop seat belt systems.

SEAT BELT WARNING SYSTEM — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	DURING SYSTEM CHECK, SEAT BELT BUZZER DOES NOT OPERATE (SEAT BELT LAMP OPERATING PROPERLY)		
A2	CHECK CIRCUIT	Circuit not OK	TRACE circuit to driver's buckle switch and REPAIR as necessary. CHECK for shorted or trapped wires.
	<ul style="list-style-type: none"> Remove connector from thermal timer buzzer. Using a continuity lamp to verify vehicle ground with driver's tongue and buckle disengaged. 		

TCK5316E

SAFETY BELT WARNING SYSTEM — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	DURING SYSTEM CHECK, SAFETY BELT LAMP DOES NOT GO OUT SHORTLY AFTER ENGINE IS STARTED (BUZZER OR CHIME OPERATES PROPERLY)		
B2	CHECK CIRCUIT	Yes No	GO to B3. TRACE circuit from the thermal timer buzzer or chime connector to the bulb. REPAIR as necessary.
	<ul style="list-style-type: none"> Remove connector from thermal timer buzzer or chime. Lamp should go out. Does lamp go out? 		
B3	REPLACE THERMAL TIMER BUZZER OR CHIME	Yes No	System functional. RECHECK proper circuit input to thermal timer buzzer or chime. Inputs are ignition, ground, lamp and driver's buckle switch. Check and repair any crossed wires.
	<ul style="list-style-type: none"> Replace thermal timer buzzer or chime with known good part. Lamp and buzzer or chime should operate properly. Do lamp and buzzer or chime operate properly? 		

TCR3842C

SEAT BELT WARNING SYSTEM — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	DURING SYSTEM CHECK, SEAT BELT AND/OR BUZZER/CHIME DO NOT OPERATE		
C2	CHECK FUSE	No Yes	REPLACE fuse. If fuse blows again CHECK for short circuit. GO to C3.
	<ul style="list-style-type: none"> Check warning lamp fuse. Is fuse good? 		

DIAGNOSIS AND TESTING (Continued)

SEAT BELT WARNING SYSTEM — TEST C (Continued)			
TEST STEP		RESULT	ACTION TO TAKE
C3	CHECK IGNITION FEED CIRCUIT AND SEAT BELT LAMP CIRCUIT		
	<ul style="list-style-type: none"> Locate and remove connector for thermal timing buzzer / chime. Turn ignition key to RUN position. Using a jumper wire, jump between ignition feed terminal Circuit 640 red / yellow hash on F-150-250-350 and Bronco, Circuit 584 green / blue stripe on E-150-250-350 and seat belt lamp Circuit 450 dark green / light green stripe F-150-250-350 and Bronco, Circuit 670 pink on E-150-250-350, seat belt lamp should light. Did seat belt lamp come on? 	<p>Yes</p> <p>No</p>	<p>REPLACE thermal timer buzzer with known good unit. If lamp and buzzer operate properly, system is functional.</p> <p>GO to C4.</p>
C4	CHECK BULB		
	<ul style="list-style-type: none"> Remove bulb and check continuity of bulb. Is bulb OK? 	<p>No</p> <p>Yes</p>	<p>REPLACE bulb.</p> <p>GO to C5.</p>
C5	CHECK CONTINUITY OF BULB WIRE		
	<ul style="list-style-type: none"> Check continuity of wire from thermal timer to bulb. Is wiring OK? 	<p>Yes</p> <p>No</p>	<p>GO to C6.</p> <p>REPAIR open circuit in wire between timer and bulb.</p>
C6	CHECK GROUND		
	<ul style="list-style-type: none"> Check for vehicle ground at bulb. Is vehicle ground at bulb OK? 	<p>Yes</p> <p>No</p>	<p>REPLACE thermal timer buzzer / chime with known good unit. RECHECK system.</p> <p>REPAIR vehicle at bulb. TRACE circuit back to junction and REPAIR.</p>

TCK5318D

Damaged Anchor Plate Threads Functional Test

Determine the type(s) of seat belt assembly(ies) that have been replaced. Then, functionally test the new seat belt assembly using the appropriate procedure.

WARNING: IF THE RETRACTOR OF A NEW SEAT BELT ASSEMBLY HAS BEEN BOLTED INTO A DAMAGED OR DISTORTED MOUNTING AREA, THE NEW RETRACTOR COULD BE WARPED AND MAY NOT FUNCTION. IF THIS IS THE CASE, REWORK THE SHEET METAL BACK TO ITS ORIGINAL SHAPE AND STRUCTURAL INTEGRITY, AND INSTALL ANOTHER NEW COMPLETE SEAT BELT ASSEMBLY.

Continuous-Loop Shoulder/Lap Belt Test, System with Movable Tongue and One Retractor

1. Driver will buckle up and proceed to a safe test area. If one of the passenger seat belts must be tested, a passenger should be buckled into the appropriate seat. The front passenger belt may be tested using a driver only, providing the driver has the ability to grasp the right shoulder belt and extend it approximately 660.4mm (26 inches) with no compromise to safe driving. This method applies to the 8.05 km/h (5 mph) test only.

NOTE: The right shoulder belt is not extended fully to preclude the possibility of a false feeling (full extension vs. lock-up).

2. After reaching a safe area to perform sudden stops, the driver will attain a speed of approximately 8 km/h (5 mph). The driver should inform the passenger, if applicable, that he is preparing to make a severe brake application. At this time, both driver and rider should grasp their respective shoulder harnesses and prepare to lean slightly forward at the moment the brake application is made.

DIAGNOSIS AND TESTING (Continued)

3. The driver will make a maximum brake application of approximately 9.7m/sec (32 ft/sec) without tire skid. The maximum brake application should be on dry concrete or equivalent hard road surface, never on a wet or gravel road. The driver and passenger should lean forward slightly into the shoulder harness. At this instant, the belts should lock up without webbing payout.

WARNING: THE DRIVER AND PASSENGER SHOULD BE PREPARED TO BRACE THEMSELVES IN THE EVENT THE SEAT BELT RETRACTOR DOES NOT LOCK.

4. If there is a lock-up of both shoulder straps, the seat belt assemblies are functioning properly. Should either or both retractors fail to lock up at the 8.05 km/h (5 mph) speed, the test should be repeated at a constant 24.14 km/h (15 mph). This test must be performed with a right side passenger if the right side belt is to be tested.
5. If any shoulder belts do not lock up at the 24.14 km/h (15 mph) test, the vehicle is to be returned for repair of the malfunctioning seat belts. Remove the retractor and rework the sheet metal in the retractor's mounting surface back to its original shape and structural integrity. Install the retractor assembly and test the seat belt assembly(ies) as previously stated.

WARNING: IF THE RETRACTOR OF A NEW SEAT BELT ASSEMBLY HAS BEEN BOLTED INTO A DAMAGED OR DISTORTED MOUNTING AREA, THE NEW RETRACTOR COULD BE WARPED AND MAY NOT FUNCTION. IF THIS IS THE CASE, REWORK THE SHEET METAL BACK TO ITS ORIGINAL SHAPE AND STRUCTURAL INTEGRITY AND INSTALL ANOTHER NEW COMPLETE SEAT BELT ASSEMBLY.

Webbing Cannot Be Pulled from Retractor

1. From the fully stowed position, attempt to pull webbing out of the lap belt retractor.

2. If OK, withdraw lap belt webbing and buckle up while sitting in seat. Repeat five times to obtain proper operation. If not OK, replace the seat belt assembly.

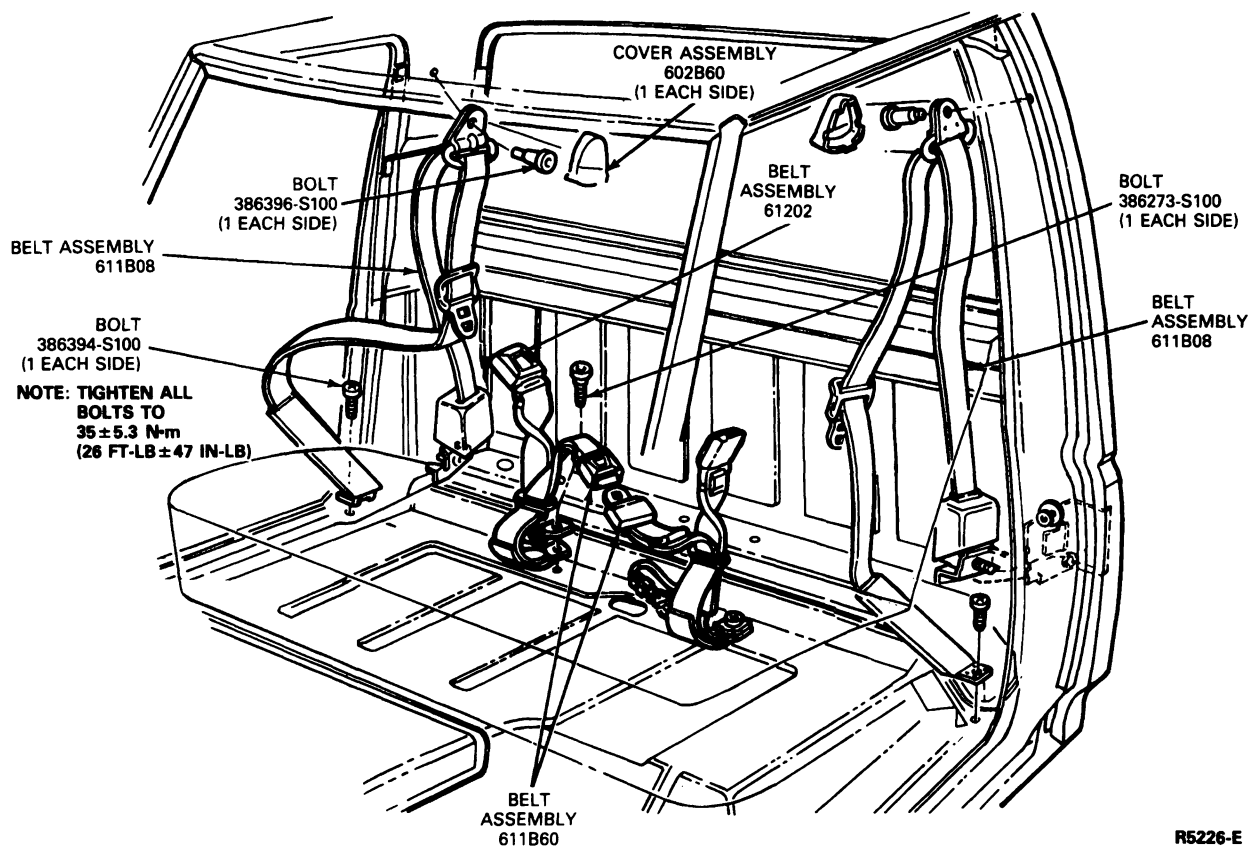
Retractor Does Not Lock, Crew Cab

1. Withdraw a minimum of 458mm (18 inches) of webbing from lap belt retractor. Allow 50.8mm (2 inches) of webbing to retract, and pull out again to check for lock-up. Retractor must lock up after 458mm (18 inches) of webbing has been withdrawn.
2. If not OK, replace the seat belt assembly. If OK, withdraw lap belt webbing and buckle up while sitting in seat. Repeat five times to obtain proper operation. If not OK, replace the seat belt assembly.

REMOVAL AND INSTALLATION**Seat Belts, Front Seats, F-Series and Bronco****Removal and Installation**

1. Remove shoulder belt retractor trim cover.
2. Remove shoulder belt retractor anchor bolt, floor anchor bolt and D-ring cover and attachment. Remove buckle, if replacing.
NOTE: Disconnect driver's electrical switch before removing anchor bolt.
3. Remove affected seat belt assembly.

For installation, follow removal procedures, in reverse order. Check sealer around anchor bolt holes. Add Ford Caulking Cord D6AZ-19560-A (ESB-M4G32-A) or equivalent, if necessary.

REMOVAL AND INSTALLATION (Continued)**Front Seat Belt Installation, F-150-250-350 Regular Cab Shown, F-350 Crew Cab Similar**

R5226-E

Seat Belts, Front and Rear Outboard Position Removal

1. Remove cover from D-ring attachment.
 2. Remove rear seat trim panel from over shoulder belt retractor. Refer to Section 01-05A or 01-05B.
 3. Remove shoulder belt retractor anchor bolt, D-ring attaching bolt and lap belt bolt using Seat Belt Bit 77L-2100-A.
 4. Remove damaged and/or distorted seat belt assembly.
 5. If removing front seat buckle, lift cover and remove seat belt anchor bolt.
- NOTE:** Disconnect electrical switch on driver's buckle before removing anchor bolt.

Installation

1. Follow the removal procedures in reverse order.
2. Tighten anchor bolts to 35 ± 5.3 N·m (26 ft-lb \pm 47 in-lb).
3. Check sealer around floor anchor bolt holes and add Ford Caulking Cord D6AZ-19560-A (ESB-M4G32-A), if necessary.

4. Check seat belts for proper operation.

Seat Belts, Rear Seat and Front Center Position Removal

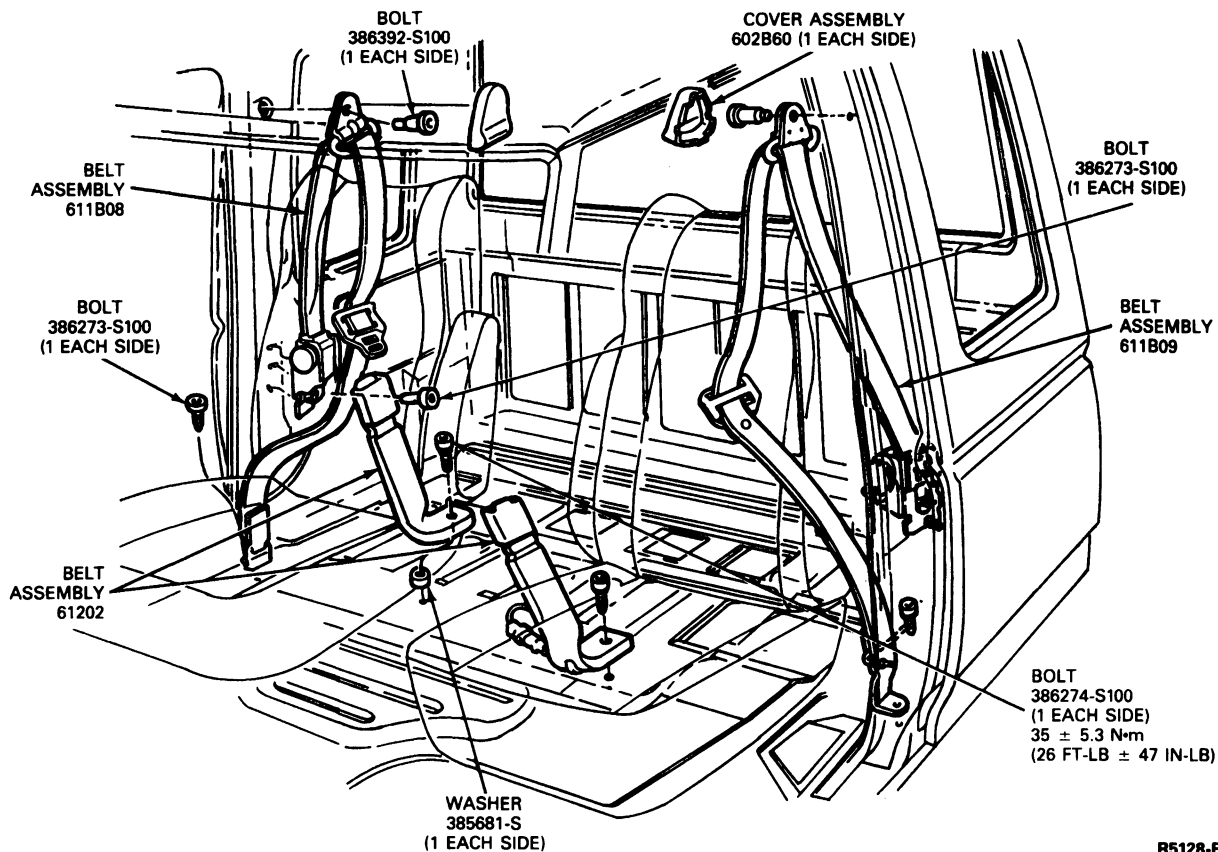
1. Using Seat Belt Bit T77L-2100-A, remove anchor bolts from rear floor.
2. Remove damaged or distorted seat belt assembly.

Installation

1. Follow the removal procedures in reverse order.
2. Check sealer around floor anchor holes and add Ford Caulking Cord D6AZ-19560-A (ESB-M4G32-A), if necessary.
3. Tighten anchor bolts to 35 ± 5.3 N·m (26 ft-lb \pm 47 in-lb).
4. Check seat belt for proper operation.

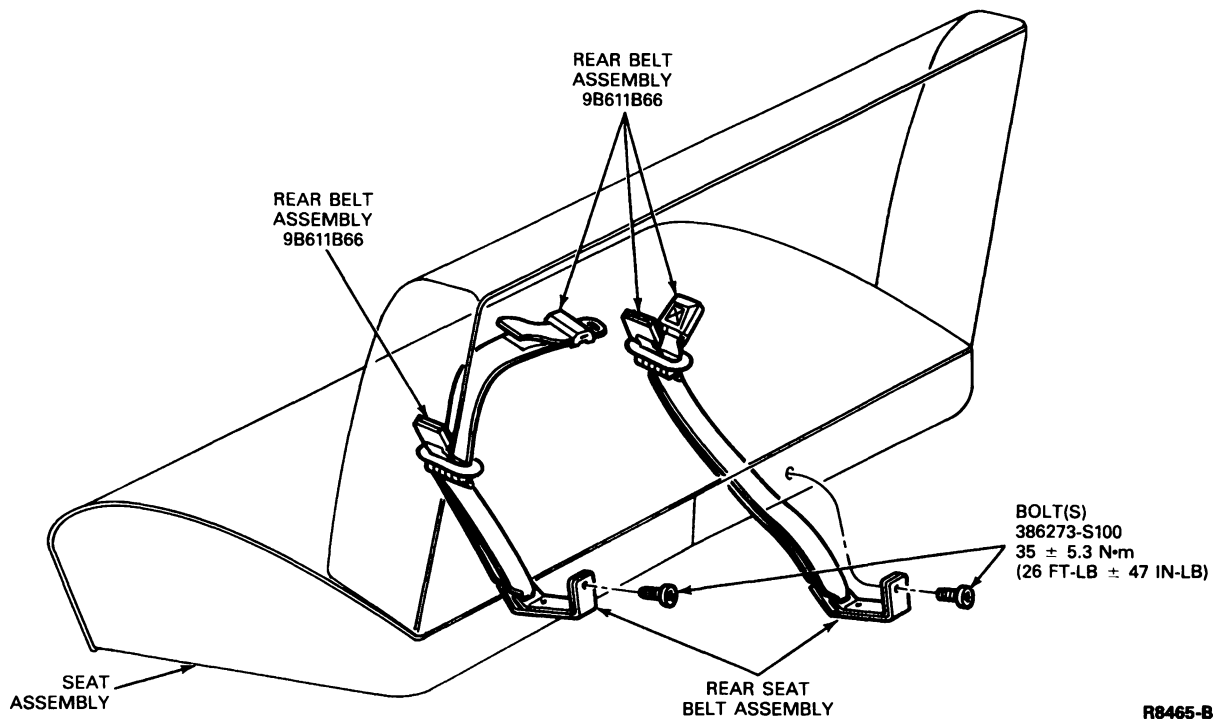
REMOVAL AND INSTALLATION (Continued)

Front Seat Belt Installation, SuperCab With Bucket/ Captain's Chairs Shown, F-Series and Bronco Similar



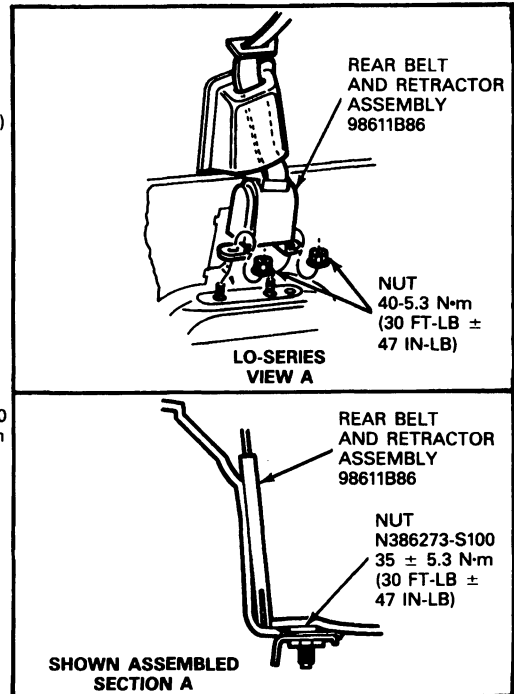
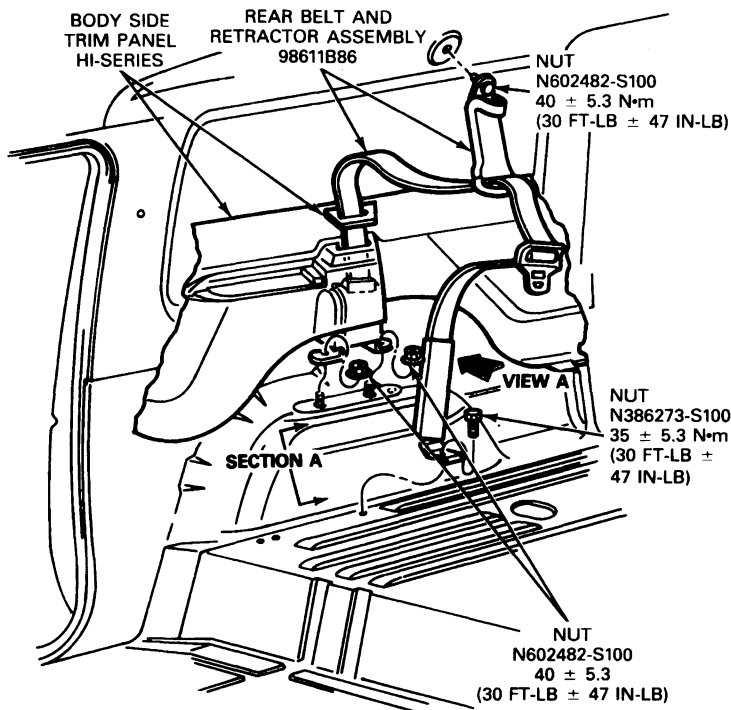
REMOVAL AND INSTALLATION (Continued)

Seat Belt Assemblies, Rear Center Seat

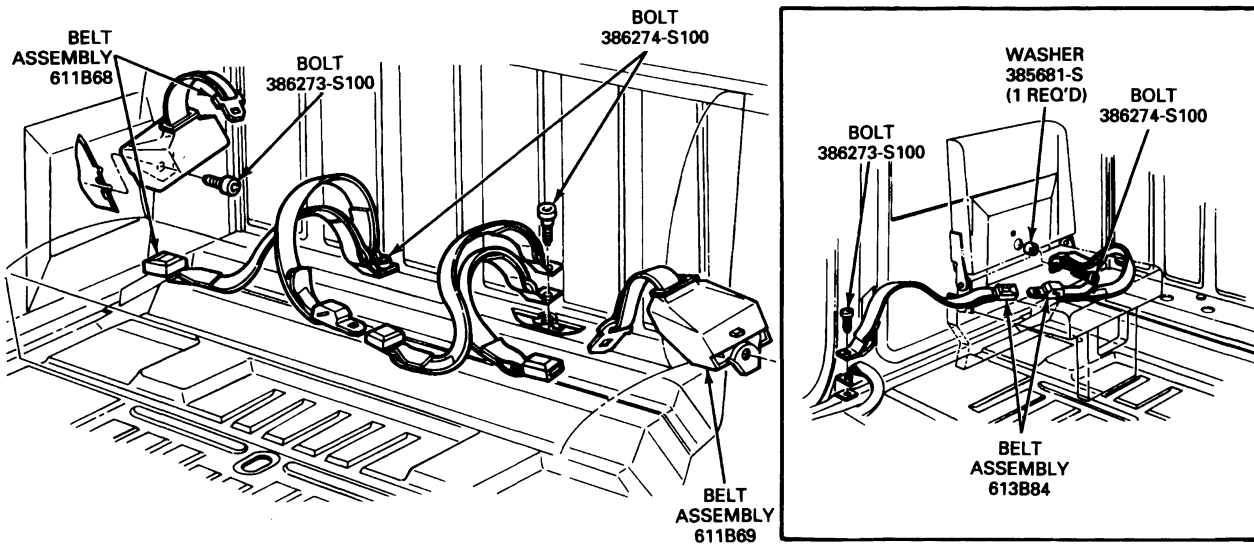


R8465-B

Seat Belt Assemblies, Rear Outboard Seats



R8467-B

REMOVAL AND INSTALLATION (Continued)**Rear Seat Belt, F-Series SuperCab With Jumper Seat**

R3802-F

Seat Belts, E-150-250-350 Front and Rear Seats, F-350 Crew Cab Rear Seat**Removal and Installation**

1. Open the D-ring covers (if so equipped) and remove the bolt.
2. Disengage the detachable anchor tongue end from the detachable anchor (if so equipped) on the side of the seat by inserting a key into the slot in the anchor and lift the key upward.
3. Remove the bolt from the floor anchor end of the belt assembly.
4. Remove the affected trim panel(s).
5. Remove the belt loop (if so equipped) by carefully prying the loop away from the sheet metal.

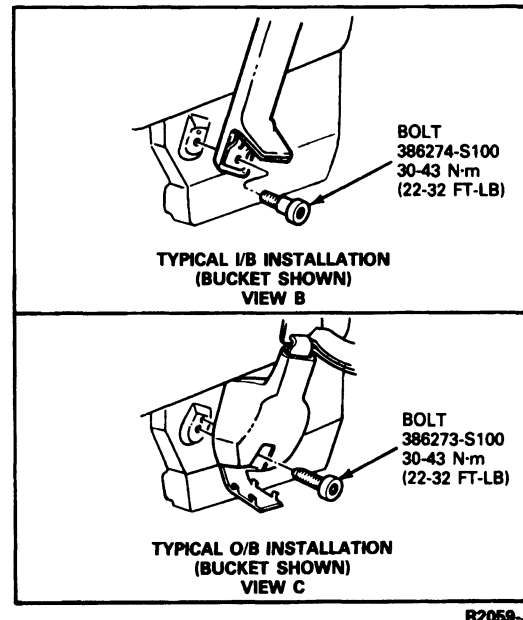
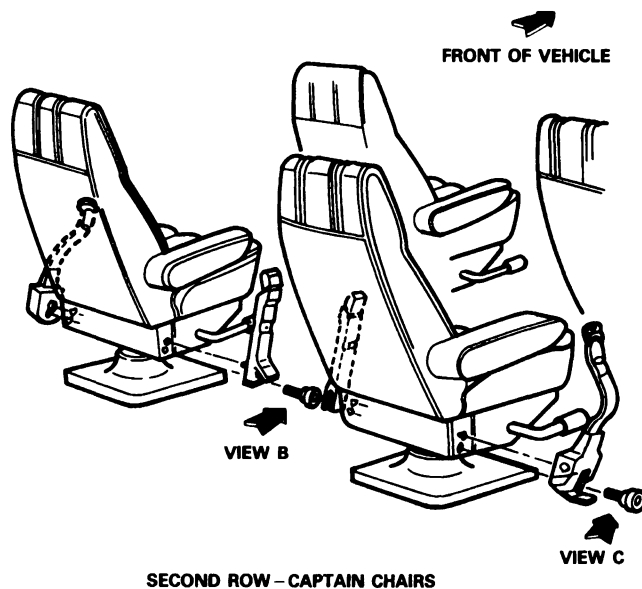
6. Remove the bolt securing the retractor to the vehicle.
7. Remove the belt assembly from the vehicle.
8. If the belt loop is damaged, the belt loop can be removed from the belt assembly by carefully cutting through the slot located on the back side of the belt loop.

NOTE: To prevent damage to the safety belt webbing when cutting through the slot in the belt loop, place a smooth, flat, hard object such as a metal ruler between the webbing and the back side of the belt loop.

For installation, follow the removal procedures in reverse order. Tighten all anchor bolts to 35 ± 5.3 N·m (26 ft-lb \pm 47 in-lb).

REMOVAL AND INSTALLATION (Continued)

Rear Seat, Captain's Chairs, E-150-250-350



Detachable Rear Shoulder Belt, E-150-250-350

All rear outboard seating positions in Econoline vehicles have rear seat shoulder safety belts.

In addition to anchorages in the floor and roof structures, some of the new safety belts have a detachable anchor mounted to the outboard side of the rear seats. However, only the second row passenger side outboard seating position of a unit equipped with a three-passenger bench seat or captain's chair in the second row (aisle side) utilizes a hook above the sliding / cargo door to stow the shoulder safety belt when it is not being used.

NOTE: The following bilingual (English / French) WARNING statement is shown on the WARNING label attached to the lower portion of the safety belt.

WARNING: THIS SEAT BELT GIVES NO PROTECTION UNLESS THIS END IS BUCKLED TO SIDE OF SEAT.

NOTE: The following bilingual CAUTION statement is shown on the CAUTION label attached to the upper portion of the safety belt.

CAUTION: DO NOT USE SEAT BELT FOR SUPPORT WHEN IT IS ATTACHED TO STOWAGE HOOK. THE HOOK MAY BREAK AND YOU MAY FALL.

Removal

NOTE: Safety belt must be detached when removing rear seat. Refer to Section 01-10B for rear seat removal.

1. Disengage belt from seat by inserting key or small screwdriver into slot located in detachable anchor.
2. Lift screwdriver up and disengage belt.
3. Attach tongue end of detachable anchor onto stowage hook.

Installation

1. Install rear seat. Refer to Section 01-10B.
2. Insert detachable anchor tongue into detachable anchor until you hear a snap and feel latch is engaged.

NOTE: Seat belt should not be twisted. If seat belt is twisted, disengage tongue end and straighten twist. Re-insert tongue.

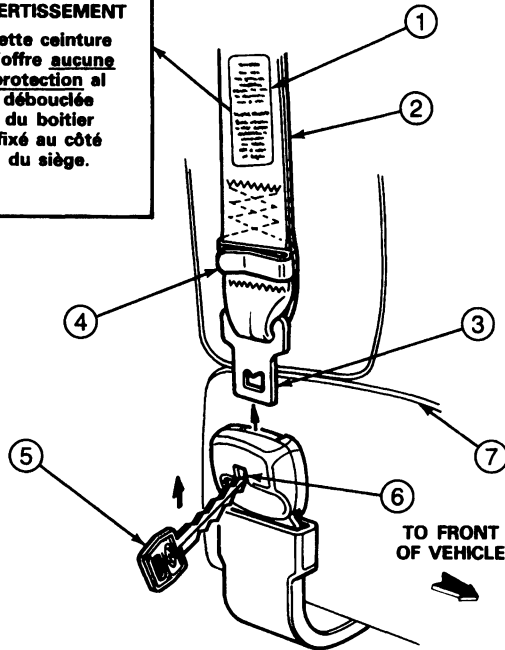
REMOVAL AND INSTALLATION (Continued)

REAR SEAT SHOULDER SAFETY BELTS,
USAGE AND STOWAGE, ECONOLINE**WARNING**

This seat belt gives no protection unless this end is buckled to side of seat.

AVERTISSEMENT

Cette ceinture n'offre aucune protection si le bout de la ceinture n'est fixé au côté du siège.



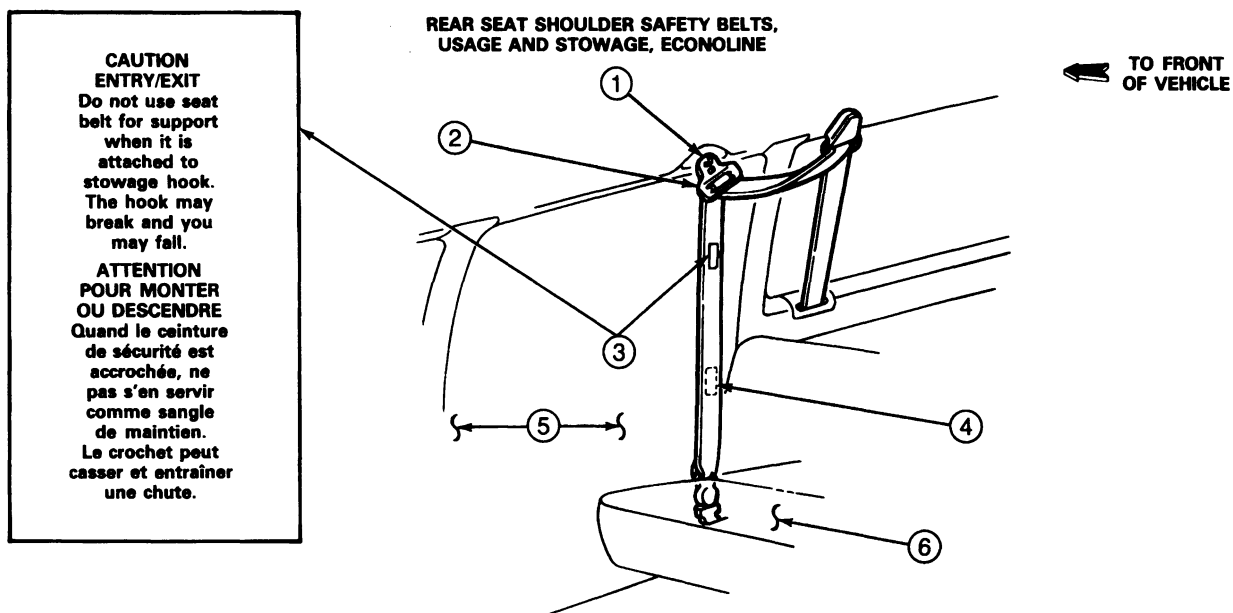
THE REAR SEAT SHOULDER SAFETY BELTS SHOULD REMAIN ENGAGED IN THEIR DETACHABLE ANCHORS, EXCEPT WHEN THE REAR SEATS REQUIRE REMOVAL.

R8471-A

Item	Description
1	Detachable Anchor Warning Label on Shoulder Belt
2	Shoulder Safety Belt, Detached Position
3	Tongue End of Detachable Anchor
4	Shoulder Safety Belt, Stowage Retainer
5	Key (May Substitute Small Screwdriver)
6	Key Slot in Detachable Anchor
7	Seat Assembly, Second Row Left & Third Row Right and Left Bed Seat Only

WARNING: WHEN INSTALLING A REAR SEAT IN THE VEHICLE, INSTALL THE REAR SEAT IN ITS ORIGINAL LOCATION. IMPROPER INSTALLATION OF THE SEAT WILL PREVENT CORRECT USE OF THE SHOULDER SAFETY BELT. IMPROPER USE OF THE SAFETY BELT COULD INCREASE THE RISK/OR SEVERITY OF INJURY AND ACCIDENTS.

REMOVAL AND INSTALLATION (Continued)



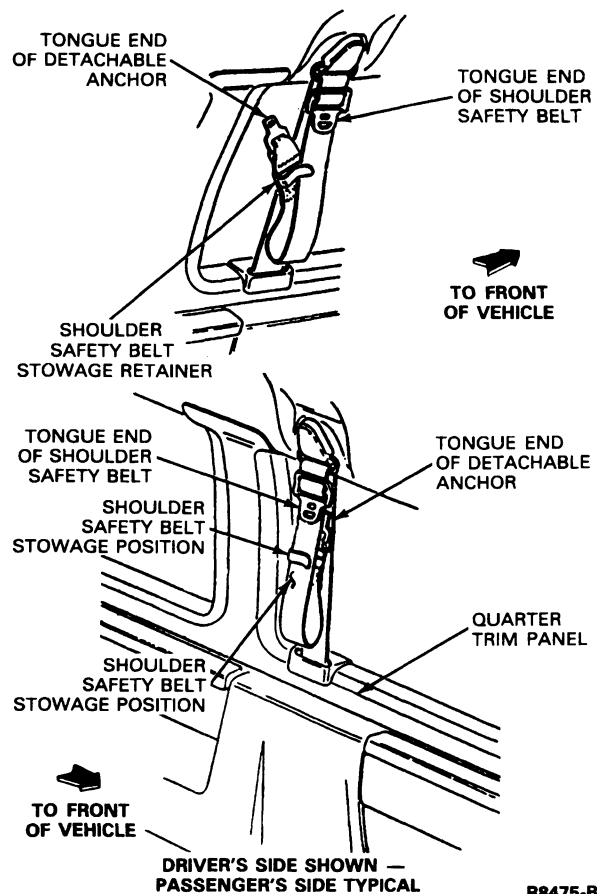
**NOTE: SECOND ROW THREE-PASSENGER BENCH
INSTALLATION SHOWN — SECOND ROW RIGHT
PASSENGER SIDE CAPTAIN'S CHAIR SEAT
INSTALLATION (NOT SHOWN) IS SIMILAR.**

R8469-A

Item	Description
1	Stowage Hook for Shoulder Safety Belt Tongue
2	Shoulder Safety Belt, Stowed Position
3	Caution Label on Both Sides of Belt At This Area

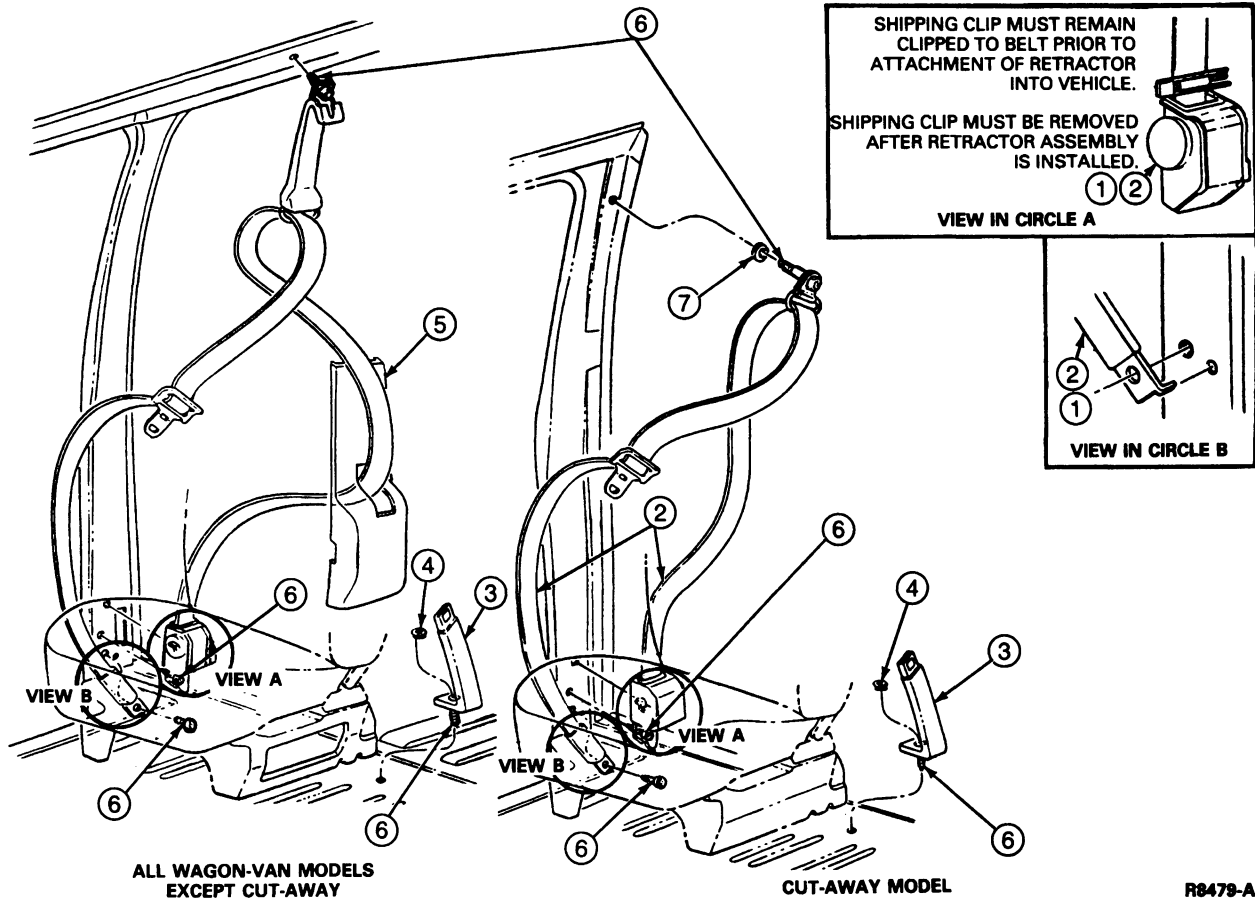
Item	Description
4	Child Safety Seat Locking Clip Label Location
5	Door Opening (Reference)
6	Second Row Right Outboard (Aisle Side) Seating Position

(Continued)

REMOVAL AND INSTALLATION (Continued)**Rear Seat Shoulder Safety Belts, Usage and Stowage, Econoline**

REMOVAL AND INSTALLATION (Continued)

Seat Belt Assemblies, Right Front Bucket/Captain's Chair, Typical View



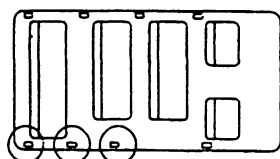
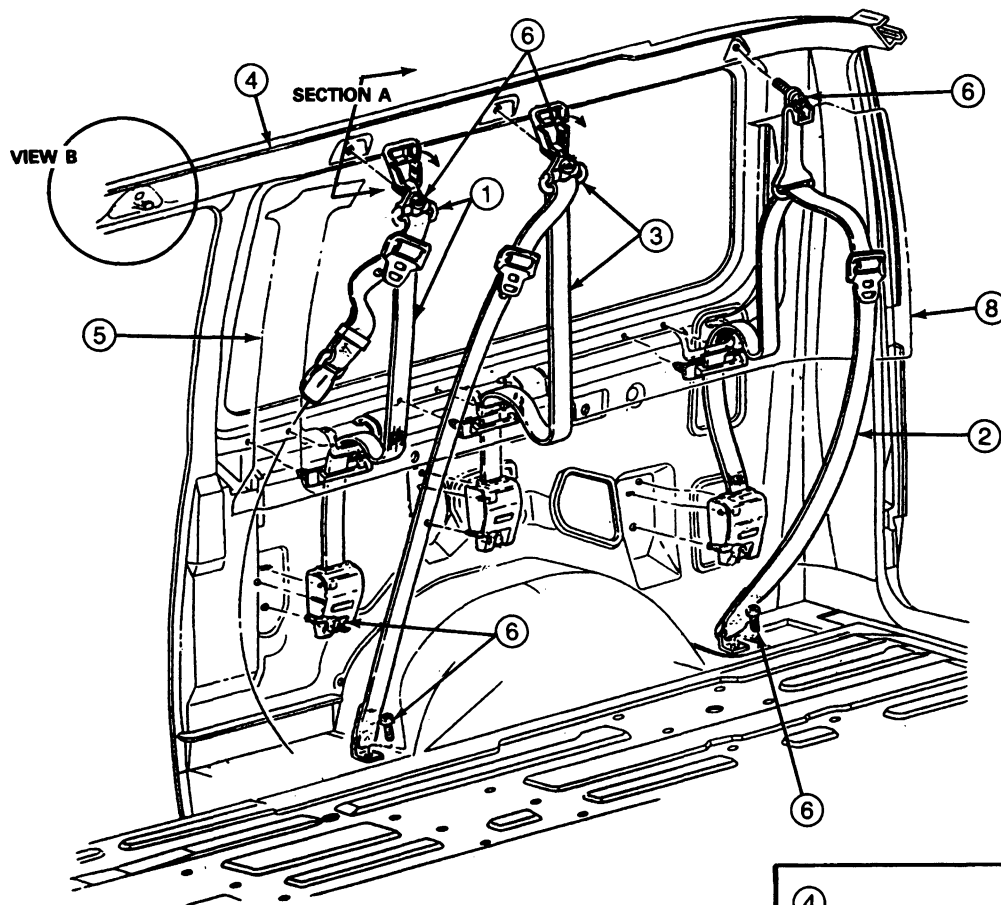
Item	Part Number	Description
1	15611B08	Belt and Retractor Assembly, Front Seat
2	37611B06	Belt and Retractor Assembly, Front Seat
3	1561202	Belt and Buckle Assembly, Right

(Continued)

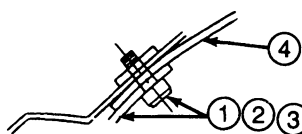
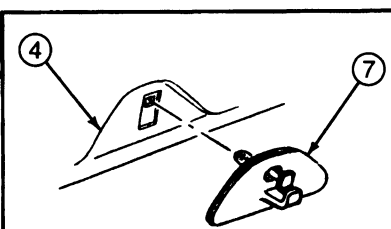
Item	Part Number	Description
4	54611B32	Plug, Front Seat Belt Boot
5	—	Panel Assembly, Body Lock
6	386273-S100	Pillar Inside Finish, Lower
7	N805266-S	Bolt 35 ± 5.3 N-m (26 Ft-Lb ± 47 In-Lb) Washer, Flat-Felt

REMOVAL AND INSTALLATION (Continued)

Rear Seat Restraints, 2nd, 3rd and 4th Row Bench Seats, Econoline



ASSEMBLY LOCATIONS

TYPICAL 3 PLACES
SECTION A

VIEW IN CIRCLE B

R8481-B

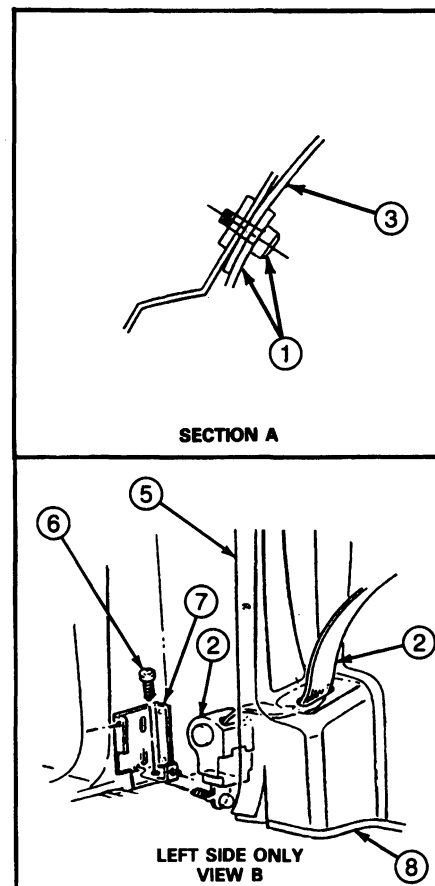
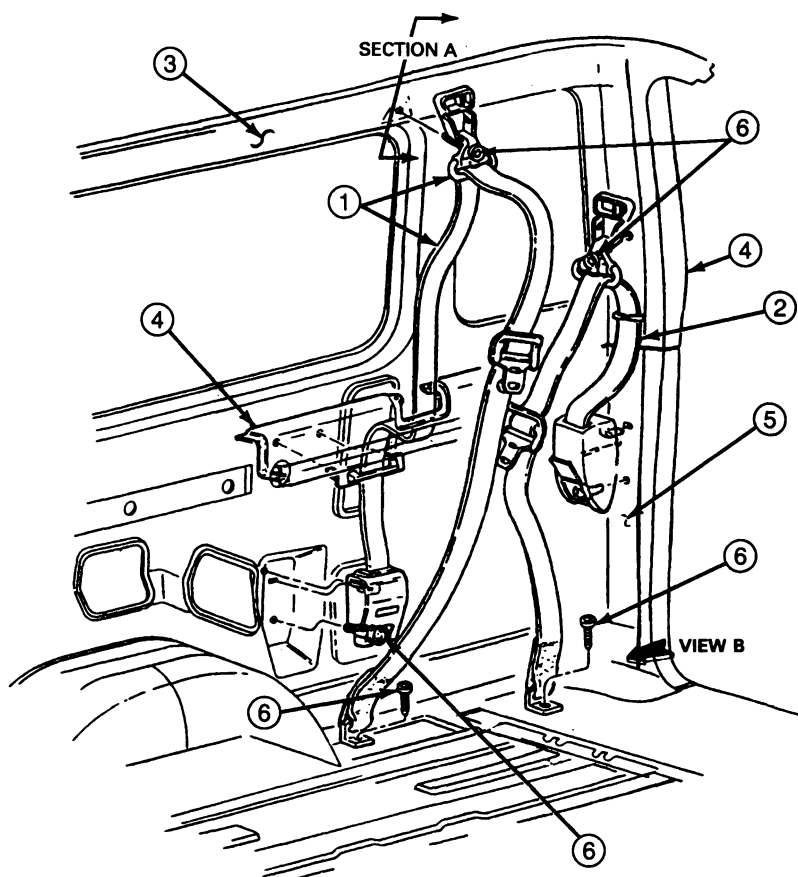
Item	Part Number	Description
1	16611B68	Belt and Retractor Assembly
2	16611B68	Belt and Retractor Assembly
3	16611B68	Belt and Retractor Assembly
4	—	Headlining Assembly (Reference)
5	—	Panel Assembly, Body Side Trim, Upper Front (Reference)

(Continued)

Item	Part Number	Description
6	386273-S100	Bolt 35 ± 5.3 N-m (26 Ft-Lb ± 47 In-Lb)
7	1613E00	Retainer, Rear Seat Belt Tongue
8	—	Panel Assembly, Body Side Trim, Upper Rear (Reference)

REMOVAL AND INSTALLATION (Continued)

Rear Seat Restraints, 4th and 5th Row Bench Seats, Econoline



R8485-B

Item	Part Number	Description
1	16611B68	Belt and Retractor Assembly
2	39611B68	Belt and Retractor Assembly
3	—	Headlining Assembly (Reference)
4	—	Panel Assembly, Quarter Trim (Reference)

(Continued)

Item	Part Number	Description
5	—	Panel Assembly, Body Side Trim, Upper Rear (Reference)
6	386273-S100	Bolt 35 ± 5.3 N·m (26 Ft-Lb \pm 47 In-Lb)
7	39601A84	Retractor, Floor Mount Bracket
8	—	Panel Assembly, Body Side Trim, Lower Rear

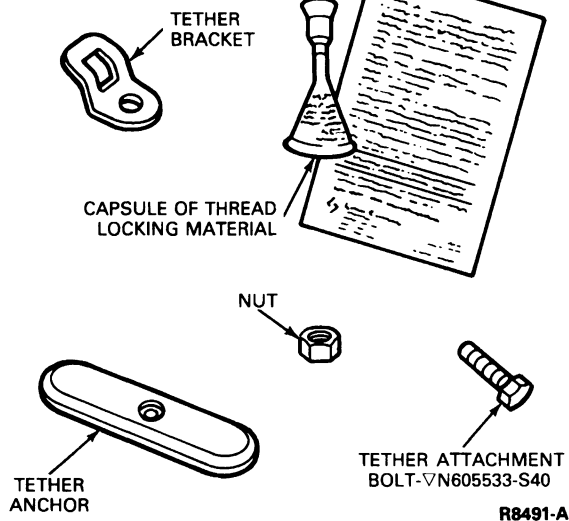
REMOVAL AND INSTALLATION (Continued)

Child Safety Seat Tether Anchor Kit Installation

General Instructions

Read these instructions carefully prior to installation of the child tether anchor kit.

PARTS CONTAINED IN CHILD TETHER ANCHOR KIT



Some manufacturers make safety seats with a tether strap that goes over the back of the vehicle seat and attaches to an anchoring point behind the vehicle seat.

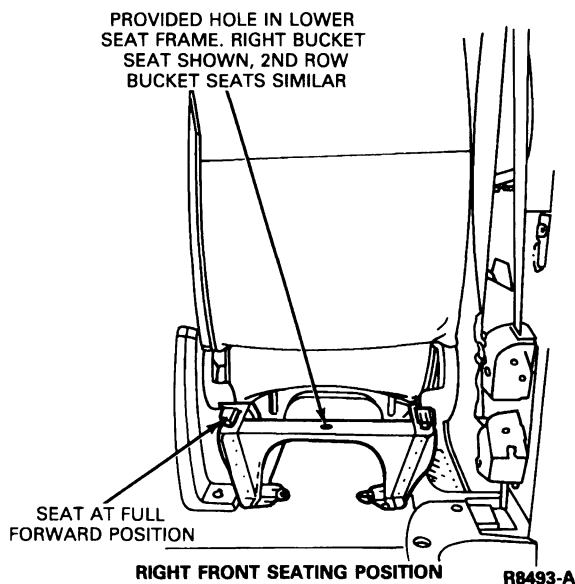
Ford recommends the placement of tethered safety seats in a rear seating position with the tether strap attached to the tether anchoring point as shown in the following illustration. The right front seating position may be used if it is the only seating position available.

WARNING: FAILURE TO FOLLOW THESE PRECAUTIONS COULD INCREASE THE CHANCE AND/OR SEVERITY OF INJURY IN AN ACCIDENT.

Locating and Installing Tether Strap Anchorage, Right Front and Second Row Bucket Seats, Econoline

1. Adjust the front seat full forward for easier access to the lower rear area of the seat.

2. Locate the hole provided in the lower seat frame behind the seat cushion.



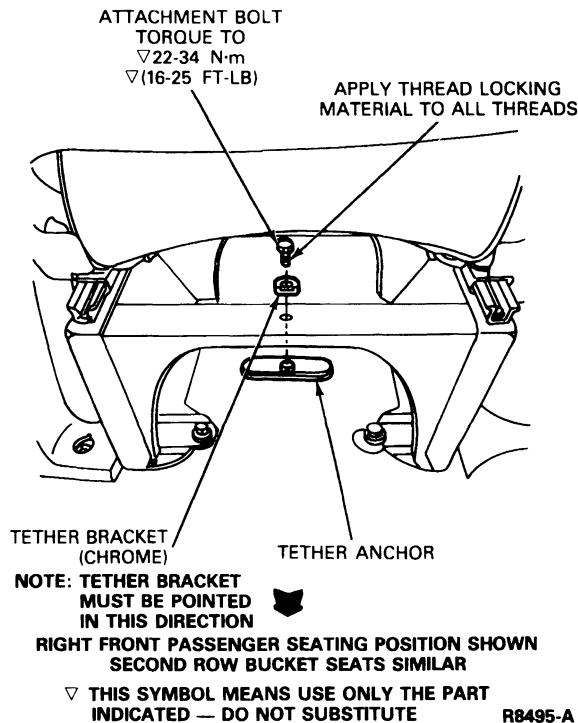
3. Before installing the tether hardware, read the instructions on the thread locking material package. Open the capsule and apply thread locking material to all threads on the tether attachment bolt.

WARNING: THE THREADED HOLE IN THE TETHER ANCHOR OR NUT HAS AN 8MM METRIC THREAD. AN 8MM METRIC WRENCH IS NEEDED TO TIGHTEN THE 8MM BOLT TO THE REQUIRED TORQUE. SOME CHILD RESTRAINTS COME WITH A NON-METRIC BOLT WITH A DIFFERENT THREAD. DO NOT USE A NON-METRIC BOLT AS IT MAY BE IMPOSSIBLE TO SCREW IT ALL THE WAY INTO THE HOLE, RESULTING IN INADEQUATE RETENTION OF THE CHILD RESTRAINT. USE ONLY THE METRIC ANCHOR BOLT SUPPLIED IN THIS KIT. IF YOU NEED A REPLACEMENT METRIC BOLT OR ASSISTANCE, ANY FORD DEALER WILL ASSIST YOU.

REMOVAL AND INSTALLATION (Continued)

4. Assemble the bolt, tether bracket and anchor to rear seat frame rail.

NOTE: The tether bracket must be pointing rearward and assembled as shown in the following illustration.



5. Tighten the retaining bolt to 22-34 N·m (16-25 ft-lb).
6. Follow the child seat manufacturer's instructions to attach the tether strap to the tether bracket.

**Locating and Installing Tether Strap Anchorage,
Second Row Three-Passenger Bench Seat**

1. Remove the second row three-passenger bench seat. Refer to Section 01-10B for removal procedures.
2. Place the seat assembly upside down on a clean, protected surface.
3. Choose the desired seating position for the child seat (left, center or right position).
4. Locate the corresponding tether attachment hole.

NOTE: The holes are located under the upholstery in the rear rail of the seat cushion frame. The J strip must be detached from the rear rail to release the upholstery and gain access to the three holes provided.

WARNING: USE ONLY THE TETHER ATTACHMENT HOLES LOCATIONS SHOWN. THE TETHER ANCHORAGE WILL NOT PERFORM PROPERLY IF THE WRONG MOUNTING LOCATION IS USED.

5. Before installing the tether hardware, read the instructions on the thread locking material package. Open the capsule and apply thread locking material to all tether attachment bolt threads.

WARNING: THE THREADED HOLE IN THE TETHER ANCHOR OR NUT HAS AN 8MM METRIC THREAD. AN 8MM METRIC WRENCH IS NEEDED TO TIGHTEN THE 8MM BOLT TO THE REQUIRED TORQUE. SOME CHILD RESTRAINTS COME WITH A NON-METRIC BOLT WITH A DIFFERENT THREAD. DO NOT USE A NON-METRIC BOLT AS IT MAY BE IMPOSSIBLE TO SCREW IT ALL THE WAY INTO THE HOLE, RESULTING IN INADEQUATE RETENTION OF THE CHILD RESTRAINT. USE ONLY THE METRIC ANCHOR BOLT SUPPLIED IN THIS KIT. IF YOU NEED A REPLACEMENT METRIC BOLT OR ASSISTANCE, ANY FORD DEALER WILL ASSIST YOU.

6. Assemble the bolt, tether bracket and anchor to the frame rail at the rear of the seat.

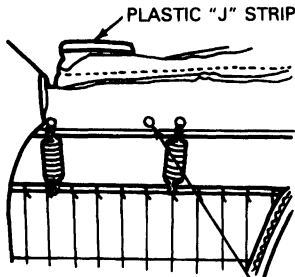
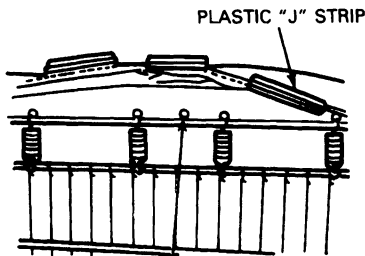
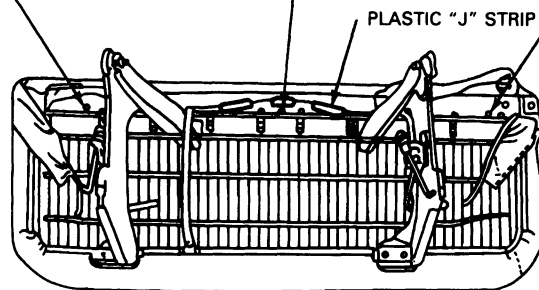
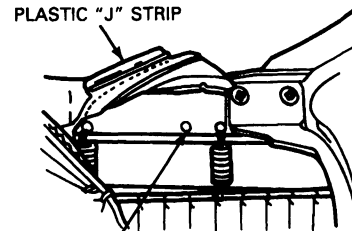
NOTE: The tether bracket must be pointing rearward.

7. Tighten the retaining bolt to 22-34 N·m (16-25 ft-lb).
8. Trim the plastic J strip where required and reattach to the rear rail.
9. Follow the child seat manufacturer's instructions to attach the tether strap to the tether bracket.

WARNING: THE TETHER BRACKET MUST BE BOLTED DIRECTLY TO THE SHEET METAL. THE INTERIOR TRIM MUST BE TRAPPED BETWEEN THE ANCHOR BRACKET AND THE SHEET METAL. FAILURE TO PROPERLY INSTALL THE ANCHOR BRACKET COULD RESULT IN IMPROPER PERFORMANCE IN THE EVENT OF AN ACCIDENT.

REMOVAL AND INSTALLATION (Continued)

Tether Strap Anchorage

SECOND ROW
THREE-PASSENGER BENCH SEAT
LEFT SIDESECOND ROW
THREE-PASSENGER BENCH SEAT
CENTERSECOND ROW
THREE-PASSENGER BENCH SEAT
RIGHT SIDESECOND ROW THREE-PASSENGER BENCH SEAT
TETHER ATTACHMENT LOCATIONS (PLASTIC "J" STRIP
DETACHED AT 3 LOCATIONS)

R8494-A

Ford recommends placement of tethered safety seats in a rear seating position with the tether strap attached to the tether anchoring point as shown in the following illustrations.

If a tethered seat is installed in the front seat, Ford recommends the center front seating position, with the tether strap secured to the center rear lap belt tongue or to the webbing of the buckled center rear lap belt behind the child safety seat. The right front seating position may be used if it is the only position available.

WARNING: FAILURE TO FOLLOW THESE PRECAUTIONS COULD INCREASE THE CHANCE AND/OR SEVERITY OF INJURY IN AN ACCIDENT.

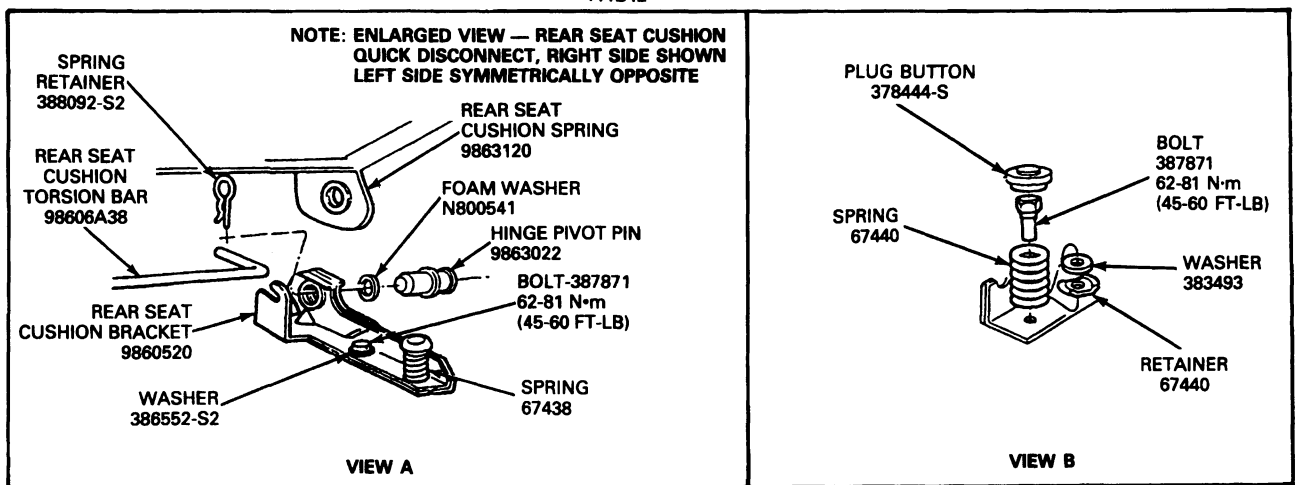
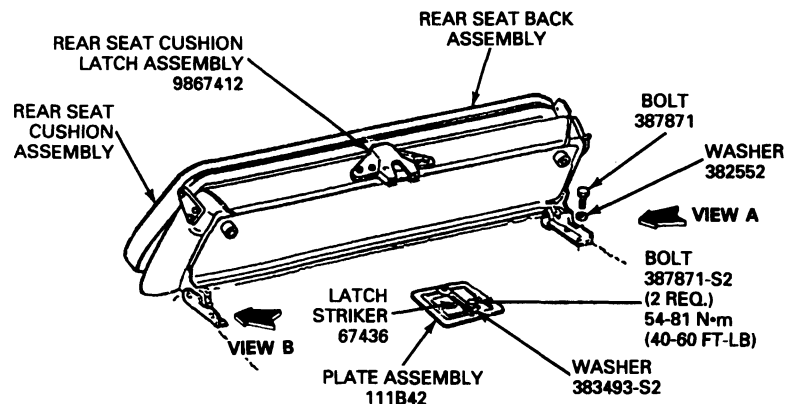
Locating and Installing Tether Strap Anchor, Right Front and Rear Outboard, Bronco

Broncos have provisions to attach a tether anchorage in the right front and all second row seating positions. It is easier to install a tether anchor at the second row, rear center seating position.

1. Remove the second row bench seat to gain access to the affected area beneath the carpet.
2. Remove the rear fold-down seat as follows:
 - a. Unlock the latch and fold the seat forward.
 - b. Remove the rear seat cushion torsion bar. Release it from the right floor bracket by pushing forward and up.
 - c. Remove the spring retainers and the hinge pivot pins from both the floor brackets.
 - d. Remove the seat assembly.
 - e. Remove the front bolts that fasten the bracket to the floor.
 - f. Remove the plug buttons from the spring. Remove the bolt from the spring. Remove the spring, washer and the retainer from the bracket.

REMOVAL AND INSTALLATION (Continued)

Second Row Bench Seat



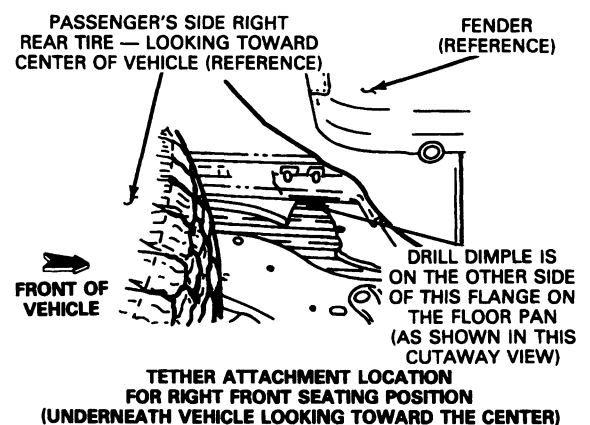
R8506-A

- Lift the flap of the floor carpeting and pull it back to expose the drill dimple provided for attachment of the tether strap bracket.

NOTE: When the carpeting is pulled back, you will see a colored 51mm x 51mm (2 inch x 2 inch) square box with a large block letter T inside. This marks the approximate area of the floor where the drill dimple is located.

- Locate the drill dimple approximately 14.3 cm (5-5/8 inches) toward the center of the vehicle from the right bracket bolt. A letter T is stamped next to the drill dimple to help find location.
- From inside the cargo area, drill a 9mm (0.354-inch) hole through the desired dimple(s).

CAUTION: Verify, prior to drilling the hole through the floor pan, that the drilling will not damage any underbody components.



R8507-A

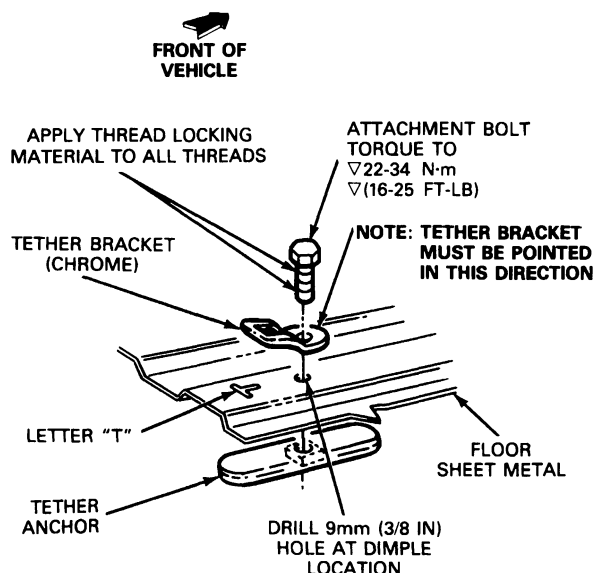
NOTE: An assistant will be needed underneath the vehicle to attach the tether anchor. Before installing the tether hardware, read the instructions on the thread locking material package. Open the capsule and apply thread locking material to all the threads on the tether attachment bolt.

REMOVAL AND INSTALLATION (Continued)

6. Install the child tether hardware as shown in the following illustrations. Tighten tether attaching bolts to 22-34 N·m (16-25 ft·lb).

NOTE: Do not install the **black** colored tether strap bracket at these locations.

WARNING: THE TETHER BRACKET MUST BE BOLTED DIRECTLY TO THE FLOOR SHEET METAL. INTERIOR TRIM MUST NOT BE TRAPPED BETWEEN THE ANCHOR AND THE SHEET METAL. FAILURE TO PROPERLY INSTALL THE ANCHOR COULD RESULT IN IMPROPER PERFORMANCE IN THE EVENT OF AN ACCIDENT.



SECOND ROW OUTBOARD
TETHER ATTACHMENT
(INSIDE CARGO AREA VIEW
WITH CARPET PULLED AWAY)

▽ THIS SYMBOL MEANS USE ONLY THE PART
INDICATED — DO NOT SUBSTITUTE

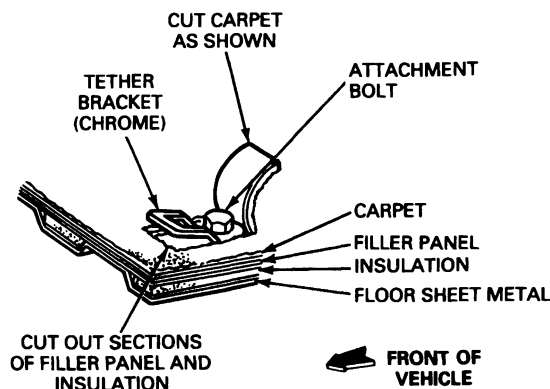
R8511-A

WARNING: THE THREADED HOLE IN THE TETHER ANCHOR HAS AN 8MM METRIC THREAD. AN 8MM WRENCH WILL BE NEEDED TO TIGHTEN THE 8MM BOLT TO THE REQUIRED TORQUE SPECIFICATION. SOME CHILD RESTRAINTS COME WITH A NON-METRIC BOLT WITH A DIFFERENT THREAD. DO NOT USE A NON-METRIC BOLT AS IT MAY BE IMPOSSIBLE TO SCREW IT ALL THE WAY INTO THE HOLE, RESULTING IN INADEQUATE RETENTION OF THE CHILD RESTRAINT. USE ONLY THE METRIC BOLT SUPPLIED IN THE KIT. IF YOU NEED A REPLACEMENT BOLT, ANY FORD DEALER WILL ASSIST YOU.

WARNING: IF THE ANCHOR BOLT(S) ARE EVER REMOVED, THE HOLE(S) IN THE FLOOR PAN MUST BE SEALED TO PREVENT THE POSSIBILITY OF EXHAUST FUMES ENTERING THE PASSENGER COMPARTMENT.

7. Install rear seat.

WARNING: FOLLOW THE CHILD SEAT MANUFACTURER'S INSTRUCTIONS TO ATTACH THE TETHER STRAP TO THE TETHER BRACKET.



CUT CARPET AS SHOWN FOR
FRONT RIGHT HAND TETHER ATTACHMENT

INSIDE CARGO AREA-INSTALLED VIEW
RIGHT FRONT ATTACHMENT

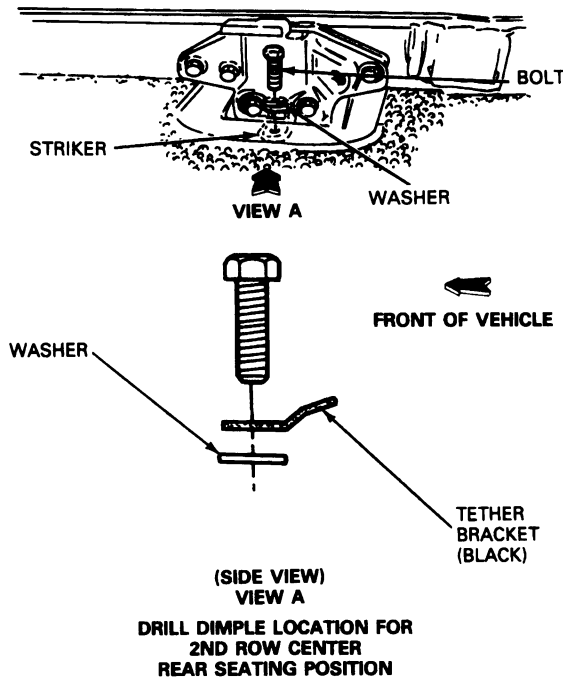
R8512-A

Installing Tether Strap Anchor, Second Row Rear Center Seating Position, Bronco

1. Locate the latch assembly and latch striker. The rear bolt holding the latch striker to the floor pan is the bolt used for mounting the tether strap.

REMOVAL AND INSTALLATION (Continued)

2. With the rear seat folded forward, remove the rear bolt retaining the striker bar to the floor pan sheet metal.



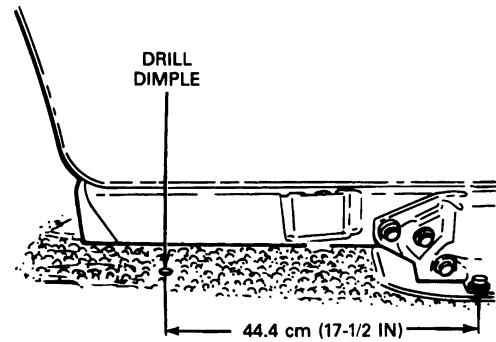
R8514-A

3. Before installing the hardware, read the instructions on the thread locking material package. Open the capsule and apply thread locking material to all attaching bolt threads.
4. Assemble bolt. Black tether bracket must be pointing rearward and assembled as shown.
5. Install the bolt assembly and tighten to 61.3-81.7 N·m (45-60 ft·lb).

NOTE: Use the black colored tether strap bracket at THIS LOCATION ONLY.

Locating and Installing Tether Anchor, Second Row Right and Left Seating Positions

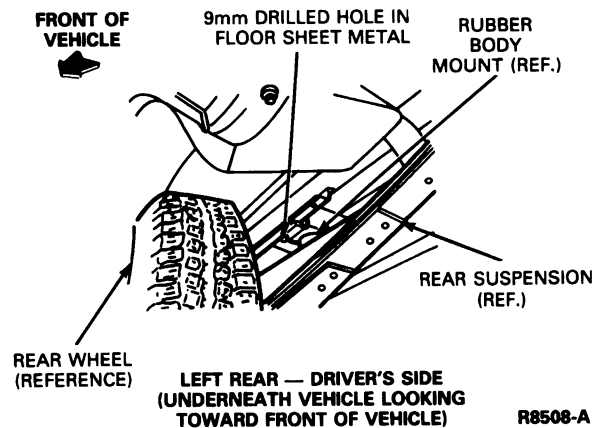
1. Open the liftgate. Remove the attaching screws retaining the rear floor scuff plate to the body.
2. Fold rear bench seat forward.
3. Fold back the rear floor carpet and lift the carpet assembly to expose the floor sheet metal.
4. From inside the cargo area, locate two drill dimples, one for each side of the vehicle, in the floor near the embossed letter T. The drill dimples are located approximately 44.4 cm (17-1/2 inches) from the rear striker bolt.



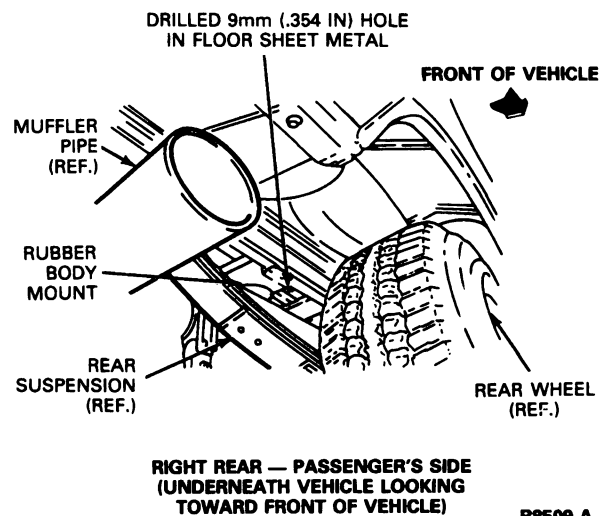
DRILL DIMPLE LOCATION FOR 2ND ROW LEFT OUTBOARD REAR SEATING POSITION

R8516-A

5. Drill a 9mm (0.354-inch) hole through dimple(s).
CAUTION: Verify before drilling through the floor pan that the drilling will not damage any underbody components.



R8508-A



R8509-A

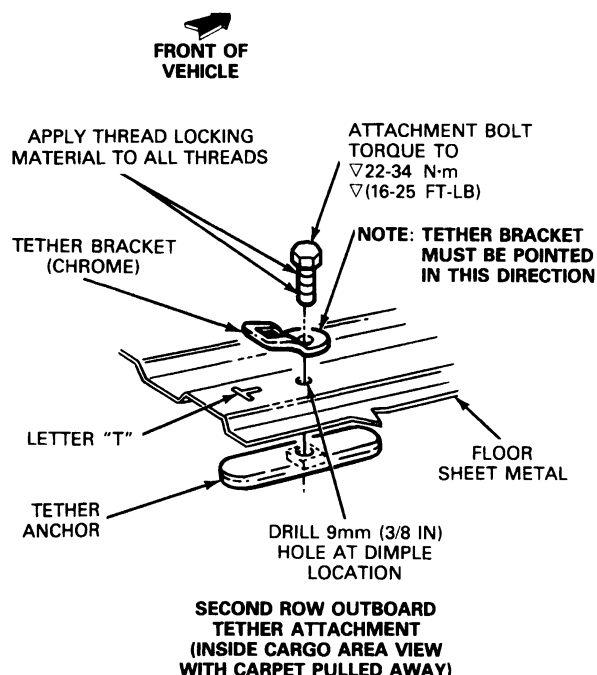
REMOVAL AND INSTALLATION (Continued)

NOTE: An assistant will be needed underneath the vehicle to attach the tether anchor. Before installing the tether hardware, read the instructions on the thread locking material package. Open the capsule and apply thread locking material to all tether attachment bolt threads.

6. Install the child tether hardware. Tighten tether attaching bolts to 22-34 N·m (16-25 ft-lb).

NOTE: Do not install the **black** colored tether strap bracket at these locations.

WARNING: THE TETHER BRACKET MUST BE BOLTED DIRECTLY TO THE FLOOR SHEET METAL. INTERIOR TRIM MUST NOT BE TRAPPED BETWEEN THE ANCHOR AND THE SHEET METAL. FAILURE TO PROPERLY INSTALL THE ANCHOR COULD RESULT IN IMPROPER PERFORMANCE IN THE EVENT OF AN ACCIDENT.



▽ THIS SYMBOL MEANS USE ONLY THE PART INDICATED — DO NOT SUBSTITUTE

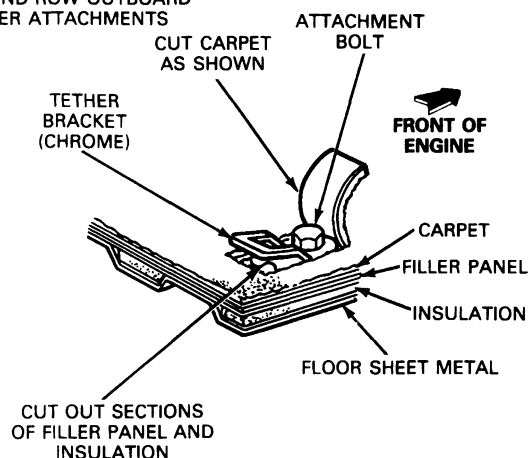
R8511-A

WARNING: THE THREADED HOLE IN THE TETHER ANCHOR HAS AN 8MM METRIC THREAD. AN 8MM WRENCH WILL BE NEEDED TO TIGHTEN THE 8MM BOLT TO THE REQUIRED TORQUE SPECIFICATION. SOME CHILD RESTRAINTS COME WITH A NON-METRIC BOLT WITH A DIFFERENT THREAD. DO NOT USE A NON-METRIC BOLT AS IT MAY BE IMPOSSIBLE TO SCREW IT ALL THE WAY INTO THE HOLE, RESULTING IN INADEQUATE RETENTION OF THE CHILD RESTRAINT. USE ONLY THE METRIC BOLT SUPPLIED IN THE KIT. IF YOU NEED A REPLACEMENT BOLT, ANY FORD DEALER WILL ASSIST YOU.

WARNING: IF THE ANCHOR BOLT(S) ARE EVER REMOVED, THE HOLES(S) IN THE FLOOR PAN MUST BE SEALED TO PREVENT THE POSSIBILITY OF EXHAUST FUMES ENTERING THE PASSENGER COMPARTMENT.

7. Pull back the carpet and find the 51mm x 51mm (2 inch x 2 inch) colored square on the back side of the carpet. The colored square is the approximate location of the required cut-out in the carpet. Using the colored square as a guide, establish the location where a 51mm x 51mm (2 inch x 2 inch) cut-out in the carpet will expose the chrome tether bracket.

CUT CARPET AS SHOWN FOR SECOND ROW OUTBOARD TETHER ATTACHMENTS



INSIDE CARGO AREA — INSTALLED VIEW
SECOND ROW RIGHT AND LEFT ATTACHMENT

R8513-A

For installation, follow removal procedures in reverse order. Tighten seat retaining bolts 62-81 N·m (45-60 ft-lb).

WARNING: FOLLOW THE CHILD SEAT MANUFACTURER'S INSTRUCTIONS TO ATTACH THE TETHER STRAP TO THE TETHER BRACKET.

Seat Belt Bolt Without Damaged Anchor Plate Threads

Removal and Installation

1. Remove damaged anchor reinforcement bolt and discard.
2. Install a new bolt with the same part number as indicated in the parts replacement chart in the Specifications portion of this section. Tighten to 35 ± 5.3 N·m (26 ft-lb \pm 47 in-lb).

REMOVAL AND INSTALLATION (Continued)

Seat and Shoulder Harness Belt Bolt with Damaged Anchor Plate Threads

Removal and Installation

1. Remove the broken or stripped bolt and discard.
2. Drill out the internal threads in the seat belt anchor plate with a 27 / 64-inch drill.
3. Re-thread the anchor plate with a 1 / 2-13 tap (seat belt).
4. Blow out the chips.
5. Install the attachment parts in the sequence shown. Refer to applicable illustration. Tighten the replacement bolt to $35 \pm 5.3 \text{ N}\cdot\text{m}$ (26 ft-lb \pm 47 in-lb). Original parts are to be replaced with the repair parts indicated in the seat belt parts replacement guides. Refer to the Parts Replacement Chart in the Specifications portion of this section. Unless specified in the guides, use original parts.
6. When repairing a multiple belt and attachment, install nut 382599-S100 to the bolt in the tunnel area from the underside of the floorpan. Tighten to $35 \pm 5.3 \text{ N}\cdot\text{m}$ (26 ft-lb 47 in-lb).

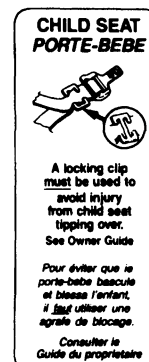
ADJUSTMENTS

Child Seat Locking Clip

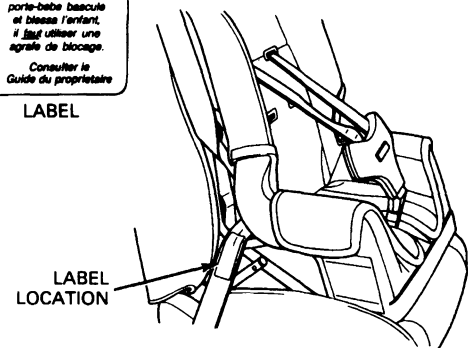
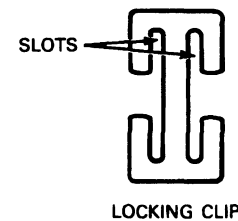
The locking clip must be used to secure a child seat when your vehicle has a shoulder and lap belt with a sliding tongue. Every seat belt that requires a locking clip is identified on the belt with a label shown in the following illustration. The locking clip is installed on a sample piece of webbing to show proper installation.

WARNING: IF YOU DO NOT USE A LOCKING CLIP, INJURIES COULD RESULT FROM THE CHILD SEAT TIPPING OVER DURING NORMAL BRAKING OR CORNERING.

SAFETY BELT LOCKING CLIP LABEL

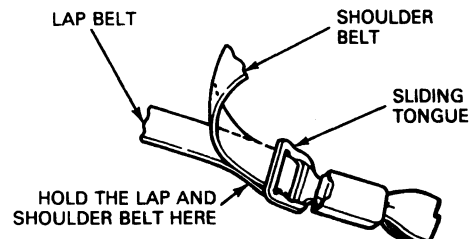


LABEL



R7458-A

1. Thread the belt webbing through the child seat according to the child seat manufacturer's instructions.
2. Buckle seat belt.



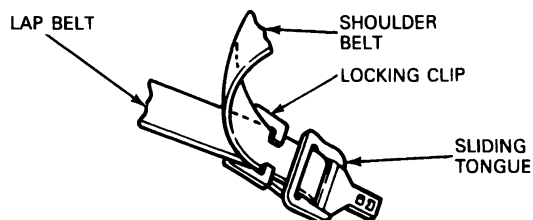
END RELEASE BUCKLE SHOWN
OTHER BUCKLES SIMILAR

R7459-A

3. Pull on the shoulder portion of the belt to make the lap portion fit snugly.

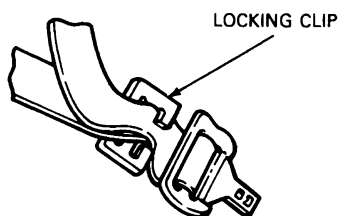
ADJUSTMENTS (Continued)

4. Keeping the lap belt snug, hold the lap and shoulder belt portion of the webbing together next to the slip tongue and unbuckle the seat belt.



R7460-A

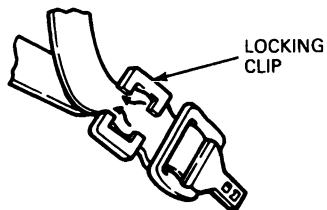
5. Slide either corner of the locking clip slot closest to the tongue over both layers of the webbing as shown.



PINCH BOTH OPPOSITE EDGES OF WEBBING TOGETHER AND INSERT INTO LOCKING CLIP SLOT

R7461-A

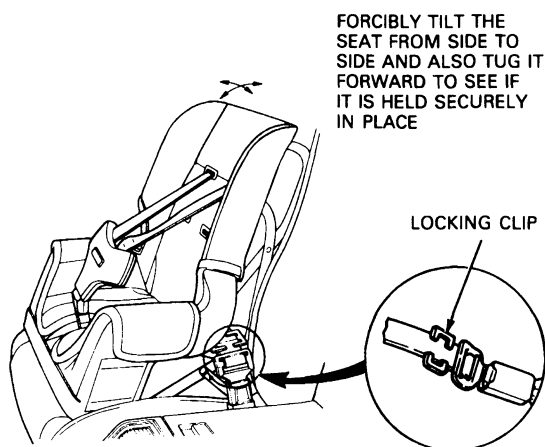
6. Pinch both opposite edges of the webbing together and insert them into the locking clip as shown.
7. Pinch both layers of the webbing together and insert into other slot of locking clip as shown.



INSERT BOTH LAYERS OF WEBBING INTO OTHER SLOT OF LOCKING CLIP

R7462-A

8. Re-buckle the belt. Forcibly tilt the child seat from side to side. Also tug it forward to see if it is held securely in place as shown in the following illustration.
9. If excessive movement occurs, repeat Steps 2 through 8 or properly install child seat in a different seating position in the vehicle.



R7463-A

Seat Belt Extension Assembly

A seat belt assembly that is too short, even when fully extended over the lap of a vehicle occupant, can be lengthened approximately 203mm (8 inches) with a seat belt extension assembly which can be obtained through local Ford Dealers. The seat belt extension assembly is only available with black webbing and standard buckle and must be of the same manufacture as the belt system to which it is attached.

Safety Belt

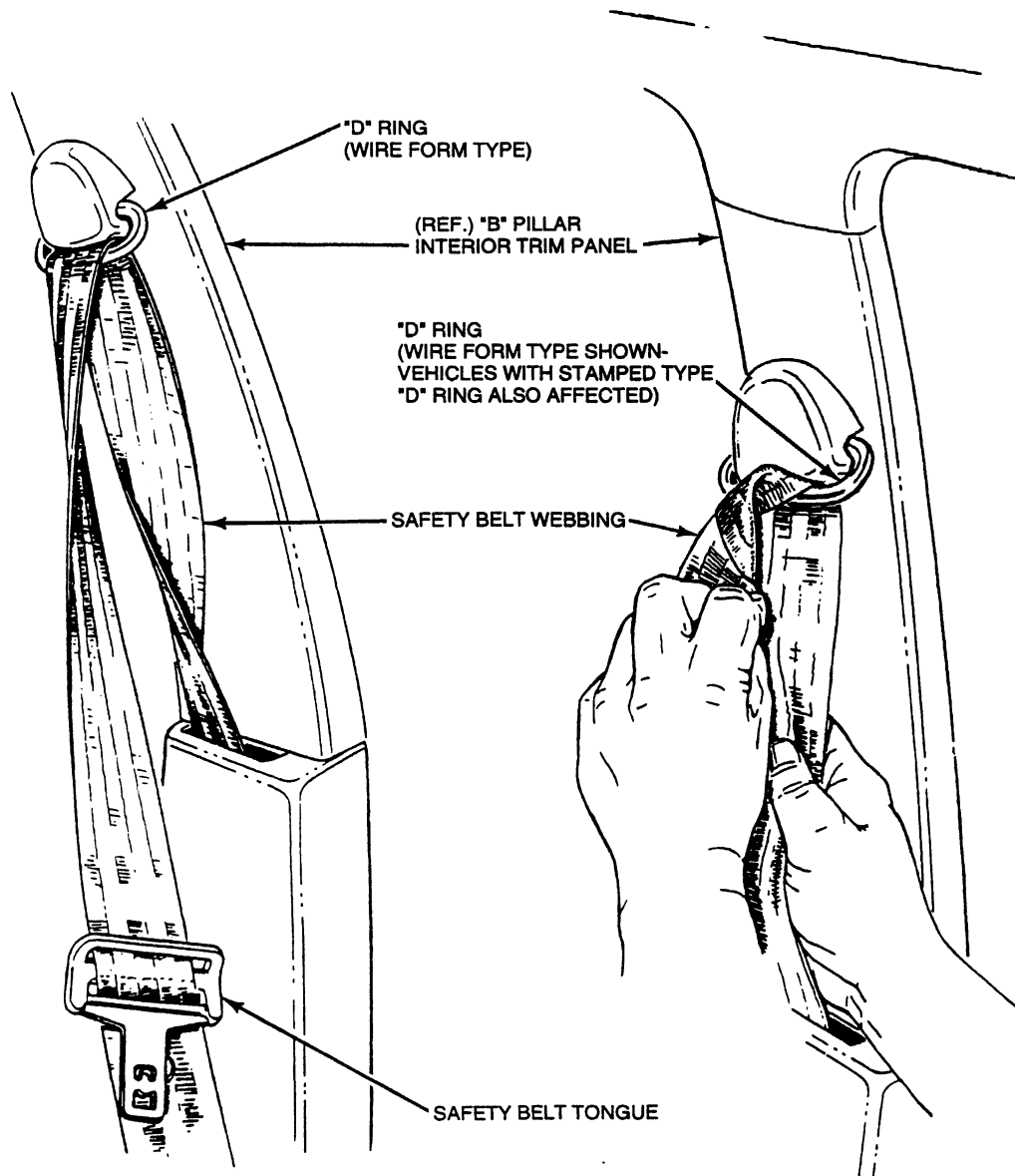
NOTE: These procedures affect both wire-formed and stamped D-ring designs.

Safety Belt Twisted at the D-Ring

1. Grasp the belt webbing at the D-ring as shown.
2. Rotate and fold the belt webbing over itself to remove the twist.

ADJUSTMENTS (Continued)

SAFETY BELT TWISTED AT THE "D" RING



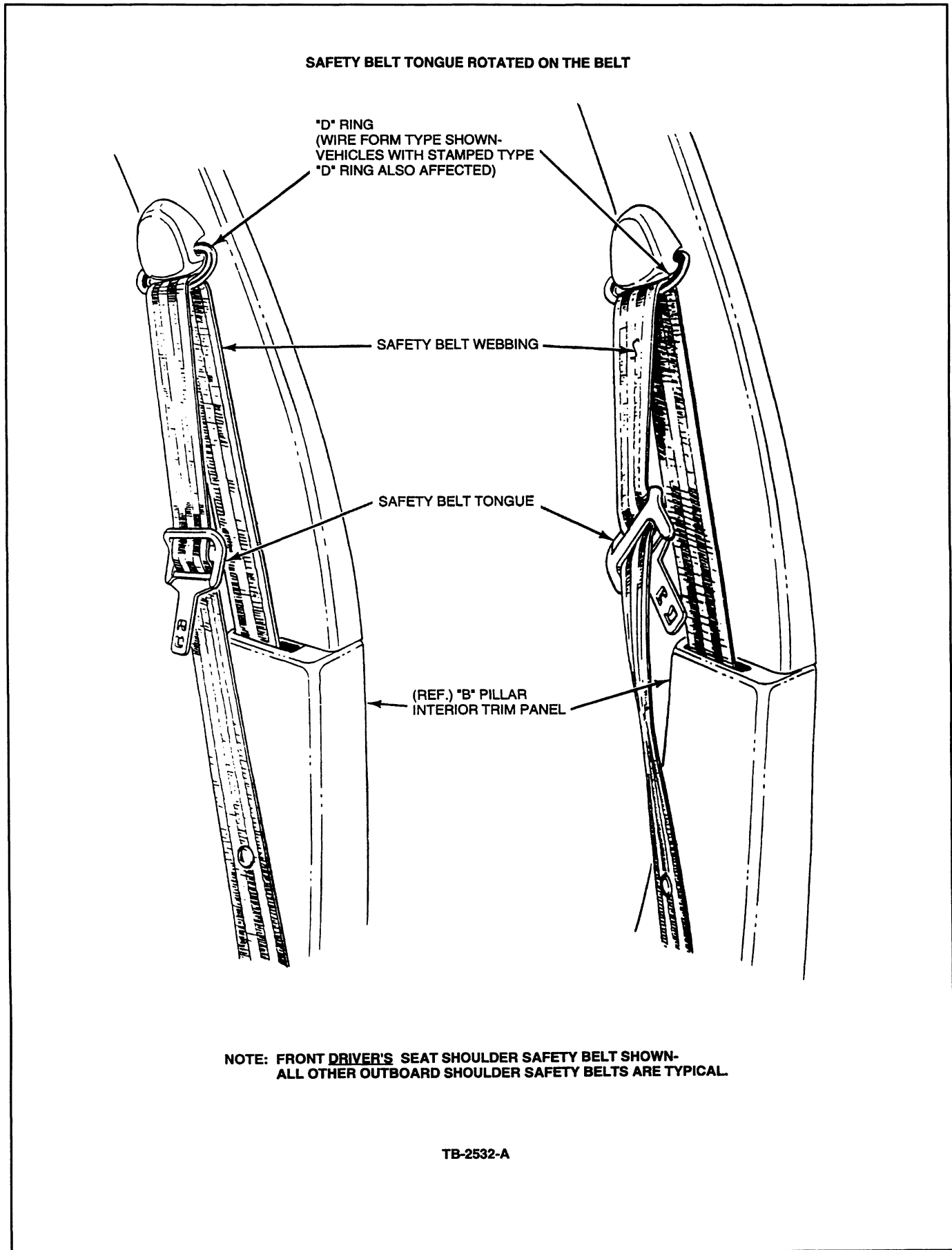
NOTE: FRONT DRIVER'S SEAT SHOULDER SAFETY BELT SHOWN-
ALL OTHER OUTBOARD SHOULDER SAFETY BELTS ARE TYPICAL.

TB-2531-A

ADJUSTMENTS (Continued)**Safety Belt Tongue Rotated on Belt**

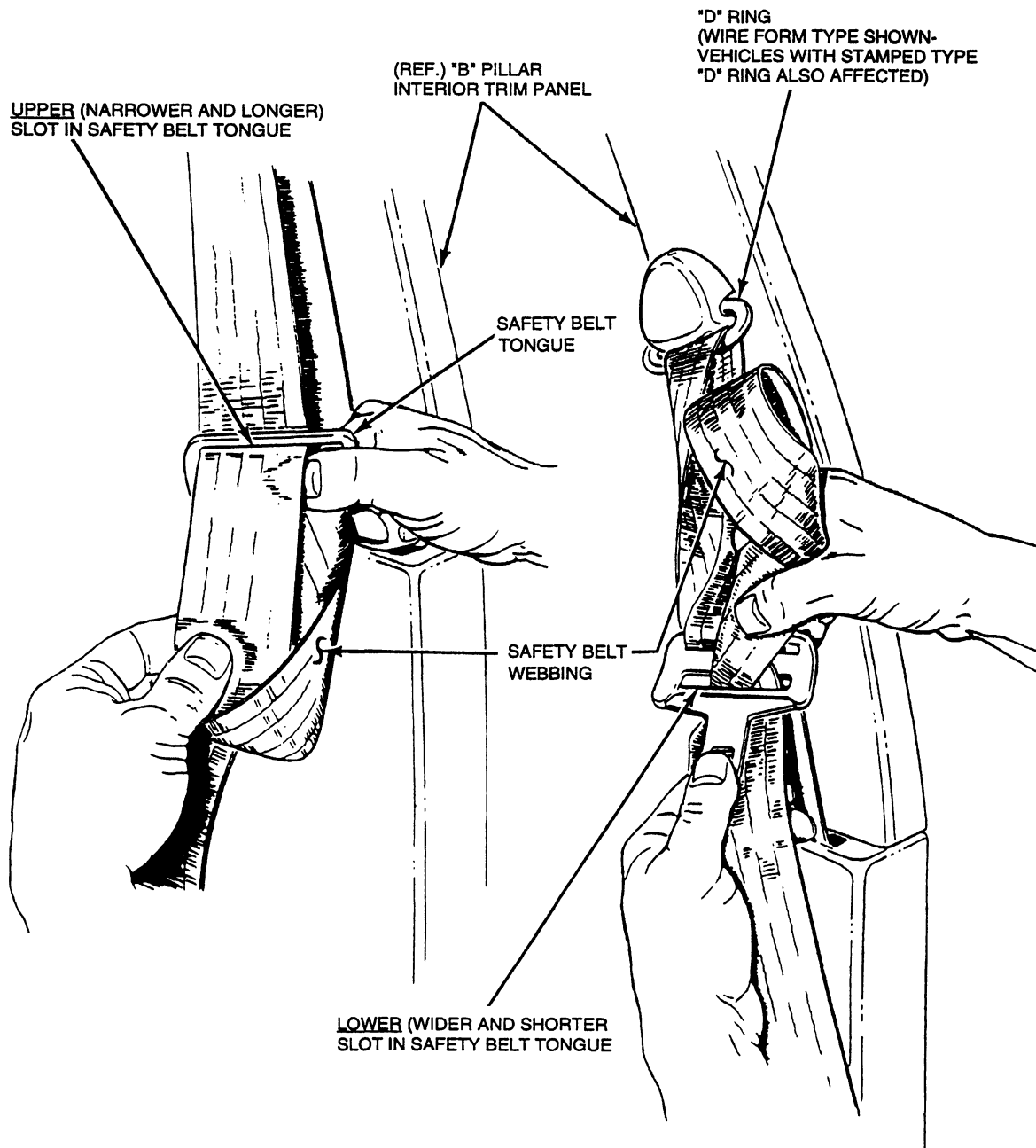
1. Grasp the belt tongue and pull down on the belt webbing closest to you to form a loop through the upper (narrow and longer) slot in the tongue.
2. Working within the upper slot, rotate and fold the belt webbing over itself as required to remove the twist.
3. Pull the excess belt webbing back through the upper slot in the tongue.
4. Repeat the above steps to complete the removal of the twist at the lower (wider and larger) slot in the tongue.

ADJUSTMENTS (Continued)



ADJUSTMENTS (Continued)

SAFETY BELT TONGUE ROTATED ON THE BELT



NOTE: FRONT DRIVER'S SEAT SHOULDER SAFETY BELT SHOWN-
ALL OTHER OUTBOARD SHOULDER SAFETY BELTS ARE TYPICAL.

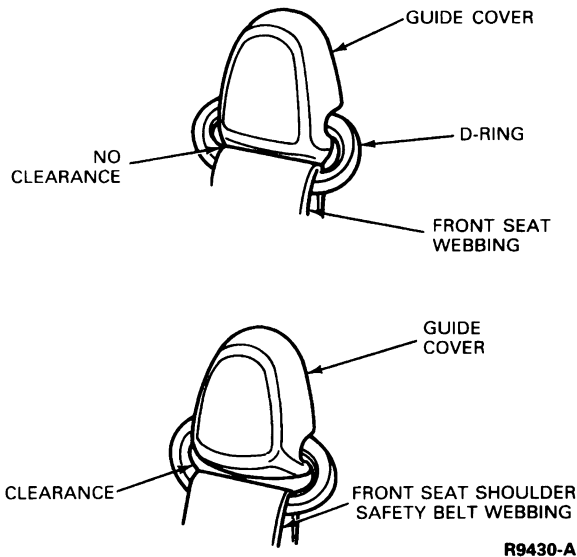
TB-2533-A

ADJUSTMENTS (Continued)

Slow Or Lazy Retraction At D-Ring, F-Series, F-Super Duty and Bronco

Removal and Installation

1. Remove and discard guide ring cover.
2. Install new guide cover.



Inspection Procedure After An Accident

Safety belt assemblies should be periodically inspected to make sure they have not become damaged and that they remain in proper operating condition, particularly if they have been subjected to severe stress, such as an accident.

WARNING: ALL SAFETY BELT ASSEMBLIES INCLUDING RETRACTORS AND ATTACHING HARDWARE SHOULD BE INSPECTED AFTER ANY COLLISION. FORD RECOMMENDS THAT ALL SAFETY BELT ASSEMBLIES IN USE DURING A COLLISION BE REPLACED UNLESS THE COLLISION WAS MINOR AND A QUALIFIED TECHNICIAN FINDS THAT THE BELTS SHOW NO DAMAGE AND CONTINUE TO OPERATE PROPERLY. SAFETY BELT ASSEMBLIES NOT IN USE DURING A COLLISION SHOULD ALSO BE INSPECTED AND REPLACED IF EITHER DAMAGE OR IMPROPER OPERATION IS NOTED.

Before installing the new safety belt assembly, the safety belt attaching areas must be inspected for damage and distortion. If the attaching points are damaged and distorted, the sheet metal must be worked back to its original shape and structural integrity.

Install the new safety belt(s) using the appropriate instructions. Perform Functional Test Procedure.

SPECIFICATIONS

CLEANING AND INSPECTION

Cleaning Belt Webbing

CAUTION: Do not bleach or re-dye the webbing. Bleaching or dyeing the webbing can reduce both belt effectiveness and occupant safety.

Clean the belt webbing with any mild soap solution recommended for cleaning upholstery or carpets following the instructions provided with the soap.

Description	N·m	Lb·Ft
Safety Belt Attaching Bolts	35 ± 5.3	26 ± 47 In-Lb
Body Side Trim Panel and Rear Seat Retracting Assembly Nuts (Bronco)	35 ± 5.3	26 ± 47 In-Lb
Tether Bracket to Seat Frame Rail Attaching Bolt	22-34	16-25

SPECIFICATIONS (Continued)

PARTS REPLACEMENT CHART — SEAT AND SHOULDER BELT WITH DAMAGED WELD NUT ANCHOR PLATE THREADS

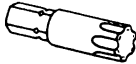
Original Parts — Seat Belt			Replacement Parts — Seat Belt		
Part No.	① Code Letter	Part Name	Part No.	① Code Letter	Part Name
386273-S100	IA	Bolt — 7/16-20 x 1.38 Pan Head Tapping	383531-S36	X	Bolt — 1/2-13 x 1.38 Pan Locking
386274-S100	IB	Bolt — 7/16-20 x 1.75 Pan Head Tapping (.50 Shoulder)	383753-S36	Y	Bolt — 1/2-13 x 1.75 Pan Locking (.50 Shoulder)
382629-S100	—	Washer — .463/.443 I.D. Plate (1.80 Dia. .190 Thick)	382552-S100	—	Washer — 1/2 Flat (1.30 Dia. .190 Thick)
382583-S100	—	Washer — 1/2 Serrated (.18 Thick)	382533-S100	—	Washer — 1/2 Flat (.25 Thick)
386272-S100	IF	Bolt — 7/16-20 x .88 Pan Head Tapping	383437-S36	W	Bolt — 1/2 x 13 Pan Locking
386276-S100	IL	Bolt — 7/16-20 x 1.75 Pan Shoulder Tapping (.75 Shoulder)	383754-S36	Z	Bolt — 1/2-13 x 2.25 Pan Locking (.88 Shoulder)
386277-S100	IK	Bolt — 7/16-20 x 1.38 Pan Shoulder Tapping (.50 Shoulder)	385709-S	T	Bolt — 1/2-13 x 1.38 Pan Head Shoulder Locking
382580-S100	—	Washer — 7/16	383754-S36	Z	Bolt — 1/2-13 x 2.25 Pan Locking (.88 Shoulder)
386392-S100	IG	Bolt — Pan Head Tapping (7/16-20 x 2.15)	389478-S190	U	1/2 x 13 x 1.15
384966-S100	V	Bolt — 7/16-20 x 1.75 Pan Head Tapping	389548-S191	S	1/2 x 13 x 1.5
389370-S100	IM	7/16 x 20 x 1.15	390691-S190	D	1/2 x 13 x 2.0
389547-S190	IR	7/16 x 20 x 1.54			
390775-S190	ID	7/16 x 20 x 2.00			

① Identification letter on top of bolt head or face of spacer.

NOTE: Bolt Torque Must be Maintained at 35.0 ± 5.3 N•m (26.0 Ft-Lb ± 47 In-Lb)

CR3104-C

SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
T77L-2100-A Seat Belt Bolt Bit	 T77L-2100-A

SECTION 01-20B Restraints, Passive, Supplemental Air Bag System

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DIAGNOSIS AND TESTING (Cont'd.)	
Clockspring Alignment	01-20B-62	Location of Air Bag System	
DESCRIPTION AND OPERATION		Components	01-20B-11
Clockspring Assembly	01-20B-5	No Air Bag Lamp	01-20B-14
Driver Air Bag	01-20B-2	Rapid Continuous Flashing	01-20B-54
Electrical System	01-20B-2	DISPOSAL PROCEDURES	
Supplemental Air Bag Restraint (SRS)	01-20B-1	Air Bag Disposal	01-20B-61
System Operation	01-20B-5	Deployed Air Bag	01-20B-61
Warning Labels	01-20B-5	Scrapped Vehicle	01-20B-61
DIAGNOSIS AND TESTING		Undeployed Air Bag, Faulty	01-20B-61
Air Bag System Diagnostic Procedures	01-20B-9	GENERAL SERVICE PROCEDURES	
Air Bag System Reconnect Checklist	01-20B-10	Air Bag Module	01-20B-7
Continuous Air Bag Lamp	01-20B-15	General Instructions	01-20B-9
Diagnosing Customer Concerns Without Hard		Parts Replacement	01-20B-6
Fault Codes	01-20B-9	Service of Air Bag Equipped Vehicles Involved	
Fault Code 12	01-20B-17	In Accidents	01-20B-7
Fault Code 13	01-20B-19	Service Precautions	01-20B-8
Fault Code 21	01-20B-23	REMOVAL AND INSTALLATION	
Fault Code 22	01-20B-25	Clockspring Assembly	01-20B-59
Fault Code 23	01-20B-27	Diagnostic Monitor	01-20B-58
Fault Code 24	01-20B-29	Module, Driver Air Bag	01-20B-59
Fault Code 32	01-20B-33	Sensor Rear Crash Sensor (Right	
Fault Code 33	01-20B-35	Frame)	01-20B-56
Fault Code 34	01-20B-36	Sensor Right Cowl Side (Safing) Sensor	01-20B-57
Fault Code 35	01-20B-38	Sensor, Front Center Primary Crash Sensor	
Fault Code 41	01-20B-40	(Upper Radiator Support)	01-20B-56
Fault Code 44	01-20B-43	Trim Panel and Steering Column	
Fault Code 45	01-20B-45	Opening	01-20B-60
Fault Code 46	01-20B-47	SPECIAL SERVICE TOOLS/EQUIPMENT	01-20B-63
Fault Code 51	01-20B-49	SPECIFICATIONS	01-20B-62
Fault Code 52	01-20B-51	VEHICLE APPLICATION	01-20B-1
Fault Code 53	01-20B-53		

VEHICLE APPLICATION

Econoline Vehicles

DESCRIPTION AND OPERATION

Supplemental Air Bag Restraint (SRS)

The Supplemental Air Bag Restraint System is designed to provide increased accident protection for front seat occupants IN ADDITION TO that provided by the three point safety belt system. Safety belt use is necessary to obtain the best occupant protection and to receive the full advantages of the supplemental air bag. **FORD RECOMMENDS THE USE OF SAFETY BELT SYSTEMS FOR ALL VEHICLE OCCUPANTS.**

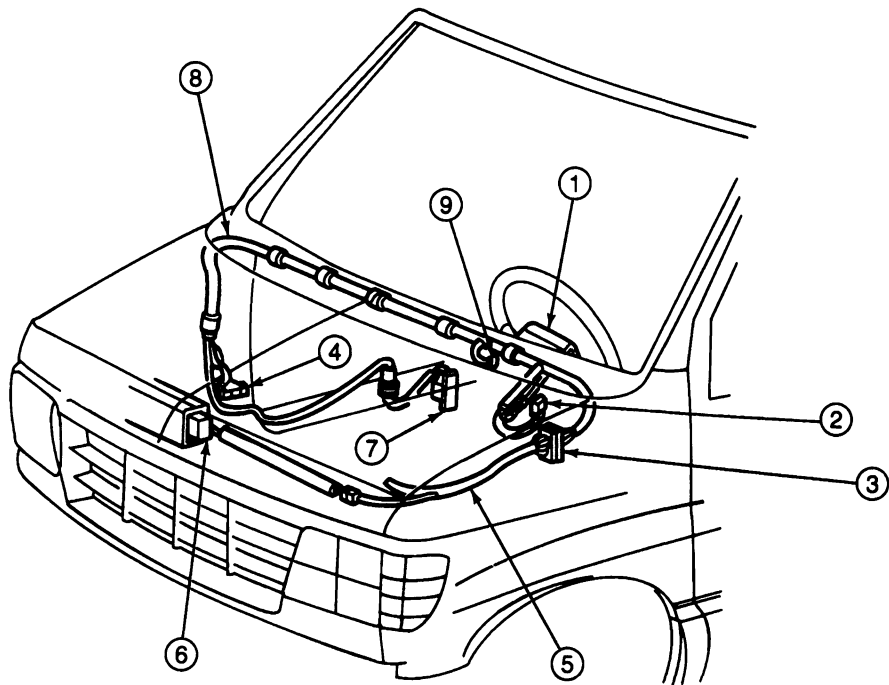
Refer to Section 01-20 for information on seat and shoulder belts.

The Supplemental Air Bag Restraint System (SRS) consists of:

- Electrical system
- Air bag module
- Sensors (crash and safing)
- Air bag diagnostic monitor
- Air bag lamp
- Tone generator

DESCRIPTION AND OPERATION (Continued)

Supplemental Restraint System Component Location



R8195-A

Item	Description
1	Air Bag
2	Diagnostic Monitor
3	Connector at Safety Wall
4	Safing Sensor

(Continued)

Item	Description
5	Engine Compartment Harness
6	Crash Sensor
7	Crash Sensor
8	Instrument Panel Harness
9	Readiness Indicator (Light)

Electrical System

The Supplemental Air Bag Restraint System (SRS) is powered directly from the battery. The SRS can function with the ignition switch in any position, including OFF and LOCK. The SRS can also function when the driver's seat is unoccupied. The electrical system performs three main functions:

- Detects impacts
- Supplies electric power to the igniter(s).
- Monitors the system to determine system readiness.

The electrical system components include:

- Diagnostic monitor
- Air bag lamp
- Wiring harness and clockspring assembly
- Sensors (crash and safing)
- The igniter within the driver air bag.

Driver Air Bag

The driver air bag is mounted in the center of the steering wheel. The module consists of:

- Inflator
- Air bag
- Mounting plate and retaining ring
- Steering wheel trim cover

NOTE: The driver air bag is serviced as a complete assembly.

Inflator

NOTE: The inflator is a component of the air bag module and is not a serviceable item. The air bag module is serviced as a complete assembly.

When the sensors close, signaling a crash, electric current flows to the air bag inflator. Inside the inflator, an igniter converts the electrical signal to thermal (heat) energy, causing the ignition of the inflator gas generant. This ignition reaction combusts the sodium azide / copper oxide gas generant in the inflator, producing nitrogen gas, which inflates the air bag.

DESCRIPTION AND OPERATION (Continued)**Air Bag**

NOTE: The air bag is a component of the air bag module and is not a serviceable item. The air bag module is serviced as a complete assembly.

The air bag:

- is constructed of neoprene coated nylon.
- is 711mm (28 inches) in diameter.
- fills to a volume of 0.065m³ (2.3 ft³) in approximately 40 milliseconds.

Mounting Plate and Retaining Ring

NOTE: The mounting plate and retaining ring are components of the air bag module and are not serviceable items. The air bag module is serviced as a complete assembly.

The mounting plate and retaining ring attach and seal the bag assembly to the inflator. The mounting plate is also used to attach the trim cover and to mount the entire module to the wheel.

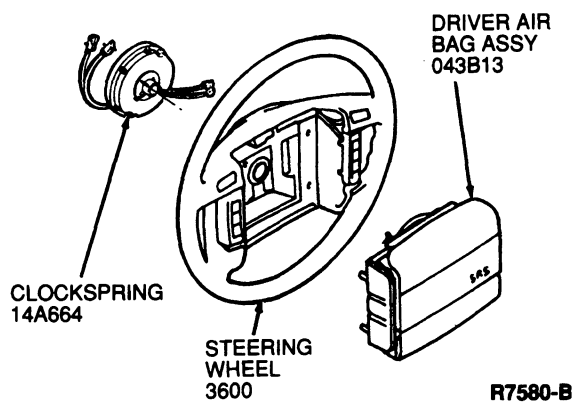
Steering Column and Wheel

The steering column has a clockspring assembly to transfer electrical signals from the steering column to the steering wheel for the air bag system.

Steering Wheel Trim Cover

NOTE: The steering wheel trim is a component of the air bag module and is not a serviceable item. The air bag module is serviced as a complete assembly.

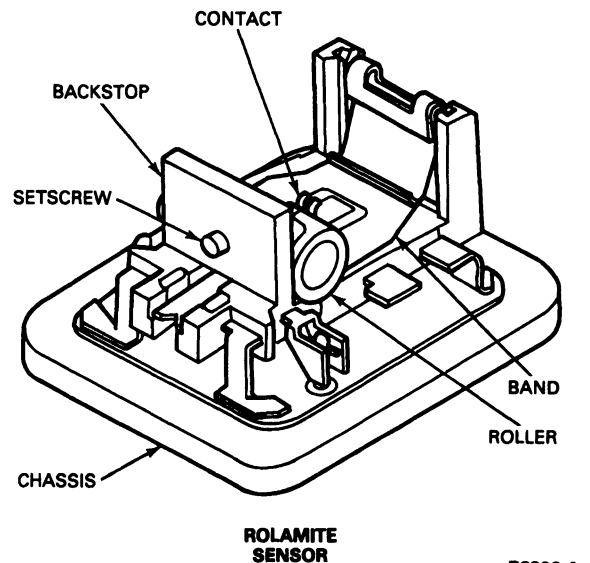
The steering wheel trim cover is made of injection-moulded plastic and encases the air bag. When the SRS is activated, tear seams moulded into the steering wheel trim cover separate, allowing inflation of the air bag.

Air Bag Assembly**Sensors (Primary Crash and Safing)**

WARNING: VEHICLE SENSOR ORIENTATION IS CRITICAL FOR PROPER SYSTEM OPERATION. IF A VEHICLE EQUIPPED WITH AN AIR BAG SYSTEM HAS BEEN INVOLVED IN A CRASH WHERE THE FENDERS OR GRILLE AREA HAVE BEEN DAMAGED, INSPECT THE SENSOR MOUNTING BRACKETS FOR DEFORMATION. IF DAMAGED, THE SENSOR SHOULD BE REPLACED WHETHER OR NOT THE AIR BAG IS DEPLOYED. IN ADDITION, ENSURE THAT THE BODY STRUCTURE IN THE AREA OF THE SENSOR MOUNTING IS RESTORED TO ITS ORIGINAL CONDITION.

NOTE: Undamaged sensors will reset automatically after an accident and can be reused.

The primary sensors are electrical switches which react to impacts according to direction and force. They discriminate between impacts that require air bag inflation and impacts that do not require air bag inflation. When an impact occurs that requires air bag inflation, the sensor contacts close, completing the electrical circuit necessary for system operation.



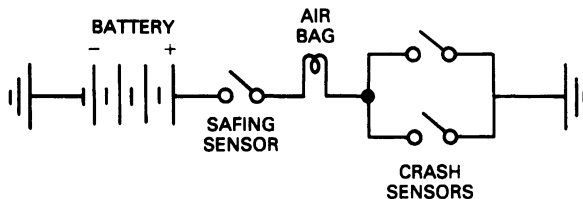
Three sensors are mounted in the vehicle. Their locations are as follows:

- A primary crash sensor at the center of the radiator support.
- A primary crash sensor on the right frame rail.
- A primary safing sensor at the right cowl side kick panel.

DESCRIPTION AND OPERATION (Continued)

At least two sensors (one crash sensor and the safing sensor) **must** be activated to inflate the air bag.

AIR BAG FIRING CIRCUIT DIAGRAM



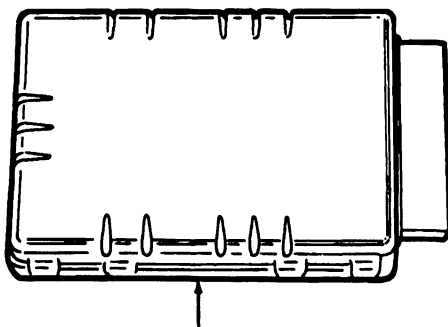
R8194-A

Crash sensors automatically "reset" after a collision and do not need to be replaced unless they are physically damaged. Replace only if proper alignment is not possible due to bent brackets, cut wires, etc.

Air Bag Diagnostic Monitor

The air bag diagnostic monitor continually monitors all air bag system components and wiring connections for possible faults in the system. If the diagnostic monitor detects a fault in the air bag system when the ignition switch is in the ON position, a fault code will be displayed on the air bag lamp, located in the instrument cluster. Performing system diagnostics is the main purpose of the diagnostic monitor.

The air bag diagnostic monitor does not deploy the air bag in the event of a crash. The crash sensors are "hard wired" to the air bag, therefore, the crash sensor and safing sensor determine when to deploy the air bag.



AIR BAG DIAGNOSTIC MONITOR R8664-A

Features and functions of the air bag diagnostic monitor are described below.

- The air bag diagnostic monitor illuminates the air bag lamp for approximately six seconds when the ignition switch is in the ON position and then turns the lamp off. This shows that the air bag lamp is operational. **If the air bag lamp does not illuminate or the lamp stays on or flashes at any time, a fault has been detected by the air bag diagnostic monitor.**

- Fault codes may not be displayed for approximately 30 seconds after the ignition switch is placed in the ON position. This is the amount of time the air bag diagnostic monitor requires to perform all tests and verify system faults, if present.

- Each fault code (a series of flashes and pauses of the air bag lamp) represents a two-digit number. Each fault code is always displayed at least twice. For example, a fault code 32 is displayed as follows:

— Three flashes, followed by a one second pause, then two flashes, followed by a three second pause.

- If a system fault is present and the air bag lamp is malfunctioning, an audible tone will be heard, indicating that system service is required. The tone is a series of five sets of five beeps. **This does not indicate a fault code 55.** If the tone is heard, the air bag lamp is inoperative and a system fault that requires service is present.
- If a fault exists that makes unwanted air bag deployment possible, the air bag diagnostic monitor has an internal thermal fuse that will blow (open) automatically. This removes all power to the air bag deployment circuit. The air bag lamp will flash the appropriate fault code to indicate the suspect circuit.

CAUTION: The thermal fuse does not blow (open) because of excessive current flowing through it. DO NOT attempt to jumper out the thermal fuse with a circuit breaker or any other type of fuse.

- Fault codes are prioritized numerically so that if two or more different faults occur at the same time, the fault having the highest priority will be displayed first. After that fault has been corrected, the next highest priority fault will be displayed.
- The air bag diagnostic monitor includes an internal backup power supply. This feature provides sufficient backup power to deploy the air bag in the event that the battery or battery cables are damaged in an accident before the crash and safing sensors close. The backup power supply will deplete its stored energy approximately one minute after the **positive** battery cable is disconnected.

WARNING: THE BACKUP POWER SUPPLY ENERGY MUST BE DEPLETED BEFORE ANY AIR BAG COMPONENT SERVICE IS PERFORMED. TO DEplete THE BACKUP POWER SUPPLY ENERGY, DISCONNECT THE POSITIVE BATTERY CABLE AND WAIT ONE MINUTE.

DESCRIPTION AND OPERATION (Continued)

System Readiness Indicator

The system readiness indicator will light continuously for approximately six seconds whenever the ignition switch is turned from OFF to RUN if the air bag is working properly. If an air bag system fault is present, the indicator will either fail to light, remain lit continuously or light in a flashing manner. The flashing manner may not occur until approximately 30 seconds after the ignition switch has been turned from OFF to RUN. This is the time required for the diagnostic monitor to test and verify any and all system faults. If the air bag indicator is inoperative and an air bag system fault exists, a tone will sound signaling that the air bag readiness indicator is inoperative and an air bag system fault exists. Refer to the Diagnosis and Testing portion of this section.

Tone Generator

The air bag readiness indicator is the prime means of determining the air bag system status. However, if the air bag indicator is inoperative and an air bag system fault exists, a tone will sound in a pattern of five sets of five beeps. If this occurs, the air bag indicator will need to be serviced before further diagnosing and testing can be completed. **Unless serviced, the Supplemental Air Bag Restraint System may not function properly in the event of an accident.**

AIR BAG INDICATOR LOCATED
RIGHT OF THE STEERING WHEEL



R8205-A

Clockspring Assembly

The clockspring assembly is mounted on the steering column, behind the steering wheel. The clockspring assembly transfers electrical signals from the steering column to the steering wheel contact for the air bag system.

System Operation

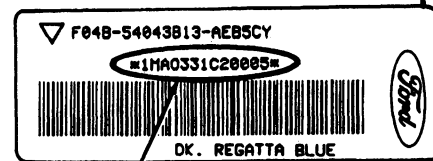
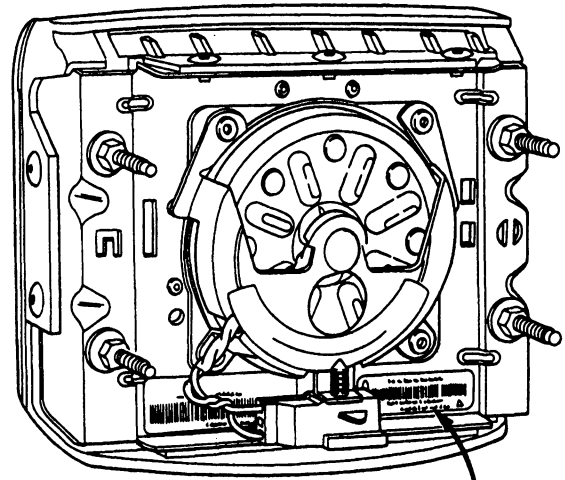
The following four steps show how the SRS works:

NOTE: Steps 1-3 take place in a fraction of a second.

1. The sensors in the vehicle detect a severe frontal impact. When a crash sensor and the safing sensor are closed at the same time, electric current flows to the inflator and ignites the chemicals.
2. The chemicals then rapidly burn in the metal container. The rapid burning produces nitrogen gas and small amounts of dust. The nitrogen gas and dust are cooled and filtered during inflation of the air bag.
3. The inflating air bag splits open the trim cover. The air bag then rapidly unfolds and inflates in front of the driver.
4. After inflation, the gas empties through holes in the air bag. The air bag deflates at once.

Warning Labels

Warning labels for the air bag are shown in the following illustrations.



AIR BAG SERIAL NUMBER

R7586-A

DESCRIPTION AND OPERATION (Continued)



ON HOOD LATCH SUPPORT

<p>DANGER POISON</p> <p>KEEP OUT OF THE REACH OF CHILDREN</p>	<p>DANGER: Contains Sodium Azide and Sodium Nitrate. Contents are Poisonous and Extremely Flammable. DO NOT dismantle or Incinerate this unit. DO NOT Probe with Electrical Test Devices. Dispose as Instructed in the Ford Air Bag Shop Manual.</p>	<p>DANGER: Contient de l'azide de sodium et du nitrate de sodium. Contenu toxique et extrêmement inflammable. NE PAS démonter NI incinérer ce dispositif. NE PAS palper avec la sonde d'un appareil de contrôle de circuits électriques. Mettre au rebut conformément aux instructions du manuel technique Ford sur les coussins de sécurité.</p>	<p>DANGER POISON</p> <p>GARDER HORS D'ATTEINTE DES ENFANTS</p>
---	---	--	--

ON DRIVER'S AIR BAG

AVERY "STICK ON"

Un système de retenue supplémentaire (SRS) protège le conducteur. Ce COUSSIN DE SÉCURITÉ complète la ceinture de sécurité en se gonflant lors d'un choc frontal moyen ou violent. Comme il ne se déploie pas lors d'un impact latéral ou arrière, d'un capotage ou d'un faible choc frontal, IL FAUT TOUJOURS BOUCLER SA CEINTURE.

Le témoin « AIR BAG » s'allume un moment quand on met le contact. AUCUN ENTRETIEN NE S'IMPOSE, sauf si:

- Le témoin clignote ou reste allumé.
- Le témoin reste éteint quand on met le contact.
- Des séries de 5 « bip » se font entendre.

POUR PLUS DE DÉTAILS, VOIR LE GUIDE DU PROPRIÉTAIRE.

ON HEADLINER ABOVE DRIVER VISOR
(CANADIAN EXPORT ONLY)

This vehicle has a DRIVER AIR BAG Supplemental Restraint System (SRS). The SRS supplements the driver's seat belt by inflating in moderate or severe frontal collisions. It is not designed to inflate in side or rear crashes, rollovers, or minor frontal collisions, so ALWAYS WEAR SEAT BELT.

"AIR BAG" lamp normally lights briefly when ignition key is turned on. NO SRS MAINTENANCE IS NEEDED unless:

- "AIR BAG" lamp flashes or stays lit.
- "AIR BAG" lamp does not light when key is turned on.
- Groups of five beeps are heard.

SEE OWNER GUIDE FOR MORE AIR BAG INFORMATION.

ON DRIVER SUN VISOR
VISIBLE WHEN VISOR IS IN DOWN POSITION

R8215-A

GENERAL SERVICE PROCEDURES

Parts Replacement

NOTE: The various major assemblies in the air bag system have been designed to be tamper-resistant and are not to be disassembled for service. Component assemblies may be removed and replaced as required by diagnosis and testing.

NOTE: Original parts should be reinstalled in the vehicle if replacement parts have no effect on the repair.

GENERAL SERVICE PROCEDURES (Continued)

Air Bag Module

Information on safe and effective replacement for air bag components and handling are provided in this section. Refer to the Diagnosis and Testing and the Removal and Installation portions of this section for complete and effective service of the Safety Restraint System.

NOTE: When replacing an air bag, a prepaid return postcard is provided with the replacement air bag module. The serial number for the new part and vehicle VIN number must be recorded and sent to Ford Motor Company.

AIR BAG MODULE VERIFICATION

VEHICLE
SERIAL NO.

[illegible]

This 17 digit number can be found (1) on your vehicle registration
(2) on the dash panel at left side close to lower edge of windshield.

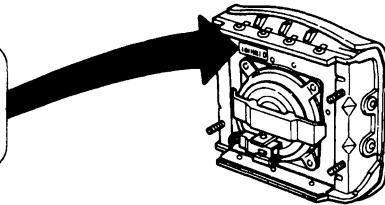
ATTENTION INSTALLER

Please complete and mail this postcard with the Air Bag Module Serial Number (shown on sample) and the Vehicle Identification Number (VIN) of the vehicle in which you are installing this module.

**THIS IS THE NUMBER TO BE
ENTERED BELOW**



SAMPLE



AIR BAG MODULE
SERIAL NO.

[illegible]**R8196-A**

Information on proper handling, storage, and disposal of the air bag inflator assemblies is provided in this section. Refer to Removal and Installation.

NOTE: When replacing an air bag, a prepaid return postcard is provided with the replacement air bag module. The serial number for the new part and vehicle VIN number must be recorded and sent to Ford Motor Company.

Service of Air Bag Equipped Vehicles Involved in Accidents

If the accident involved an air bag deployment, while servicing an air bag equipped vehicle, check the sensors and wiring for damage.

NOTE: Do not attempt to replace air bag cover with one from another air bag, for any reason.

Crash Sensors

WARNING: VEHICLE SENSOR ORIENTATION IS CRITICAL FOR PROPER SYSTEM OPERATION. IF A VEHICLE EQUIPPED WITH AN AIR BAG SYSTEM HAS BEEN INVOLVED IN A CRASH WHERE THE FENDERS OR GRILLE AREA HAVE BEEN DAMAGED, INSPECT THE SENSOR MOUNTING BRACKETS FOR DEFORMATION. IF DAMAGED, THE SENSOR SHOULD BE REPLACED WHETHER OR NOT THE AIR BAG IS DEPLOYED. IN ADDITION, MAKE SURE THAT THE BODY STRUCTURE IN THE AREA OF THE SENSOR MOUNTING IS RESTORED TO ITS ORIGINAL CONDITION.

NOTE: Undamaged sensors will reset automatically after an accident and can be reused.

Damaged Wiring

Inspect the sensor wiring and the wiring harness for any damage that may have occurred as a result of the accident. Replace as required any damaged:

GENERAL SERVICE PROCEDURES (Continued)

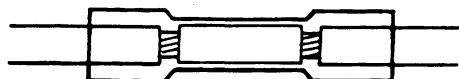
- wiring.
- terminals.
- insulation.
- connectors.

If splices are required in adjacent wiring, the splices should be staggered 50mm (2 inches) apart from each other. Service splices as follows:

- Use a waterproof butt-splice connector on any exposed wiring.
- A heat shrink nylon splice prevents water, salt, condensation and heat from affecting the wiring service.

The inner wall of the splice connector is lined with an adhesive that melts when heated with a heat gun and flows under pressure from the tubing, sealing the splice. The connectors can be crimped with a standard insulated connector crimping tool. The splices are color-coded for gauge identification, and are transparent to allow inspection of the finished splice.

INSTALLATION INSTRUCTIONS



1. STRIP WIRES 7.6mm (0.3")
INSERT INTO CRIMP BARREL



2. CRIMP USING CRIMP TOOL FOR
PREINSULATED CRIMPS.



3. HEAT SPLICE WITH HEAT GUN UNTIL
TUBING SHRINKS AND ADHESIVE
FLOWS FROM EACH END.

R6719-A

Part Number	Part Name	Class
E6FZ-14488-A	Butt Connector Gauge: 18-22, Color: Red	C
E6FZ-14488-B	Butt Connector Gauge: 14-16, Color: Blue	C
E6FZ-14488-C	Butt Connector Gauge: 10-12, Color: Yellow	C

CR6720-A

Steering Column

If the accident involved air bag deployment, the steering column may have been loaded sufficiently to deform steering column mounting brackets or damage column wiring. An inspection should be made of the column structure and clockspring wiring to make sure any damaged components are replaced. Refer to Section 11-04A.

Supplemental Air Bag-Restraint System (SRS)

CAUTION: Before attempting diagnostic prove out, check all sensors and wiring for damage or shorts that could cause the air bag diagnostic monitor thermal fuse to blow (open), causing unnecessary replacement.

After all service is completed, verify the air bag lamp operation as follows:

- Turn the ignition switch to the ON position.
- Count the air bag lamp flashes only after the code (series of flashes) has cycled twice.
- If the air bag lamp illuminates continuously for four to eight seconds and then goes out, the SRS is functioning properly and all faults have been serviced. If the air bag lamp does not illuminate, illuminates continuously for four to eight seconds then goes out, or remains continuously illuminated, there is a malfunction in the SRS. Refer to Diagnosis and Testing in this section.

Service Precautions

WARNING: SAFE HANDLING OF AIR BAGS REQUIRES FOLLOWING THE PROCEDURES DESCRIBED BELOW FOR BOTH LIVE AND DEPLOYED AIR BAGS.

ALWAYS WEAR SAFETY GLASSES WHEN SERVICING AN AIR BAG VEHICLE AND WHEN HANDLING AN AIR BAG.

Live Air Bags

WARNING: WHEN CARRYING A LIVE AIR BAG, MAKE SURE THE BAG AND TRIM COVER ARE POINTED AWAY FROM YOUR BODY. IN THE UNLIKELY EVENT OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL THEN DEPLOY WITH MINIMAL CHANCE OF INJURY.

IN ADDITION, WHEN PLACING A LIVE AIR BAG ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE. THIS WILL REDUCE THE MOTION OF THE MODULE IF IT IS ACCIDENTALLY DEPLOYED.

Deployed Air Bags

WARNING: SAFETY PRECAUTIONS MUST ALSO BE OBSERVED WHEN HANDLING A DEPLOYED AIR BAG.

AFTER DEPLOYMENT, THE AIR BAG SURFACE MAY CONTAIN DEPOSITS OF SODIUM HYDROXIDE, A PRODUCT OF THE GAS GENERANT COMBUSTION THAT IS IRRITATING TO THE SKIN.

GENERAL SERVICE PROCEDURES (Continued)

ALWAYS WEAR GLOVES AND SAFETY GLASSES WHEN HANDLING A DEPLOYED AIR BAG.

WASH YOUR HANDS WITH MILD SOAP AND WATER AFTERWARDS.

General Instructions

WARNING: NEVER PROBE THE CONNECTORS ON THE AIR BAGS. DOING SO MAY RESULT IN AIR BAG DEPLOYMENT WHICH COULD RESULT IN PERSONAL INJURY.

AIR BAG MODULES WITH DISCOLORED OR DAMAGED COVER DEPLOYMENT DOORS MUST BE REPLACED.

CAUTION: Do not repaint air bag deployment doors (covers) that show discoloration, scratches or tears. Air bag repairs are to be made by replacement only.

WARNING: BECAUSE OF THE CRITICAL OPERATING REQUIREMENTS OF THE SYSTEM, DO NOT ATTEMPT TO SERVICE SENSORS, CLOCKS, SPRING, MONITOR, OR AIR BAG. SERVICE IS MADE BY REPLACEMENT ONLY.

IF A PART IS REPLACED AND THE NEW PART DOES NOT CORRECT THE CONDITION, INSTALL THE ORIGINAL PART AND PERFORM THE DIAGNOSTIC PROCEDURE AGAIN.

ALL COMPONENT REPLACEMENTS AND WIRING BEING SERVICED MUST BE MADE WITH THE POSITIVE BATTERY CABLE DISCONNECTED FOR A MINIMUM OF ONE MINUTE BEFORE SERVICE OR REPLACEMENT IS ATTEMPTED.

THE INSTRUCTION "DISCONNECT" ALWAYS REFERS TO A CONNECTOR. NEVER DETACH A COMPONENT FROM THE VEHICLE WHEN INSTRUCTED TO "DISCONNECT."

WARNING: VEHICLE SENSOR ORIENTATION IS CRITICAL FOR PROPER SYSTEM OPERATION. IF A VEHICLE EQUIPPED WITH AN AIR BAG SYSTEM IS INVOLVED IN A CRASH WHERE THE RADIATOR SUPPORT OR FRAME HAVE BEEN DAMAGED, THE SENSOR SHOULD BE REPLACED WHETHER OR NOT THE AIR BAG IS DEPLOYED. IN ADDITION, MAKE SURE THAT BODY STRUCTURE IN THE AREA OF SENSOR MOUNTING IS RESTORED TO ITS ORIGINAL CONDITION.

DIAGNOSIS AND TESTING**Diagnosing Customer Concerns Without Hard Fault Codes**

If fault code is reported by the customer but is not present when the car comes in for service, pinpoint diagnostics cannot be used. Following the pinpoint tests or fault tree diagnosis when the code is not flashing will result in needless replacement of the diagnostic monitor and repeat repairs. The diagnostic monitor does not contain any memory of the fault code after the key is turned off. If the fault code is unknown, instruct the customer on how to count a fault code. Demonstrate a fault code by disconnecting a primary crash sensor, turn the key to the ON position, and allow customer to count fault code. Reconnect the primary crash sensor and instruct customer to return when the code is known. Once the code is known, read the "Normal Operation" section for the fault code involved. Study the circuit diagram and determine the location of components that are involved in creating that fault code. Do a thorough visual inspection of components, connectors, splices and wiring harnesses, looking for pinched wires, worn insulation on conductors, open, shorts, or loosely mounted sensors. The section "Possible Causes" list the common concerns that relate to that particular fault code. Each concern is listed in the order that they are most likely to occur.

Air Bag System Diagnostic Procedures

Most air bag system diagnostic procedures will require the use of the System Deactivation and System Reactivation Procedures outlined below. These procedures allow the removal of the air bags from the vehicle, removing the risk of air bag deployment while diagnostics are performed.

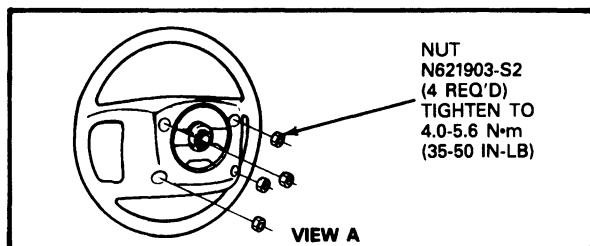
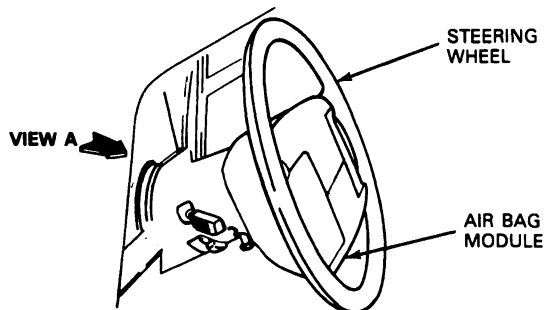
The Rotunda Air Bag Simulator 105-00010 is required to perform diagnosis and testing of the air bag system. The air bag simulator is a 2 ohm resistor that must be used to simulate an air bag connection in the system as specified in the deactivation procedure. It is not acceptable to jump the air bag connection with a zero ohm jumper wire. If a zero ohm jumper wire is used, a system fault may be displayed (Fault Code 34 or 35) according to the priority scheme.

Deactivation Procedure

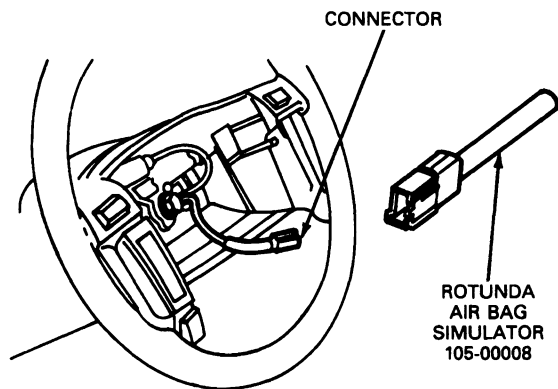
1. Disconnect positive battery cable.
2. Wait one minute. This is the time required for backup power supply in diagnostic monitor to deplete its stored energy.

DIAGNOSIS AND TESTING (Continued)

3. Remove four nut and washer assemblies retaining driver air bag module to steering wheel. Disconnect driver air bag connector. Connect air bag simulator to vehicle harness at top of steering wheel.



R8216-B



R9433-A

4. Connect positive battery cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Reactivation Procedure

1. Disconnect positive battery cable.

2. Wait one minute for backup power supply to deplete stored energy.
3. Remove air bag simulator from vehicle harness connector at top of steering column. Reconnect driver air bag connector. Position driver air bag on steering wheel and secure with four nut and washer assemblies (10mm). Tighten nut and washer assemblies 4.0-5.6 N·m (35-50 in-lb).
4. Connect positive battery cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

5. PROVE-OUT system.

WARNING: THE AIR BAG SIMULATOR(S) MUST BE REMOVED AND THE AIR BAG(S) RECONNECTED WHEN THE SYSTEM IS REACTIVATED.

Air Bag System Reconnect Checklist

The checklist below should be completed following diagnosis or repair of any air bag system concern.

1. Are all crash sensors connected and mounted to vehicle?
2. Is right kick panel safing sensor connected and mounted to vehicle?
3. Is gray three-way connector at base of steering column connected?
4. Is air bag or air bag simulator connected?
5. Is diagnostic monitor connected?
6. Is vehicle battery connected?

Air Bag System Diagnostic Procedure Glossary

The terms below are used to direct actions during diagnostic procedures. They are provided here with a thorough description of the action intended.

Air Bag Simulator (105-00010)

A Rotunda tester consisting of a 2 ohms resistor used to simulate air bag connection to system.

Disconnect Component

Disconnect component means disconnect component connector and vehicle harness connector. It does not mean remove component. Also, a disconnected part should not be reconnected unless instructed to do so.

Deactivate System

Deactivate system means to perform the Deactivation Procedure outlined under Diagnostic Procedures.

DIAGNOSIS AND TESTING (Continued)**Prove-Out System**

Prove-out system means to turn the ignition switch from OFF to RUN and visually monitor the air bag indicator. The air bag will light continuously for approximately six seconds and then turn off. If an air bag system fault is present, the indicator will either fail to light, remain lit continuously or light in a flashing manner. The flashing manner may not occur until approximately 30 seconds after the ignition switch has been turned from OFF to RUN. This is the time required for the diagnostic monitor to complete testing of the air bag system. If the air bag indicator is inoperative and an air bag system fault exists, a tone will sound in a pattern of five sets of five beeps. If this occurs, the air bag indicator will need to be serviced before further diagnosis can be done.

Reactivate System

Reactivate system means to perform the Reactivation Procedure outlined under Diagnostic Procedures.

WARNING: WHEN THE SYSTEM IS REACTIVATED, THE AIR BAG SIMULATORS MUST BE REMOVED AND THE AIR BAG MODULE RECONNECTED.

Reconnect System

Reconnect system means to reconnect all system components. Refer to Air Bag System Reconnect Checklist if necessary.

Replace Component

Replace component means to remove the existing component and replace it with an authorized replacement part obtained from Ford Parts and Service Division. Also, the replacement component should be installed on vehicle and all necessary electrical connections should be completed.

Verify System

Verify System means to prove out system with air bag simulator in place of the air bag.

2. Right frame rail crash sensor — right frame rail at B-pillar support
3. Right kick panel safing sensor — right cowl panel
4. Driver air bag — steering wheel
5. Clockspring — behind steering wheel
6. Diagnostic monitor — under instrument panel left of steering column.

NOTE: A thermal fuse is built into the diagnostic monitor. If a short to ground should occur in the air bag deployment circuit, the microcomputer in the diagnostic monitor will send a signal to the fuse causing it to open. The open fuse removes all firing power (battery / backup power) from the deployment circuits. This prevents unwanted air bag deployments due to damaged vehicle wiring.

NOTE: Code 51 is displayed whenever the diagnostic monitor thermal fuse is open and no other higher priority faults exist (consult Fault Code Priority Table). Code 51 is normally seen after service of a Code 13 condition.

NOTE: If a Code 51 exists and a code 13 condition has not been serviced, this means an **intermittent** short-to-ground exists in the air bag deployment wiring. The intermittent short-to-ground must be located and serviced before servicing the Code 51 condition.

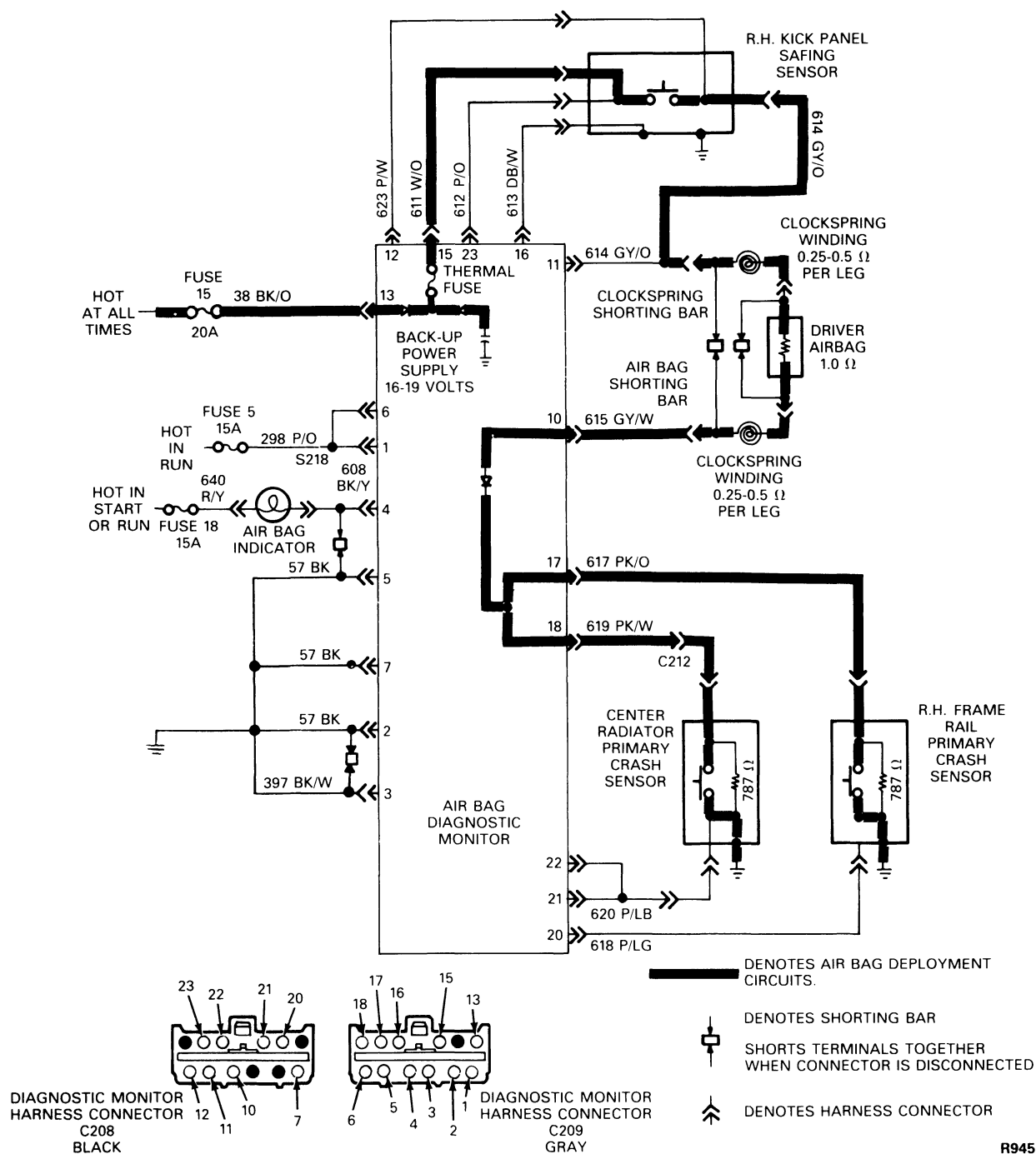
NOTE: Since the thermal fuse is built into the diagnostic monitor, the monitor must be replaced to service a Code 51 condition. **NEVER** replace the diagnostic monitor without first determining the cause for the Code 51 condition. If the short-to-ground is not properly serviced, the short may reoccur, once again destroying the thermal fuse in the diagnostic monitor.

Location of Air Bag System Components

1. Center front radiator support crash sensor — center of radiator support

DIAGNOSIS AND TESTING (Continued)

Air Bag System Wiring Schematic



AIR BAG DIAGNOSTIC MODULE FAULT CODES

Code	Component/Fault Description
—	No Air Bag Lamp — Inoperative Lamp Circuit or No Ignition Voltage to Diagnostic Monitor
—	Continuous Air Bag Lamp — Diagnostic Monitor Disconnected or Inoperative
12	Air Bag Deployment Circuit Drop in Battery Voltage

(Continued)

DIAGNOSIS AND TESTING (Continued)**AIR BAG DIAGNOSTIC MODULE FAULT CODES (Cont'd)**

Code	Component/Fault Description
13	Air Bag Circuit or Crash Sensor Circuit Short to Ground
21	Safing Sensor Not Mounted to Vehicle Properly
22	Safing Sensor Circuit Shorted to Battery Voltage
23	Safing Sensor Circuit Battery Feed Circuit Open
24	Safing Sensor Diagnostic Circuit Open or Low Resistance in a Primary Crash Sensor
32	Driver Side Air Bag High Resistance or Open in Circuit
33	Passenger Air Bag Circuit High Resistance or Open
34	Driver Side Air Bag Low Resistance in Circuit
35	Passenger Air Bag Circuit Low Resistance or Shorted
41	Crash Sensor High Resistance or Open in Circuit
44	RH Frame Rail Crash Sensor Not Mounted to Vehicle Properly
45	Center Radiator Crash Sensor Not Mounted to Vehicle Properly
46	Open Splice Center Radiator Primary Crash Sensor Ground Monitor
51	Diagnostic Monitor Internal Thermal Fuse Blown and Short to Ground No Longer Exists
52	Backup Power Supply Voltage Boost Fault
53	Internal Diagnostic Monitor Failure
—	Rapid Continuous Flashing — All Crash Sensors Disconnected

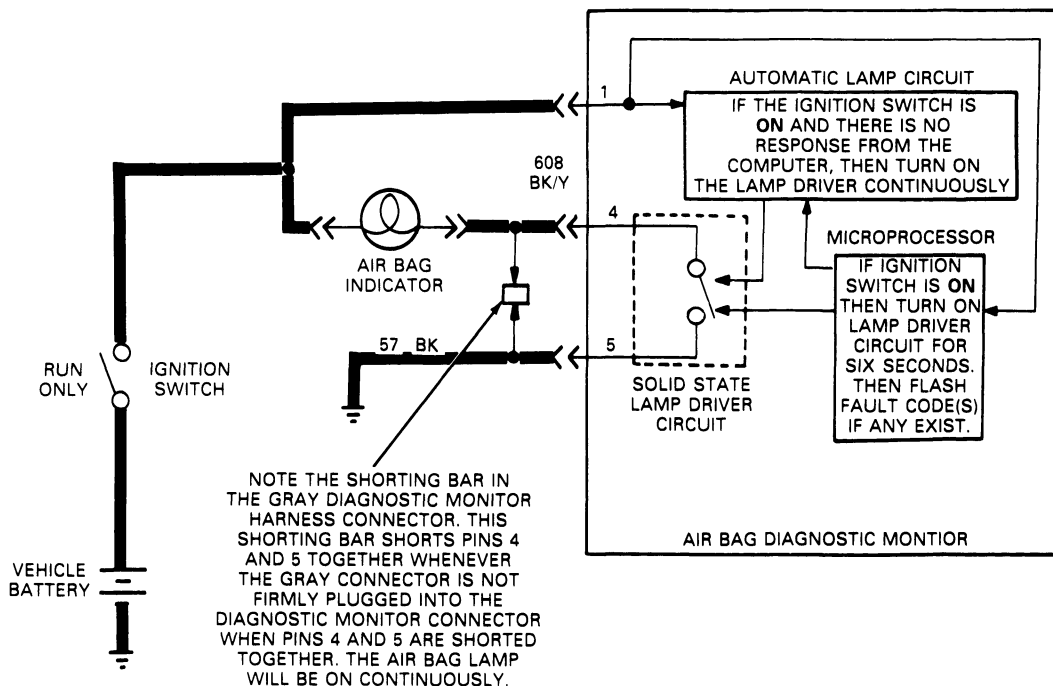
DIAGNOSTIC TEST INDEX

Condition	Test
No Air Bag Lamp	N
Continuous Air Bag Lamp	C
Fault Code 12, Air Bag Deployment Circuit Drop in Battery Voltage	12
Fault code 13, Air Bag or Crash Sensor Circuit Short to Ground	13
Fault Code 21, Safing Sensor Not Mounted to Vehicle Properly	21
Fault Code 22, Safing Sensor Circuit Shorted to Battery Voltage	22
Fault code 23, Safing Sensor Circuit, Battery Feed Circuit Open	23
Fault Code 24, Safing Sensor Diagnostic Circuit Open or Low Resistance in a Primary Crash Sensor	24
Fault Code 32, Driver Side Air Bag High Resistance or Open in Circuit	32
Fault Code 33, Passenger Air Bag Circuit High Resistance or Open	33
Fault Code 34, Driver Side Air Bag Low Resistance in Circuit	34
Fault Code 35, Passenger Air Bag Circuit Low Resistance or Shorted	35
Fault Code 41, Crash Sensor High Resistance or Open in Circuit	41
Fault Code 44, RH Frame Rail Crash Sensor Not Mounted to Vehicle Properly	44
Fault Code 45, Center Radiator Crash Sensor Not Mounted to Vehicle Properly	45
Fault Code 46, Open Splice Center Radiator Primary Crash Sensor Ground Monitor	46
Fault Code 51, Diagnostic Monitor Internal Thermal Fuse Blown and Short to Ground No Longer Exists (Short to Ground Was Repaired or is Intermittent)	—
Fault Code 52, Backup Power Supply Voltage Boost Fault	52
Fault Code 53, Internal Diagnostic Monitor Failure	53
Rapid Continuous Flashing of Air Bag Lamp, All Crash Sensors Disconnected	—

DIAGNOSIS AND TESTING (Continued)

No Air Bag Lamp**Inoperative Lamp Circuit or No Ignition Voltage to Diagnostic Monitor****Circuit Description****Normal Operation**

The air bag lamp is designed to illuminate for $6 (\pm 2)$ seconds when the ignition key is turned to the ON position. This initial 6 seconds of air bag lamp illumination (continuous lamp) is considered normal operation and is called prove out of the air bag lamp.

No Lamp Wiring Schematic

R9435-A

NO LAMP

TEST STEP		RESULT	ACTION TO TAKE
N-1	CHECK IGNITION VOLTAGE		
	<ul style="list-style-type: none"> Deactivate air bag system. Disconnect Diagnostic Monitor. Turn key to ON position. Measure voltage between pins 1 (+) and 3 (-). Is the voltage measured equal to battery voltage? 	<p>Yes</p> <p>No</p>	<p>GO to N-2.</p> <p>LOCATE and SERVICE the open circuit in the "hot in run" feed from the fuse block. CHECK the fuse, connector, etc. CHECK for proper ground on pin 3 of Diagnostic Monitor connector. RECONNECT system. VERIFY system. REACTIVATE system.</p>

DIAGNOSIS AND TESTING (Continued)

NO LAMP (Continued)		
TEST STEP	RESULT	ACTION TO TAKE
N-2 CHECK FOR OPEN LAMP CIRCUIT		
<ul style="list-style-type: none"> Leave Diagnostic Monitor disconnected and key in ON position. Is air bag lamp ON? 	Yes	REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
	No	GO to N-3.
N-3 CHECK INSTRUMENT CLUSTER		
<ul style="list-style-type: none"> Is the air bag lamp operated by an electronic (digital) instrument cluster? 	Yes	GO to N-4.
	No	LOCATE and SERVICE the open circuit in the air bag lamp circuitry. CHECK for a burned out bulb, open connectors, pushed out pins, blown fuse, etc. RECONNECT system. VERIFY system. REACTIVATE system.
N-4 CHECK FOR ELECTRONIC INSTRUMENT CLUSTER		
<ul style="list-style-type: none"> Remove the block locking wedge from the Diagnostic Monitor harness connector. Measure the voltage between pin 4 (+) and 3 (-). Is the voltage equal to battery voltage? 	Yes	REPLACE instrument cluster RECONNECT/VERIFY/REACTIVATE system.
	No	CHECK connectors on cluster. REPLACE instrument cluster if no poor connections are located. RECONNECT system. VERIFY system. REACTIVATE system.

TR8573A

Continuous Air Bag Lamp**Diagnostic Monitor Disconnected or Inoperative****Circuit Description****Normal Operation**

The air bag lamp is designed to illuminate for 6 (\pm 2) seconds when the ignition key is turned to the ON position. This initial 6 seconds of air bag lamp illumination (continuous lamp) is considered normal operation and is called prove out of the air bag lamp. If the diagnostic monitor detects any faults in the air bag system following prove out, it will flash the air bag lamp a series of times to indicate the fault code that has been detected. If the air bag lamp comes on when the ignition key is turned to the ON position and stays on for more than 8 seconds continuously, then a fault exists in the air bag lamp circuit.

The air bag diagnostic monitor incorporates a solid state circuit that shorts the air bag lamp line (Circuit 608 BK/Y) to ground to turn the air bag lamp on. When the gray diagnostic monitor harness connector is unplugged from the diagnostic monitor, a shorting bar within the harness connector connects pins 4 (air bag lamp) and 5 (ground) together. Therefore, the shorting bar will turn the air bag lamp on whenever the gray diagnostic monitor harness connector is disconnected. Because the shorting bar makes a continuous connection between pins 4 and 5 when the connector is disconnected, the air bag lamp will not flash; instead, it will be illuminated continuously.

When the ignition key is turned on, the computer inside the diagnostic monitor "wakes up" and after approximately 6 seconds turns the air bag lamp off. If the computer fails to wake up, the lamp driver circuit will automatically turn the air bag lamp on continuously indicating a problem in the air bag diagnostic monitor or at the gray diagnostic monitor connector.

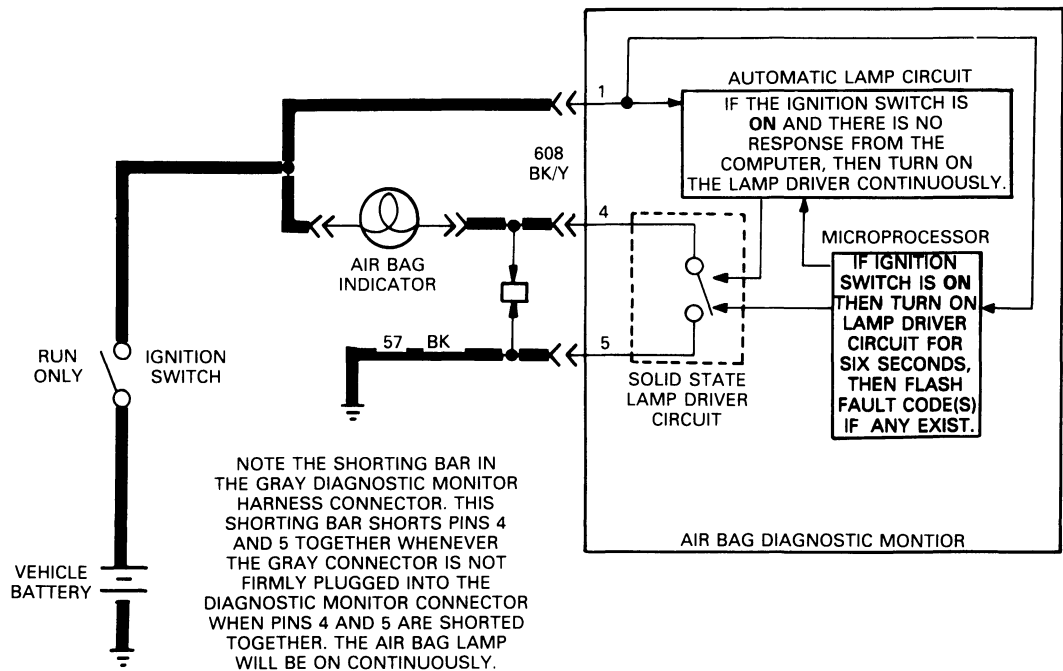
Possible Causes

Continuous illumination of the air bag lamp can be caused by:

DIAGNOSIS AND TESTING (Continued)

1. A disconnected or poorly connected diagnostic monitor may not push the shorting bar between pins 4 and 5 into its fully retracted position. This shorts the air bag lamp line to ground and causes the air bag lamp to glow continuously.
2. Shorted air bag lamp wiring.
3. A faulty diagnostic monitor.

Continuous Lamp Wiring Schematic



R9436-A

CONTINUOUS LAMP

TEST STEP		RESULT	ACTION TO TAKE
C-1	CHECK IF DIAGNOSTIC MONITOR IS CONNECTED		
	<ul style="list-style-type: none">Deactivate the air bag system.Inspect connectors on Diagnostic Monitor.Are the connectors fully pushed together?	Yes No	GO to C-2. Firmly mate the connectors to the Diagnostic Monitor. VERIFY system. REACTIVATE system.
C-2	CHECK LAMP CIRCUITRY		
	<ul style="list-style-type: none">Disconnect Diagnostic Monitor.Remove plastic locking wedge from the gray Diagnostic Monitor harness connector.Turn key to ON position.Is the air bag lamp on?	Yes No	LOCATE and SERVICE the short to ground (in Circuit) RECONNECT system. VERIFY system. REACTIVATE system. GO to C-3.

DIAGNOSIS AND TESTING (Continued)**CONTINUOUS LAMP (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
C-3	INSPECT SHORTING BAR		
<ul style="list-style-type: none"> Inspect the shorting bars on the plastic locking wedge for proper operation. Compare with another vehicle if necessary. Is the shorting bar in good working condition? 		Yes	REPLACE Diagnostic Monitor. RECONNECT system / VERIFY system. REACTIVATE system.
		No	REPLACE the plastic locking wedge with the correct replacement. Make sure Diagnostic Monitor has shorting bars on the locking wedge. RECONNECT system. VERIFY system. REACTIVATE system.

TR8574A

Fault Code 12**Air Bag Deployment Circuit Drop in Battery Voltage****Circuit Description****Normal Operation**

The diagnostic monitor measures the voltage at pin 13 of the diagnostic monitor connector. Voltage at pin 13 should be equal to battery voltage. If the voltage measured at pin 13 drops to less than 9 volts, the diagnostic monitor will flash out code 12.

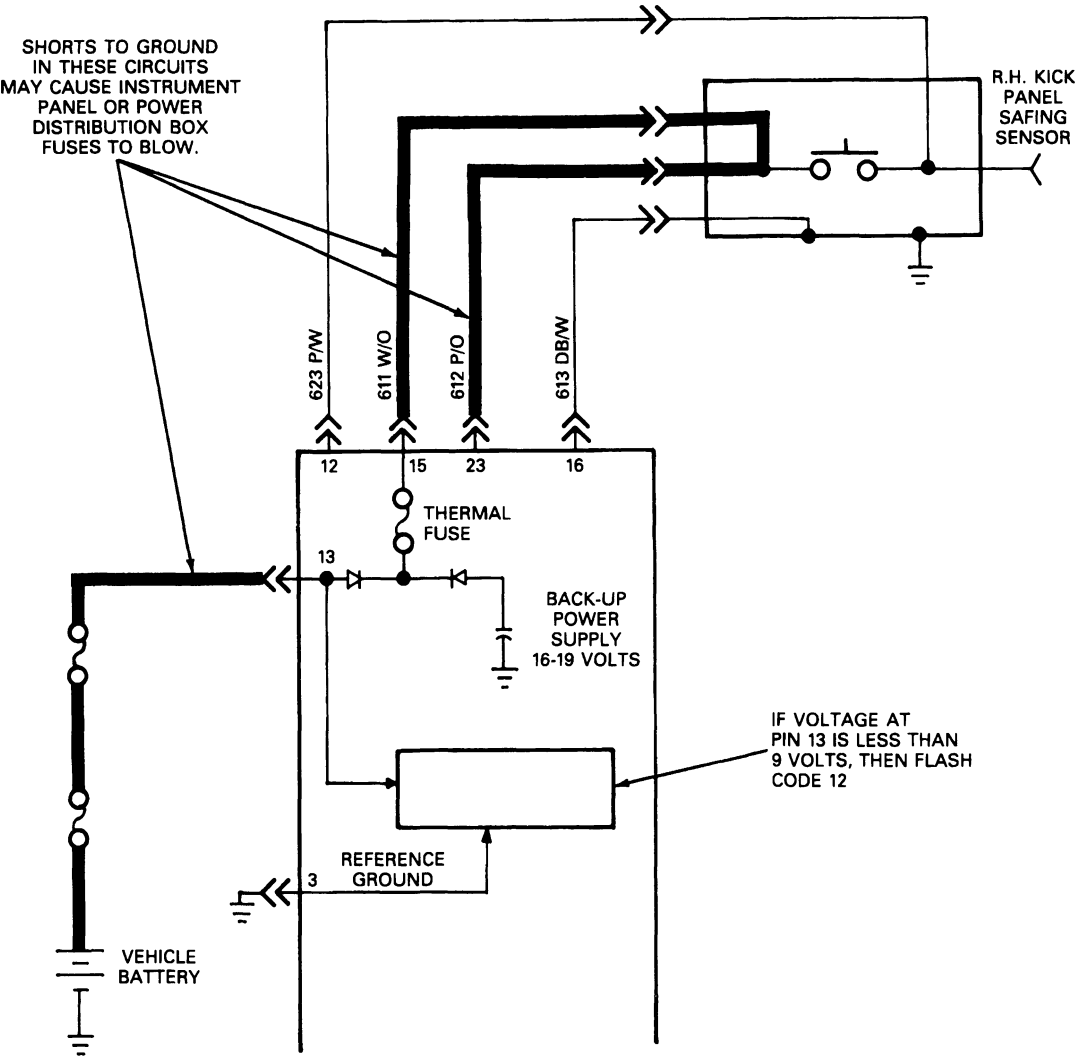
Possible Causes

A drop in battery voltage at diagnostic monitor pin 13 can be caused by:

1. An open circuit that would prevent battery voltage from reaching diagnostic monitor pin 13.
NOTE: If the instrument panel fuse and / or the power distribution fuse are blown, be sure to diagnose the system for possible causes 2 and 3 below.
2. A short to ground in Circuit 611 (W/O) or 612 (P/O) may result in a blown instrument panel fuse and / or power distribution fuse.
3. An internal short to ground within the safing sensor may result in a blown instrument panel fuse and / or power distribution fuse.
4. A problem in the charging system causing battery voltage to drop below 9 volts.

DIAGNOSIS AND TESTING (Continued)

Code 12 Wiring Schematic



R9456-A

CODE 12

TEST STEP		RESULT	ACTION TO TAKE
12-1	VERIFY CONDITION		
<ul style="list-style-type: none">● Turn key to ON.● Count fault code (if any).● Is code 12 flashing?		Yes	▶ GO to 12-2.
		No	▶ READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with pinpoint tests until the code is flashing! Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.

DIAGNOSIS AND TESTING (Continued)**CODE 12 (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
12-2	VOLTAGE CHECK		
	<ul style="list-style-type: none"> Deactivate system. Disconnect Diagnostic Monitor. Turn ignition switch from OFF to RUN. Measure voltage between Diagnostic Monitor connector pins 13 (+) and 3 (-). Is voltage on pin 13 equal to battery voltage? 	Yes	REPLACE Diagnostic Monitor. GO to 12-2.
		No	GO to 12-3.
12-3	CHECK FUSE		
	<ul style="list-style-type: none"> Check power feed fuse. Is fuse blown? 	Yes	REPLACE fuse. GO to 12-4.
		No	LOCATE and SERVICE the open circuit between fuse 15 and pin 13 of the harness connection. GO to 12-6.
12-4	CHECK FOR SHORT IN HARNESS		
	<ul style="list-style-type: none"> Replace fuse. Does fuse blow again? 	Yes	LOCATE and SERVICE the short to ground between fuse and pin 13 of the Diagnostic Monitor harness connector. GO to 12-6.
		No	GO to 12-5.
12-5	CHECK FOR SHORT IN CIRCUIT 611 AND 612		
	<ul style="list-style-type: none"> Reconnect Diagnostic Monitor. Turn ignition switch from OFF to RUN. Did fuse blow again? 	Yes	LOCATE and SERVICE short to ground in Circuit 611 (W/O) pin 15 or Circuit 12 (P/O) pin 13. GO to 12-6.
		No	The short to ground is intermittent. CHECK all circuits between the fuse Diagnostic Monitor pin 13 for pinched wires. Also check Circuit 611 (W/O) and 612 (P/O) for intermittent shorts. LOCATE and SERVICE intermittent short. GO to 12-6.
12-6	VERIFY SYSTEM		
	<ul style="list-style-type: none"> Replace fuse if necessary. Reconnect and reactivate system. Verify lamp. 		

TR8575A

Fault Code 13**Air Bag or Crash Sensor Circuit Short to Ground****Normal Operation**

The diagnostic monitor measures the voltage at pin 11 (Circuit 614 GY/O) of the diagnostic monitor connector. The voltage at pin 11 varies with charging system voltage (the expected voltage at pin 11 is shown in the chart below).

Pin 11 Voltage	System Voltage
1.9	9.0
2.0	9.5
2.1	10.0
2.2	10.5
2.3	11.0
2.4	11.5
2.5	12.0
2.6	12.5

(Continued)

DIAGNOSIS AND TESTING (Continued)

Pin 11 Voltage	System Voltage
2.7	13.0
2.7	13.5
2.9	14.0
3.0	14.5
3.1	15.0
3.2	15.5
3.3	16.0

TR8570A

Note that Circuit 614 is connected to Circuit 615 (GY/W) through the driver side air bag. Also, note that Circuit 615 is connected to the primary crash sensor feed Circuits 617 (PK/O) and 619 (PK/W) through a diode inside the diagnostic monitor. If the diagnostic monitor measures a voltage of 2.0 volts or less at pin 11, the monitor will flash out code 13 to indicate a possible short to ground on this circuit (see possible causes below for additional circuits that may be shorted to ground). When flashing code 13, the diagnostic monitor blows its internal thermal fuse. This disables the air bag deployment circuit. If the short to ground is corrected, the voltage at pin 11 will return to normal and a fault code 51 will flash, indicating an open thermal fuse (see Fault Code 51 for details).

NOTE: Fault code 13 will flash only while the short to ground is present.

Possible Causes

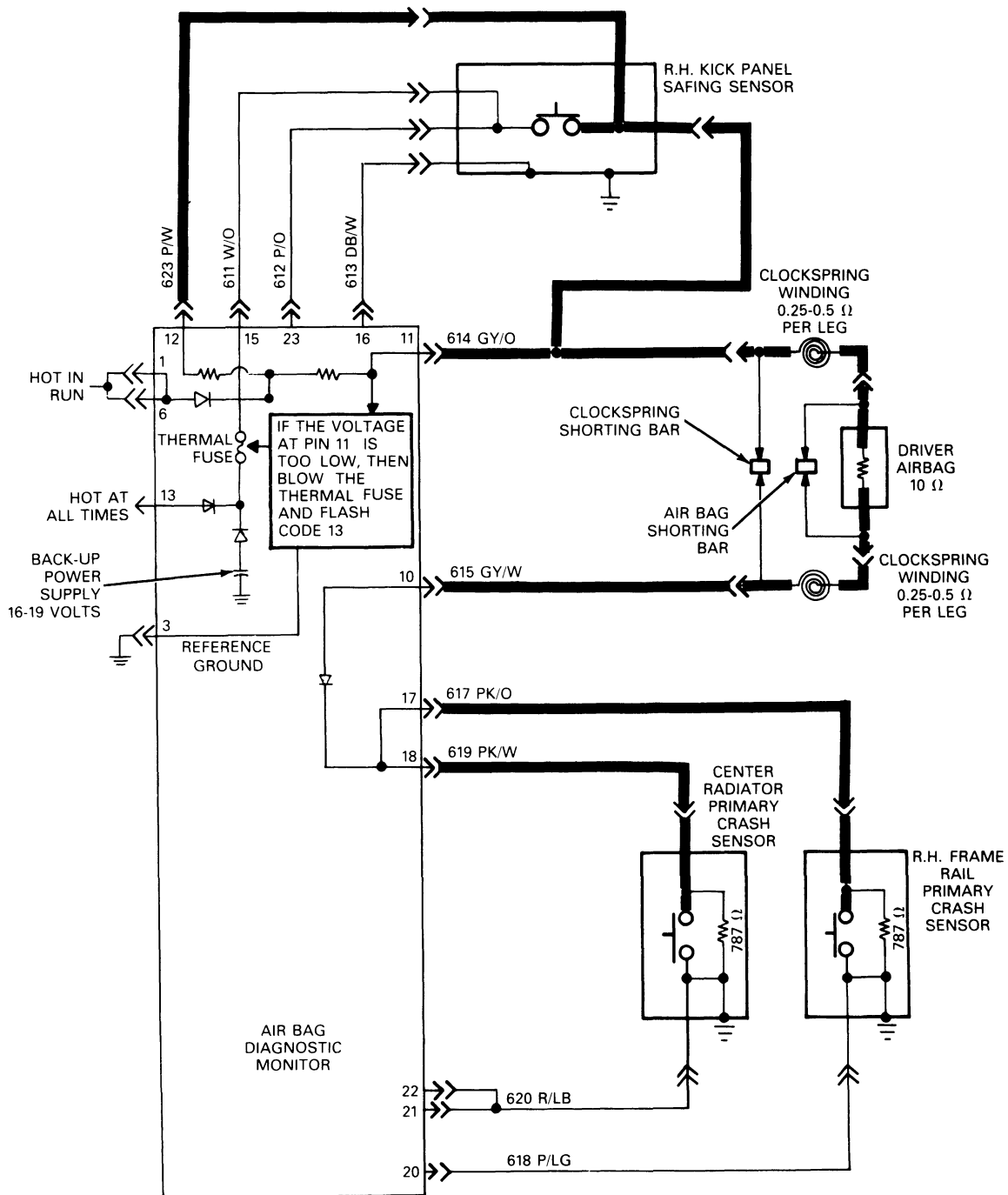
Low voltage at diagnostic monitor pin 11 can be caused by:

1. A short to ground within the wiring harness or Circuits 614 (GY/O), 615 (GY/W), 623 (P/W), 617 (PK/O) or 619 (PK/W) causing the diagnostic voltage to drop.
2. An internal short to ground within the clockspring assembly causing the driver side air bag circuit(s) to be shorted to ground.
3. An internal short to ground within the safing sensor causing Circuit 614 (GY/O) or 623 (P/W) to be shorted to ground.
4. An internal short to ground within one or more of the crash sensors causing Circuits 617 (PK/O) and 619 (PK/W) to be shorted to ground.
5. An internal short to case ground within the driver side air bag.

NOTE: Circuits 617 (PK/O) and 619 (PK/W) are connected together inside the diagnostic monitor. Therefore, a short to ground on any of these circuits will short all of the circuits to ground.

DIAGNOSIS AND TESTING (Continued)

Fault Code 13 Wiring Schematic



R9457-A

DIAGNOSIS AND TESTING (Continued)

CODE 13

TEST STEP		RESULT	ACTION TO TAKE
13-1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Turn key to ON. Count fault code (if any). Is code 13 flashing? 	Yes No	GO to 13-2. READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with pinpoint tests until the code is flashing! Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.
13-2	CHECK FOR SHORTED AIR BAG		
	<ul style="list-style-type: none"> Deactivate system. Carefully disconnect the air bag. Do not disturb the wiring. Turn key to ON. Is code 13 still flashing? 	Yes No	GO to 13-3. GO to 13-6.
13-3	CHECK FOR SHORTED WIRING		
	<ul style="list-style-type: none"> Set ohmmeter to 2000 ohms scale or Auto. Disconnect negative battery cable. Measure the resistance between pin 3 (ground) and all of the following: pin 11 (Circuit 614, GY/O) pin 17 (Circuit 617, PK/O) pin 18 (Circuit 619, PK/W) Normal resistance for these pins is as follows: pin 11 open, infinite resistance, pin 17 787 ± 10 ohms, pin 18 787 ± 10 ohms. <ul style="list-style-type: none"> Are any of these circuits shorted to ground? 	Yes No	If pin 11 is shorted to ground, GO to 13-4. If pin 17 or 18 are shorted to ground GO to 13-5. GO to 13-7.
13-4	CHECK RESISTANCE IN CLOCKSPrING		
	<ul style="list-style-type: none"> Examine wiring connector where clockspring mates to the main vehicle harness underneath the steering column. Check for pinched and/or chafed wires. Service any damaged wiring. GO to 13-7 if damaged wiring is located. If no damaged wiring is located, disconnect clockspring from main harness, connect the air bag, simulator to main vehicle harness in place of the clockspring. Measure the resistance of pin 11 to ground. Is pin 11 still shorted to ground? 	Yes No	LOCATE and SERVICE the short to ground in either Circuit: 623 — (P/W) 614 — (GY/O) 615 — (GY/W) 616 — (PK/BK) Pass. BA. Vehicles Only. CHECK OASIS for potential locations where shorts may occur. When short has been serviced, GO to 13-7. REPLACE clockspring. GO to 13-7.
13-5	LOCATE SHORTED SENSOR WIRING		
	<ul style="list-style-type: none"> Locate and disconnect the primary crash sensor that was shorted to ground. Measure resistance across the sensor contacts at the sensor connector. Normal resistance for a crash sensor is 787 ± 10 ohms. Is the sensor shorted? NOTE: Be sure to measure across the PK/W and P/LB wires to the center front crash sensor.	Yes No	REPLACE the primary crash sensor. GO to 13-7. LOCATE and SERVICE the short to ground in the wiring harness on the shorted circuit. GO to 13-7.
13-6	CHECK CLOCKSPrING		
	<ul style="list-style-type: none"> Examine the clockspring in the steering wheel hub for pinched or chafed wires. Do wires check OK? 	No Yes	REPLACE clockspring. REPLACE air bag. GO to 13-7.

DIAGNOSIS AND TESTING (Continued)**CODE 13 (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
13-7	SHORT TO GROUND REPAIRED OR CORRECTED		
	<ul style="list-style-type: none"> After a short to ground has been corrected, the Diagnostic Monitor will flash out code 51. Code 51 indicates that the fuse inside the Diagnostic Monitor is blown and the short to ground no longer exists. If a short to ground has not been located and serviced (short to ground corrected itself), consult OASIS for potential wiring shorts. If a short to ground has been correctly located and serviced then refer to Fault Code 51 in this section. 		REFER to Fault Code 51 in this section.

TR9401A

Fault Code 21**Safing Sensor Not Mounted to Vehicle Properly****Circuit Description****Normal Operation**

Circuit 613 (DB/W) is riveted to the side of the safing sensor housing and the housing is grounded to the vehicle. A resistor inside the diagnostic monitor is connected to pin 16 (Circuit 613, DB/W) and a 5-volt reference voltage. If Circuit 613 is properly grounded, the voltage at pin 16 will be 0 volts. If the voltage on Circuit 613 is greater than 0.7 volts, the diagnostic monitor may flash code 21, indicating that the safing sensor is not grounded properly to the vehicle.

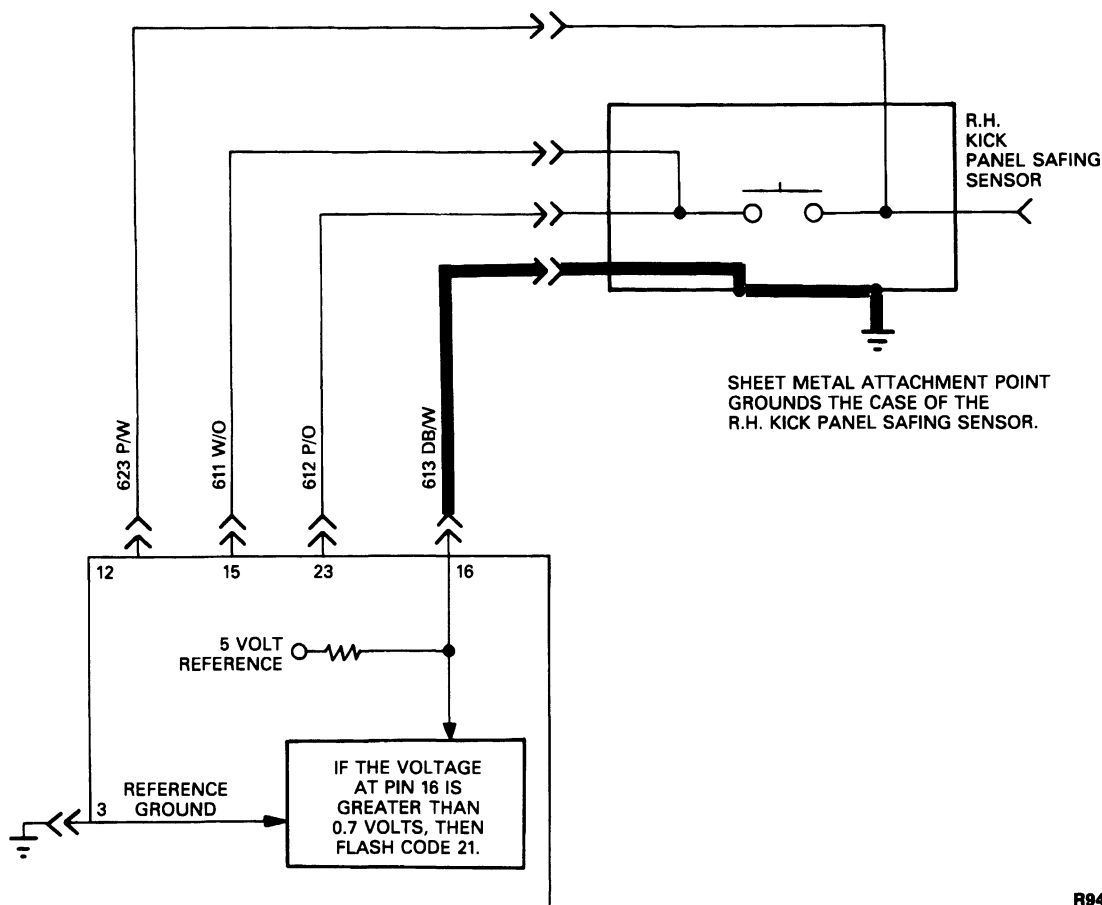
Possible Causes

High voltage at pin 16 can be caused by:

1. A poor connection due to loose mounting, dirt, or corrosion at the safing sensor mounting surface.
2. An open or damaged wire in Circuit 613 (DB/W) from pin 16 of the diagnostic monitor connector to the safing sensor.
3. An open wire or loose rivet inside the safing sensor.

DIAGNOSIS AND TESTING (Continued)

Code 21 Wiring Schematic



R9458-A

CODE 21

TEST STEP		RESULT	ACTION TO TAKE
21-1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Turn key to ON Count fault code (if any) Is code 21 flashing? 	Yes No	GO to 21-2. READ the normal operation description for this fault code, EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.) Do not proceed with pinpoint tests until the code is flashing. Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.
21-2	CHECK LEFT SAFING SENSOR GROUND		
	<ul style="list-style-type: none"> Deactivate system. Disconnect battery ground cable. Measure resistance between pin 3 (ground) and pin 16 — Circuit 613 (DB/W) — safing sensor ground. Is the resistance greater than 2 ohms? 	Yes No	GO to 21-3. REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVE system.

DIAGNOSIS AND TESTING (Continued)**CODE 21 (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
21-3	CHECK SAFING SENSOR CIRCUIT		
	<ul style="list-style-type: none"> ● Disconnect RH kick panel safing sensor. ● Measure resistance of (Circuit 613 DB/W) sensor wire to the sensor mounting sheet metal. ● Is resistance greater than 2 ohms? 	Yes No	GO to 21-4. LOCATE and SERVICE the high resistance or open circuit in Circuit 613 (DB/W). RECONNECT system. VERIFY system. REACTIVATE system.
21-4	CHECK SAFING SENSOR		
	<ul style="list-style-type: none"> ● Remove RH kick panel safing sensor from mounting to vehicle. ● Thoroughly clean the sensors mounting surface. ● Install the safing sensor. ● Measure the (Circuit 613 DB/W) sensor wire to ground. ● Is the resistance greater than 2 ohms? 	Yes No	REPLACE the safing sensor. RECONNECT system. VERIFY system. REACTIVATE system. RECONNECT system, VERIFY system. REACTIVATE system.

Fault Code 22**Safing Sensor Circuit Shorted to Battery Voltage****Circuit Description****Normal Operation**

The diagnostic monitor measures voltage at pins 11 (Circuit 614, GY/O) and 12 (Circuit 623, P/W). The voltage at these pins is controlled by two resistors inside the diagnostic monitor (along with the resistors inside the crash sensors. Refer to normal operation for code 24 for more information). This voltage varies with charging system voltage (the expected voltage at pins 11 and 12 are shown in the chart below). If the voltage at both of these pins exceeds 5 volts, the diagnostic monitor will flash out code 22.

Pin 11 and Pin 12 Voltage	System Voltage
1.9	9.0
2.0	9.5
2.1	10.0
2.2	10.5
2.3	11.0
2.4	11.5
2.5	12.0
2.6	12.5
2.7	13.0
2.7	13.5
2.9	14.0
3.0	14.5

(Continued)

Pin 11 and Pin 12 Voltage	System Voltage
3.1	15.0
3.2	15.5
3.3	16.0

TR8572A

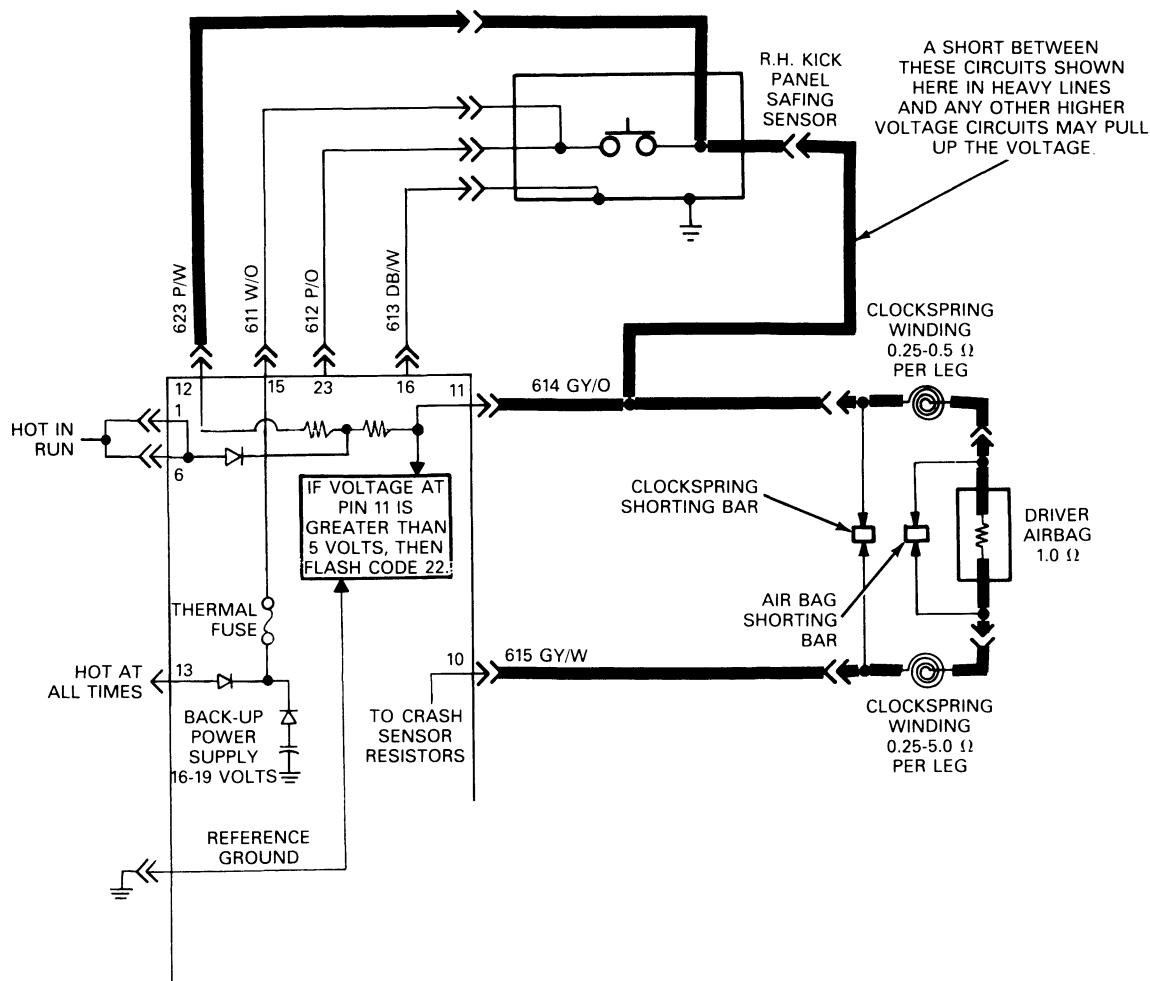
Possible Causes

High voltage at pins 11 and 12 can be caused by:

1. A short in the wiring harness between Circuits 614 (GY/O) or 623 (P/W) and another wire can cause high voltage on these circuits.
 NOTE: The wiring harness leading to the safing sensor carries higher voltage circuits that may short to Circuits 614 and 623.
2. A short in the clockspring between circuit 614 and some of the horn or speed control wiring.
3. A short across the normally open contacts of the safing sensor.
 NOTE: The voltage at Circuits 611 and 612 inside the safing sensor is usually battery voltage or higher. There should be an open circuit across the contacts of the safing sensor if the sensor is operating normally. If the sensor contacts are closed, the voltage on Circuits 614 and 623 would be high (at least battery voltage).
4. Vehicle charging system voltage too high. If the alternator output voltage is too high (greater than 17 volts) it may cause a code 22 to occur.

DIAGNOSIS AND TESTING (Continued)

Code 22 Wiring Schematic



R9459-A

CODE 22

TEST STEP		RESULT	ACTION TO TAKE
22-1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Turn key to ON. Count fault code (if any). Is code 22 flashing? 	Yes No	GO to 22-2. READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.) Do not proceed with pinpoint tests until the code is flashing. Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.

DIAGNOSIS AND TESTING (Continued)

CODE 22 (Continued)		
TEST STEP	RESULT	ACTION TO TAKE
22-2 CHECK FOR SHORTED CIRCUIT		
<ul style="list-style-type: none"> Deactivate system. Measure voltage on Circuit 614 (GY/O) — pin 11 to pin 3 (ground). Is the voltage measured high? Use voltage table specification. 	Yes	LOCATE and SERVICE the short to B+ on Circuit 614 (GY/O). GO to 22-3 .
	No	REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
22-3 CHECK FOR SHORTED WIRING		
<ul style="list-style-type: none"> Check for resistance across RH kick panel safing sensor contacts. Is resistance infinite (open)? 	Yes	CHECK for other wire to wire shorts. REPAIR short. RECONNECT system. VERIFY system. REACTIVATE system.
	No	REPLACE RH kick panel safing sensor. RECONNECT system. VERIFY system. REACTIVATE system.

Fault Code 23**Safing Sensor Circuit — Battery Feed Circuit Open****Circuit Description****Normal Operation**

Battery voltage is provided at diagnostic monitor pin 15 (Circuit 611, W/O) at all times. However, voltage at pin 15 can be as high as 19 volts (as provided by the backup power supply) when the ignition switch is in the ON position and the backup power supply in the diagnostic monitor is charged up. Circuit 612 (P/O) is connected to Circuit 611 (W/O) inside the safing sensor. Therefore, the voltage at pin 23 (Circuit 612, P/O) should be the same as the voltage at pin 15 at all times. The diagnostic monitor compares the voltage available at pins 15 and 23. If the voltage at pin 23 is low, the diagnostic monitor will flash out code 23 to indicate an open between these two circuits.

Possible Causes

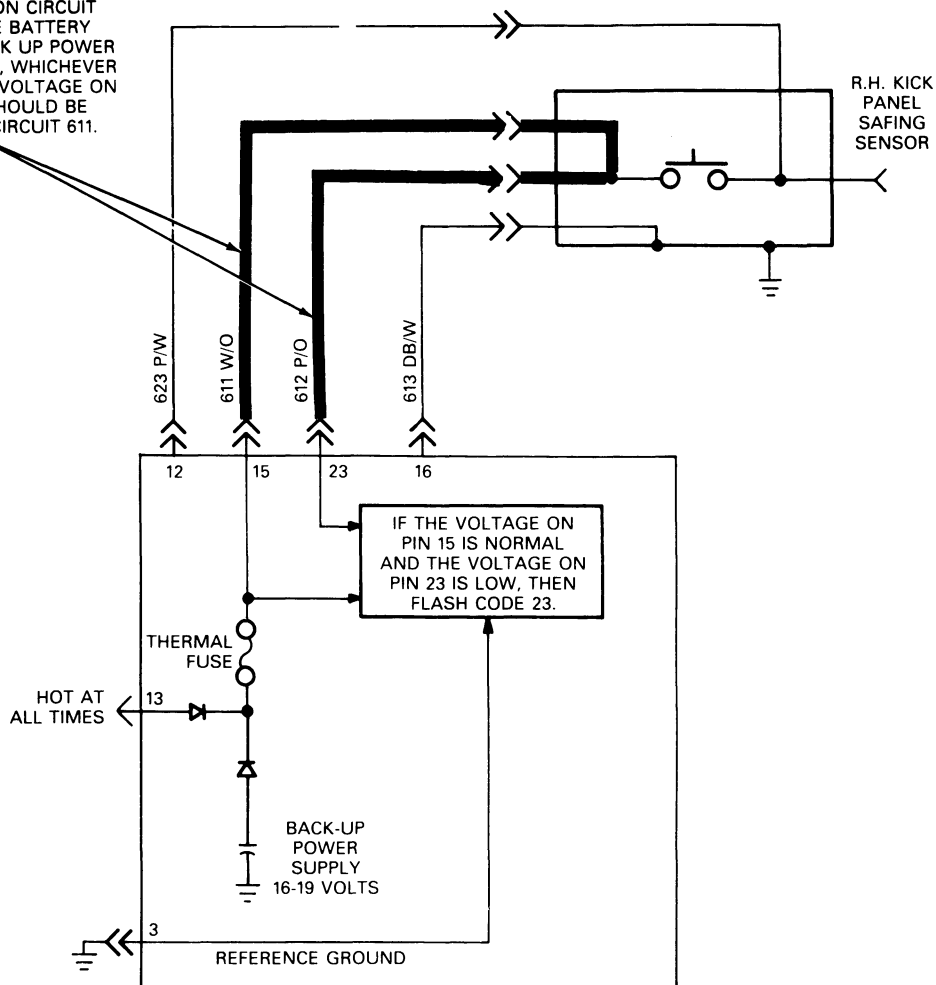
Low voltage at pin 23 can be caused by:

1. An open circuit in the wiring harness in either Circuit 611 (W/O) or 612 (P/O).
2. An open circuit inside the safing sensor across the W/O and P/O wires.

DIAGNOSIS AND TESTING (Continued)

Code 23 Wiring Schematic

THE VOLTAGE ON CIRCUIT 611 SHOULD BE BATTERY VOLTAGE OR BACK UP POWER SUPPLY VOLTAGE, WHICHEVER IS GREATER. THE VOLTAGE ON CIRCUIT 612 SHOULD BE THE SAME AS CIRCUIT 611.



R9460-A

CODE 23

TEST STEP		RESULT	ACTION TO TAKE
23-1	VERIFY CONDITION	Yes	GO to 23-2.
	<ul style="list-style-type: none"> Turn key to ON Count fault code (if any) Is code 23 flashing? 	No	READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.) Do not proceed with pinpoint tests until the code is flashing. Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.

DIAGNOSIS AND TESTING (Continued)

CODE 23 (Continued)			
TEST STEP		RESULT	ACTION TO TAKE
23-2	DEACTIVATE SYSTEM		
<ul style="list-style-type: none"> Deactivate system. Turn key off then on. Wait 30 seconds. Measure voltage on the following pins using pin 3 as a ground: Pin 15 — Circuit 611 (W/O) Pin 23 — Circuit 612 (P/O). Is the voltage on these pins normal? (Use the voltage tables for the normal specification.) 		Yes	REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
		No	GO to 23-3.
23-3	CHECK CIRCUIT CONTINUITY		
<ul style="list-style-type: none"> Disconnect the RH Kick Panel safing sensor. Measure the resistance across the (Circuit 611 W/O) and (Circuit 612 P/O) wires on the sensor connector. Is there continuity across the circuits? 		Yes	An open exists in the harness. LOCATE and SERVICE the open wire in either Circuit 611 or 612. RECONNECT the system. VERIFY system. REACTIVATE the system.
		No	REPLACE the five-wire safing sensor. RECONNECT the system. VERIFY the system. REACTIVATE the system.

Fault Code 24**Safing Sensor Diagnostic Circuit Open or Low Resistance in a Primary Crash Sensor****Circuit Description****Normal Operation**

Each primary crash sensor has an internal resistor. The diagnostic monitor uses the resistor in the primary crash sensors in combination with the two resistors inside the diagnostic monitor to create a tightly controlled diagnostic voltage at pin 11 (Circuit 614, GY/O). The primary crash sensors are tied together inside the diagnostic monitor at pins 17 (Circuit 617, PK/O) and 18 (Circuit 619, PK/W). Therefore, the resistors in the sensors are connected in parallel. The parallel combination of all the sensor resistors should be equal to 393 ohms.

The resistors inside the diagnostic monitor are connected to pins 11 (Circuit 614, GY/O) and 12 (Circuit 623, P/W) and are equal in value. Note that Circuits 614 and 623 are tied together inside the safing sensor. Therefore the two resistors inside the diagnostic monitor are connected in parallel and will function the same as one resistor of half the original value. Current flows from the ignition voltage within diagnostic monitor, through the resistors, out to Circuits 614 (GY/O) and 623 (P/W) on pins 11 and 12, through the RH kick panel safing sensor and out to the air bag. Current flows through the air bag and into pin 10 (Circuit 615, GY/W).

Current then flows from pin 10 through the diode inside the diagnostic monitor and out to the primary crash sensors through pins 17 and 18. The current flows through each primary crash sensor resistor and terminates at the case ground of each sensor. Pin 11 is the midpoint of the resistor network and voltage at pin 11 will change with charging system voltage. The expected voltage at pin 11 is shown in the table below. The diagnostic monitor measures the vehicle charging system voltage at pin 13 (battery input). By measuring the voltage at pin 13, the diagnostic monitor can accurately predict what the voltage at pin 11 should be in a normal functioning system.

If the connection between Circuits 614 (GY/O) and 623 (P/W) inside the safing sensor is broken, then the resistor on pin 12 is no longer in the diagnostic circuit explained above. Both resistors are needed to pull up the diagnostic voltage to the correct value. In this situation, the resistor on pin 11 is the only resistor inside the diagnostic monitor pulling up the voltage. Therefore, the voltage on pin 11 will be half of the normal expected voltage and the voltage on pin 12 will be approximately equal to the vehicle charging system voltage.

The diagnostic monitor does not measure the voltage on pin 12, so the monitor bases its decision strictly on the voltage at pin 11. If the voltage at pin 11 is lower than it should be, the monitor will flash code 24.

DIAGNOSIS AND TESTING (Continued)

Another situation that can cause low voltage at pin 11 is a decrease in primary crash sensor resistance (resistance is too low). If this occurs the voltage at pin 11 will be pulled down to a lower than normal value because the parallel combination resistance of the primary crash sensors will be less than 393 ohms. In this situation, the voltage at pins 11 and 12 will be identical, but the monitor does not measure the voltage at pin 12. Therefore, a primary crash sensor with low resistance may cause low voltage at pin 11 and the monitor will flash code 24 on the air bag lamp.

Possible Causes

Low voltage at pin 11 and high voltage at pin 12 can be caused by:

1. An open circuit or high resistance in the wiring harness in Circuit 614 (GY/O) or 623 (P/W).
2. An open circuit or high resistance inside the safing sensor across the GY/O and P/W wires.

Low voltage on both pins 11 and 12 can be caused by:

3. Resistance to ground on Circuit 614 or 623. Circuits 614 and 623 should be open circuits to ground when the diagnostic monitor is disconnected from the harness. Resistance to ground on these circuits can cause a drop in the diagnostic voltage on both circuits.
4. Low resistance in one or more of the primary crash sensors. If the resistance of one or more of the primary crash sensors is lower than normal, the voltage on pin 11 will be pulled down too low.
5. A poor ground on pin 3 of the diagnostic monitor may cause voltage to appear on the diagnostic monitor ground reference. Any voltage on the ground reference will cause the diagnostic monitor to measure the voltage at pin 11 as low, even though the voltage on pin 11 with respect to sheet metal is normal.

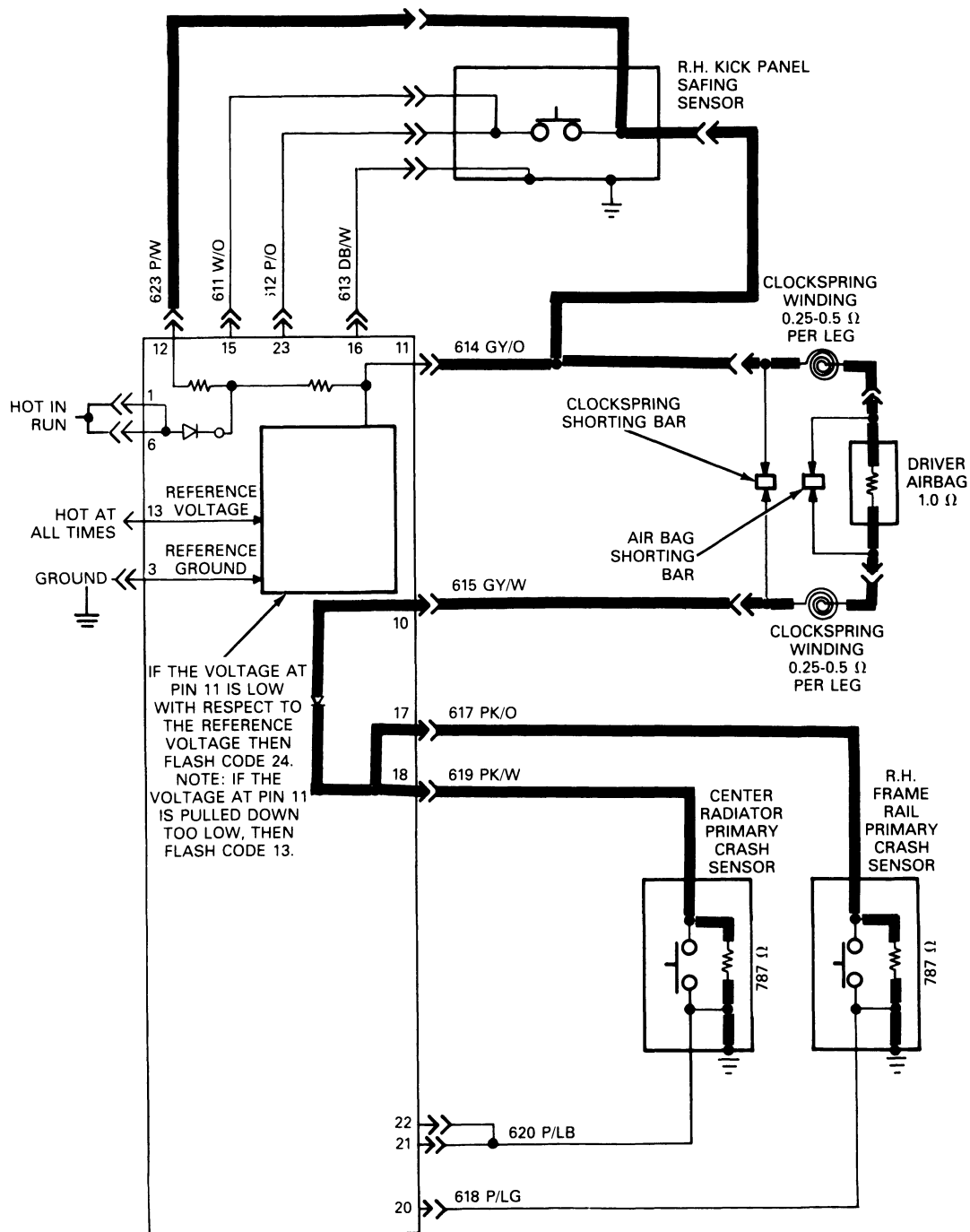
6. Intermittent battery voltage at pin 13 can cause the reference voltage inside the diagnostic monitor to fluctuate and can cause fault code 24 in some circumstances.

Pin 11 and Pin 12 Voltage	System Voltage
1.9	9.0
2.0	9.5
2.1	10.0
2.2	10.5
2.3	11.0
2.4	11.5
2.5	12.0
2.6	12.5
2.7	13.0
2.7	13.5
2.9	14.0
3.0	14.5
3.1	15.0
3.2	15.5
3.3	16.0

TR8572A

DIAGNOSIS AND TESTING (Continued)

Code 24 Wiring Schematic



R9461-A

DIAGNOSIS AND TESTING (Continued)

CODE 24

TEST STEP		RESULT	ACTION TO TAKE
24-1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Turn key to ON. Count fault code (if any). Is code 24 flashing? 	Yes No	GO to 24-2. READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.) Do not proceed with pinpoint tests until the code is flashing. Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.
24-2	DEACTIVATE SYSTEM		
	<ul style="list-style-type: none"> Deactivate system. Turn the ignition key off then on. Using pin 3 as a ground measure voltage on the following circuits: Pin 11 — Circuit 614 (GY/O) Pin 12 — Circuit 623 (P/W). Are voltages at these terminals within specification? (Use the voltage table for normal specifications.) 	Yes No, both terminals measure low voltage. No, pin 12 measures high and pin 11 measures low.	CHECK the "Hot at All Times" voltage feed circuit, from the fuse block to pin 13 of the Diagnostic Monitor harness connector for intermittent open circuits. If none are found, REPLACE the Diagnostic Monitor. RECONNECT the system. VERIFY the system. REACTIVATE the system. GO to 24-3. GO to 24-4.
24-3	CHECK CIRCUIT RESISTANCE		
	<ul style="list-style-type: none"> Turn the ignition OFF. Disconnect the Diagnostic Monitor. Disconnect the battery ground cable. Using pin 3 as a ground, measure the resistance of the following pins in the Diagnostic Monitor harness connector: Pin 17 — Circuit 617 (PK/O) Pin 18 — Circuit 619 (PK/W) Are all resistance measurements 787 ohms (± 10) ohms? 	Yes No	GO to 24-6. GO to 24-5.
24-4	CHECK FOR SHORTED CIRCUIT		
	<ul style="list-style-type: none"> Turn ignition key OFF then ON. Disconnect the RH kick panel safing sensor. Measure the resistance across the (Circuit 614 GY/O) and (Circuit 623 P/W) wires in the sensor connector. Is there a short circuit across the (Circuit 614 GY/O) and (Circuit 623 P/W) wires? 	Yes No	LOCATE and SERVICE the short in Circuit 614 (GY/O) or Circuit 623 (P/W). RECONNECT system. VERIFY system. REACTIVATE system. REPLACE the RH kick panel safing sensor. RECONNECT system. VERIFY system. REACTIVATE system.

DIAGNOSIS AND TESTING (Continued)

CODE 24 (Continued)			
TEST STEP		RESULT	ACTION TO TAKE
24-5	CHECK SENSOR RESISTANCE		
<ul style="list-style-type: none"> Disconnect the abnormal primary crash sensor from the harness. Measure the resistance directly across the crash sensor contacts. Is the resistance within specification? 		Yes	<ul style="list-style-type: none"> LOCATE and SERVICE the short to ground in the wiring harness. RECONNECT system. VERIFY system. REACTIVATE system.
		No	<ul style="list-style-type: none"> REPLACE the primary crash sensor. RECONNECT system. VERIFY system. REACTIVATE system.
24-6	CHECK FOR SHORTED CIRCUIT		
<ul style="list-style-type: none"> Using pin 3 as a ground, measure the resistance of pin 11 — Circuit 614 (GY/O) to ground (ohmmeter must be on its highest scale.) Is the circuit open? 		Yes	<ul style="list-style-type: none"> REPLACE the Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
		No	<ul style="list-style-type: none"> LOCATE and SERVICE short to ground in either Circuit 614 (GY/O), 615 (GY/W), 623 (P/W). Also CHECK air bag, clockspring, and RH kick panel safing sensor for internal shorts to ground. Once repaired RECONNECT system. VERIFY system. REACTIVATE system.

Fault Code 32**Driver Side Air Bag High Resistance or Open in Circuit****Circuit Description****Normal Operation**

The diagnostic monitor measures the resistance across pin 10 (Circuit 615, GY/W) and pin 11 (Circuit 614, GY/O) every time the ignition switch is turned to the ON position. Normal resistance across these circuits is between 1.5 and 2.0 ohms. This resistance comes from the air bag itself (approximately 1.0 ohms) and the clockspring windings (approximately 0.25 to 0.5 ohms per winding, two windings in all). If the resistance across these two circuits exceeds 4.0 ohms, this indicates a high resistance and the diagnostic monitor will flash code 32.

NOTE: The connectors for the air bag and the clockspring have metal spring clips that act as shorting bars. These shorting bars are built into the plastic hardshell connectors. The shorting bars are designed to short Circuits 614 and 615 together when the connectors are not mated. **Do not attempt to remove the air bag shorting bar and measure the resistance of the air bag.**

The clockspring shorting bar may be removed to measure the clockspring resistance. Use extreme care when reinstalling the shorting bar to ensure it is installed correctly.

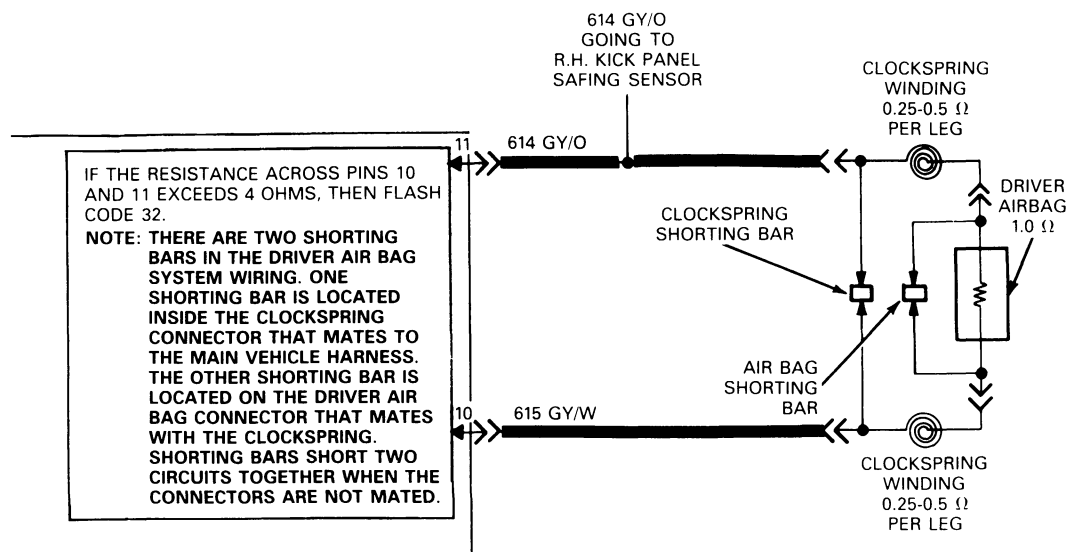
Possible Causes

Excessive resistance across pins 10 and 11 can be cause by:

1. A poor connection where the clockspring connects into the main wiring harness. The clockspring connector at the base of the steering column may have excessive resistance between the male and female terminals in the connector.
2. An open circuit or high resistance in the clockspring windings inside the clockspring assembly.
3. An open circuit or high resistance in the wiring harness in either Circuit 614 (GY/O) or Circuit 615 (GY/W).
4. An open circuit or high resistance in the driver side air bag. **DO NOT** attempt a direct resistance measurement of the air bag. Follow the diagnostic procedures to determine if the air bag resistance is higher than normal.

DIAGNOSIS AND TESTING (Continued)

Code 32 Wiring Schematic



R9462-A

CODE 32

TEST STEP		RESULT	ACTION TO TAKE
32-1	VERIFY CONDITION		
<ul style="list-style-type: none"> Turn key to ON Count fault code (if any) Is code 32 flashing? 		Yes	GO to 32-2.
		No	READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.) Do not proceed with pinpoint tests until the code is flashing. Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.
32-2	CHECK CIRCUIT RESISTANCE		
<ul style="list-style-type: none"> Deactivate system. Disconnect Diagnostic Monitor. Set ohmmeter on lowest scale possible (200 ohms for most meters). "Zero" the ohmmeter by touching the leads together and record the resistance reading. Remove the plastic locking wedge from the black harness connector. Measure the resistance across pin 11 — Circuit 614 (GY/O) and pin 10 — Circuit 615 (GY/W). Record the measurement. Subtract this reading from the reading made when zeroing the ohmmeter. Is the result less than 2.5 ohms? 		Yes	Make sure that the locking wedge has been removed from the black harness connector. Be sure to use the 1 ohm air bag simulator and not a jumper wire.
		No	GO to 32-3

DIAGNOSIS AND TESTING (Continued)

CODE 32 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
32-3	CIRCUIT RESISTANCE RESULTS		
	<ul style="list-style-type: none"> Is the result greater than 3.0 ohm? 	Yes No	GO to 32-5. GO to 32-4.
32-4	CHECK CONNECTOR		
	<ul style="list-style-type: none"> Reconnect the Diagnostic Monitor. Turn the ignition off, then on. Is code 32 still flashing? 	Yes No	REPLACE the Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system. INSPECT Diagnostic Monitor harness connector for improperly retained pins 10 & 11. If OK, INSTALL air bag sliding contact assembly (clockspring) service kit (F2UZ-14A664-C or -D).
32-5	CHECK CLOCKSPrING		
	<ul style="list-style-type: none"> Disconnect the clockspring at the base of the steering column. Install the air bag simulator on the main wiring harness at the base of the steering column. Measure the resistance across pin 10 — Circuit 615 (GY/W) and pin 11 — Circuit 614 (GY/O) on the Diagnostic Monitor harness connector. Subtract this reading from the reading made when zeroing the ohmmeter. Is the result equal to 2.0 ohm \pm 0.2 ohm? 	Yes No	INSTALL air bag sliding contact assembly (clockspring) service kit (F2UZ-14A664-C or -D). LOCATE and SERVICE the open in Circuit 614 or 615. RECONNECT system. VERIFY system. REACTIVATE system.

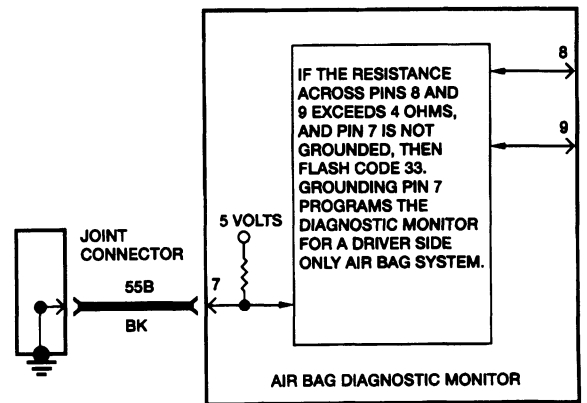
Fault Code 33**Passenger Air Bag Circuit High Resistance or Open****Circuit Description****Normal Operation**

The diagnostic monitor measures the resistance across pin 8 and pin 9 every time the ignition switch is turned to the ON position. Normal resistance across these circuits is between 0.9 ohms and 1.1 ohms with a passenger air bag installed. Pin 7 of the diagnostic monitor should be connected to ground. Connecting pin 7 to ground programs the diagnostic monitor to ignore high resistance on the passenger air bag circuits. If the resistance across these two circuits exceeds 4.0 ohms and pin 7 is not grounded, the diagnostic monitor will flash a code 33 on the air bag lamp.

Possible Causes

A high resistance or open in the air bag circuit can be caused by the following:

1. Pin 7 not connected to ground.

Electrical Schematic — Fault Code 33

R8712-A

DIAGNOSIS AND TESTING (Continued)**Pinpoint Tests — Fault Code 33****CODE 33**

TEST STEP		RESULT	ACTION TO TAKE
33-1	DEACTIVATE SYSTEM		
	<ul style="list-style-type: none"> Deactivate system. 	Yes	GO to 33-2 .
33-2	CHECK FOR GROUND		
	<ul style="list-style-type: none"> Disconnect Diagnostic Monitor. Disconnect both battery cables. Measure resistance across Diagnostic Monitor harness pin 7 and pin 3 (Ground). Is the resistance less than 10 ohms? 	Yes	REPLACE Diagnostic Monitor. RECONNECT system. VERIFY lamp.
		No	LOCATE and connect wire from pin 7 to Ground. Make sure it is connected to proper area.

Fault Code 34**Driver Side Air Bag Circuit Low Resistance or Shorted****Circuit Description****Normal Operation**

The diagnostic monitor measures the resistance across pin 10 (Circuit 615, GY/W) and pin 11 (Circuit 614, GY/O) every time the ignition switch is turned to the ON position. Normal resistance across these circuits is between 1.5 and 2.0 ohms. This resistance comes from the air bag itself (approximately 1.0 ohm) and the clockspring windings (0.25 to 0.5 ohm per winding, two windings in all). If the resistance across these two circuits is less than 0.7 ohm, the diagnostic monitor will flash code 34 on the air bag lamp.

NOTE: The connectors for the air bag and the clockspring have metal spring clips that act as shorting bars. These shorting bars are built into the plastic hardshell connectors. The shorting bars are designed to short Circuits 614 and 615 together when the connectors are not mated. **Do not attempt to remove the air bag shorting bar and measure the resistance of the air bag.** The clockspring shorting bar may be removed to measure the clockspring resistance. Use extreme care when reinstalling the shorting bar to make sure it is installed correctly.

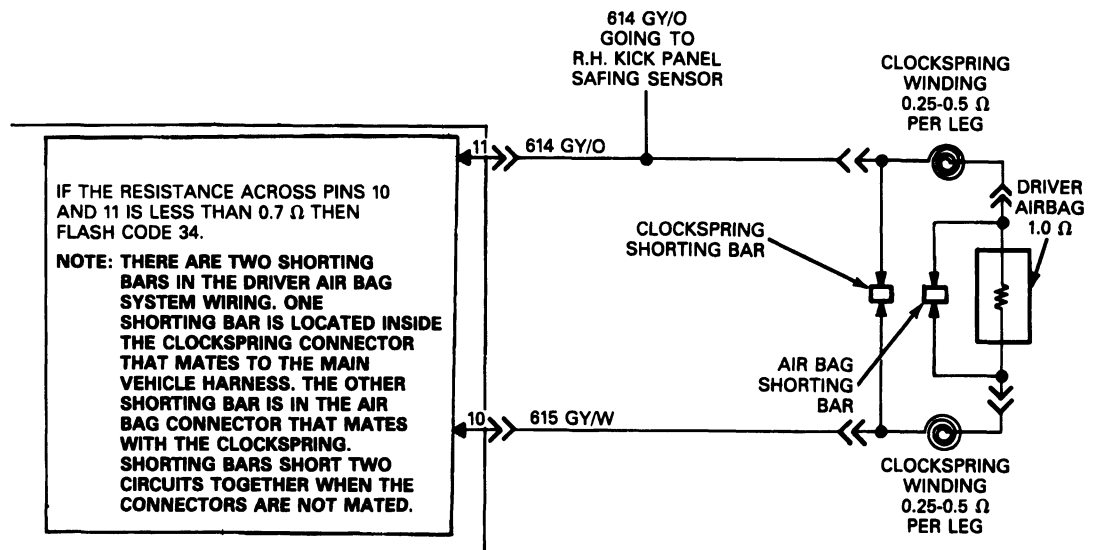
Possible Causes

Low resistance across pins 10 and 11 can be caused by:

1. A poorly mated air bag clockspring connector may not push the shorting bars back into their fully retracted positions.
2. A faulty shorting bar may short Circuits 614 and 615 together.
3. A short in the clockspring windings between Circuits 614 and 615.
4. A short across the air bag terminals within the air bag. **DO NOT** attempt a direct resistance measurement of the air bag. Follow the diagnostic procedures to determine if the air bag resistance is lower than normal.

DIAGNOSIS AND TESTING (Continued)

Code 34 Wiring Schematic



R9463-A

CODE 34

TEST STEP		RESULT	ACTION TO TAKE
34-1	VERIFY CONDITION		
<ul style="list-style-type: none"> Turn key to ON. Count fault code (if any). Is code 34 flashing? 		Yes	GO to 34-2.
		No	READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with pinpoint tests until the code is flashing! Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.
34-2	DEACTIVATE SYSTEM		
<ul style="list-style-type: none"> Deactivate system — leave driver side air bag harness connector empty (do not install the air bag simulator). Disconnect the Diagnostic Monitor. Remove the plastic locking wedge from the block harness connector. Measure the resistance across pin 11 — Circuit 614 (GY/O) and pin 10 — Circuit 615 (GY/W). Is the resistance across pins 10 & 11 infinite (open)? 		Yes	GO to 34-3.
		No	GO to 34-4.

DIAGNOSIS AND TESTING (Continued)

CODE 34 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
34-3	CHECK COMPONENT INSTALLATION		
	<ul style="list-style-type: none"> ● Install an air bag simulator onto the clockspring connector at the steering wheel. ● Reconnect the Diagnostic Monitor. ● Turn key from OFF to ON. ● Wait 30 seconds. ● Is code 34 flashing? 	<p>Yes</p> <p>No</p>	<p>▶ REPLACE Diagnostic Monitor. REACTIVATE system. VERIFY lamp.</p> <p>▶ EXAMINE the shorting bar on the driver side air bag connector for proper function.</p> <p>NOTE: Examine the clockspring to main harness connector as an example of a normal shorting bar.</p> <p>REPLACE the driver side air bag if the shorting bar is normal. REACTIVATE system. VERIFY lamp.</p>
34-4	CHECK CLOCKSPRING		
	<ul style="list-style-type: none"> ● Disconnect the clockspring at the base of the steering column where it mates with the main vehicle harness. ● Measure the resistance across pin 11 (Circuit 614, GY/O) and pin 10 (Circuit 615, GY/W). ● Is the resistance across pins 10 & 11 infinite (open)? 	<p>Yes</p> <p>No</p>	<p>▶ EXAMINE the shorting bar on clockspring and main harness connector for proper function.</p> <p>NOTE: Examine the driver side air bag connector as an example of a normal shorting bar.</p> <p>REPLACE the clockspring if the shortbar is normal. REACTIVATE system. VERIFY lamp.</p> <p>▶ LOCATE and SERVICE the short across Circuits 614 & 615 in the wiring harness. INSPECT the Diagnostic Monitor harness connector and the clockspring harness connector for shorted terminals. REACTIVATE system. VERIFY lamp.</p>

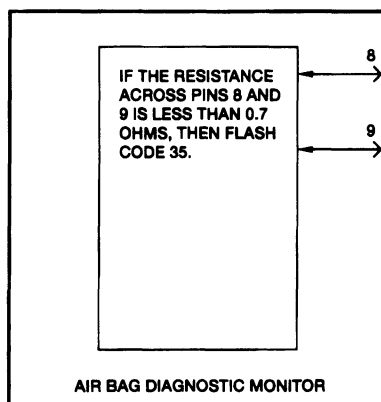
TR9403A

Fault Code 35**Passenger Side Air Bag Circuit Low Resistance or Shorted****Circuit Description****Normal Operation**

The diagnostic monitor measures the resistance across pin 8 and pin 9 every time the ignition switch is turned to the ON position. Normal resistance across these circuits is between 0.9 ohms and 1.1 ohms. If the resistance across pins 8 and 9 is less than 0.7 ohms, the monitor will flash a Code 35. Note that it does not matter if pin 7 is grounded or not. If low resistance is measured across pins 8 and 9 a fault code 35 will appear.

Possible Causes

Low resistance across pins 8 and 9 can be caused by a short between pins 8 and 9 at the air bag diagnostic monitor.

DIAGNOSIS AND TESTING (Continued)**Electrical Schematic — Fault Code 35**

R8714-A

Pinpoint Test — Fault Code 35**CODE 35**

TEST STEP		RESULT	ACTION TO TAKE
35-1	VERIFY CONDITION		
	<ul style="list-style-type: none"> ● Turn key to ON. ● Count fault code. ● Is code 35 flashing? 	Yes No	► GO to 35-2 . ► Read the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). DO NOT proceed with Pinpoint Test until the code is flashing! Failure to do so will result in needless replacement of the diagnostic monitor and repeat repairs.
35-2	CHECK FOR SHORT ACROSS PINS 8 AND 9 AT THE DIAGNOSTIC MONITOR		
	<ul style="list-style-type: none"> ● Deactivate system. ● Disconnect the Diagnostic Monitor. ● Remove the plastic locking wedge from the black harness connector. ● Measure the resistance across pin 8 (Circuit 614, GY/O) and pin 9 (Circuit 616, PK/BK). ● Is the resistance across these pins infinite (open)? 	Yes No	► REPLACE Diagnostic Monitor. RECONNECT system. REACTIVATE system. VERIFY system. ► LOCATE and SERVICE the short across Pins 8 and 9 of the wiring harness. INSPECT the Diagnostic Monitor harness connector and terminal for possible short circuits. REACTIVATE system. VERIFY lamp.

DIAGNOSIS AND TESTING (Continued)**Fault Code 41****Primary Crash Sensor Circuit High Resistance or Open****Circuit Description****Normal Operation**

Each primary crash sensor has an internal resistor. The diagnostic monitor uses the resistor in the primary crash sensors in combination with the two resistors inside the diagnostic monitor to create a tightly controlled diagnostic voltage at pin 11 (Circuit 614, GY/O). The primary crash sensors are tied together inside the diagnostic monitor at pins 17 (Circuit 617, PK/O) and 18 (Circuit 619, PK/W). Therefore, the resistors in the sensors are connected in parallel. The parallel combination of all the sensor resistors should be equal to 393 ohms. The resistance of each sensor should be $787 \text{ ohms} \pm 10 \text{ ohms}$.

The resistors inside the diagnostic monitor are connected to pins 11 (Circuit 614, GY/O) and 12 (Circuit 623, P/W) and are equal in value. Note that Circuits 614 and 623 are tied together inside the safing sensor. Therefore, the two resistors inside the diagnostic monitor are connected in parallel and will function the same as one resistor of half the original value. Current flows from the ignition voltage within the diagnostic monitor, through the resistors, out to Circuits 614 (GY/O) and 623 (P/W) on pins 11 and 12, through the 5-wire safing sensor and out to the driver side air bag. Current flows through the driver side air bag and into pin 10 (Circuit 615, GY/W). Current then flows from pin 10 through the diode inside the diagnostic monitor and out to the primary crash sensors through pins 17, 18 and 19. The current flows through each primary crash sensor resistor and terminates at the case ground of each sensor. Pin 11 is the midpoint of the resistor network and voltage at pin 11 will change with vehicle charging system voltage. The expected voltage at pin 11 is shown in the table below. The diagnostic monitor measures the vehicle charging system voltage at pin 13 (battery input). By measuring the voltage at pin 13, the diagnostic monitor can accurately predict what the voltage at pin 11 should be in a normal functioning system.

If the resistance of one or more of the crash sensors has increased in value, then the equivalent resistance of the crash sensors will be greater than 393 ohms. When crash sensor resistance increases, there is less overall resistance pulling the diagnostic voltage down. Therefore, the voltage at pin 11 will increase and the diagnostic monitor will flash code 41 to indicate high resistance (or an open circuit) in one of the primary crash sensor circuits. Another situation that may cause high voltage on pin 11 is if resistance builds up across the normally open safing sensor contacts. Safing sensor(s) do not normally have resistance across their contacts. If resistance appears across the safing sensor contacts, then current will flow from pin 15 (Circuit 611, W/O) through the abnormal resistance across the safing sensor contacts and into Circuit 614 (GY/O). Since the voltage at pin 15 is battery voltage or higher, this will also cause an increase in voltage at pin 11 and the diagnostic monitor will flash code 41.

Possible Causes

Higher than normal voltage on pin 11 can be caused by:

1. An open in one or more of the circuits between the diagnostic monitor and the primary crash sensors. Circuit 617 (PK/O) or 619 (PK/W) may have an open circuit in the wiring.
2. An abnormally high resistance value across one or more of the primary crash sensors. One or more of the primary crash sensor resistors may have too high resistance or may be completely open circuit.
3. An intermittent open between the positive terminal of the battery and pin 13 may cause the diagnostic monitor to determine that voltage on pins 17 and 18 is too high with respect to the voltage on pin 13.
4. Resistance across the safing sensor. The safing sensor is a normally open switch with infinite resistance across its contacts. If the safing sensor is faulty and some resistance builds up across the open contacts, the voltage on Circuit 611 (W/O) will pull up the voltage on Circuit 614 (GY/O).

Pin # 10 and Pin # 11 Voltage	Pin # 17 and Pin # 18 Voltage	System Voltage
1.9	1.4	9.0
2.0	1.5	9.5
2.1	1.6	10.0
2.2	1.7	10.5
2.3	1.8	11.0
2.4	1.9	11.5
2.5	2.0	12.0
2.6	2.1	12.5
2.7	2.2	13.0
2.7	2.3	13.5
2.9	2.4	14.0

(Continued)

DIAGNOSIS AND TESTING (Continued)

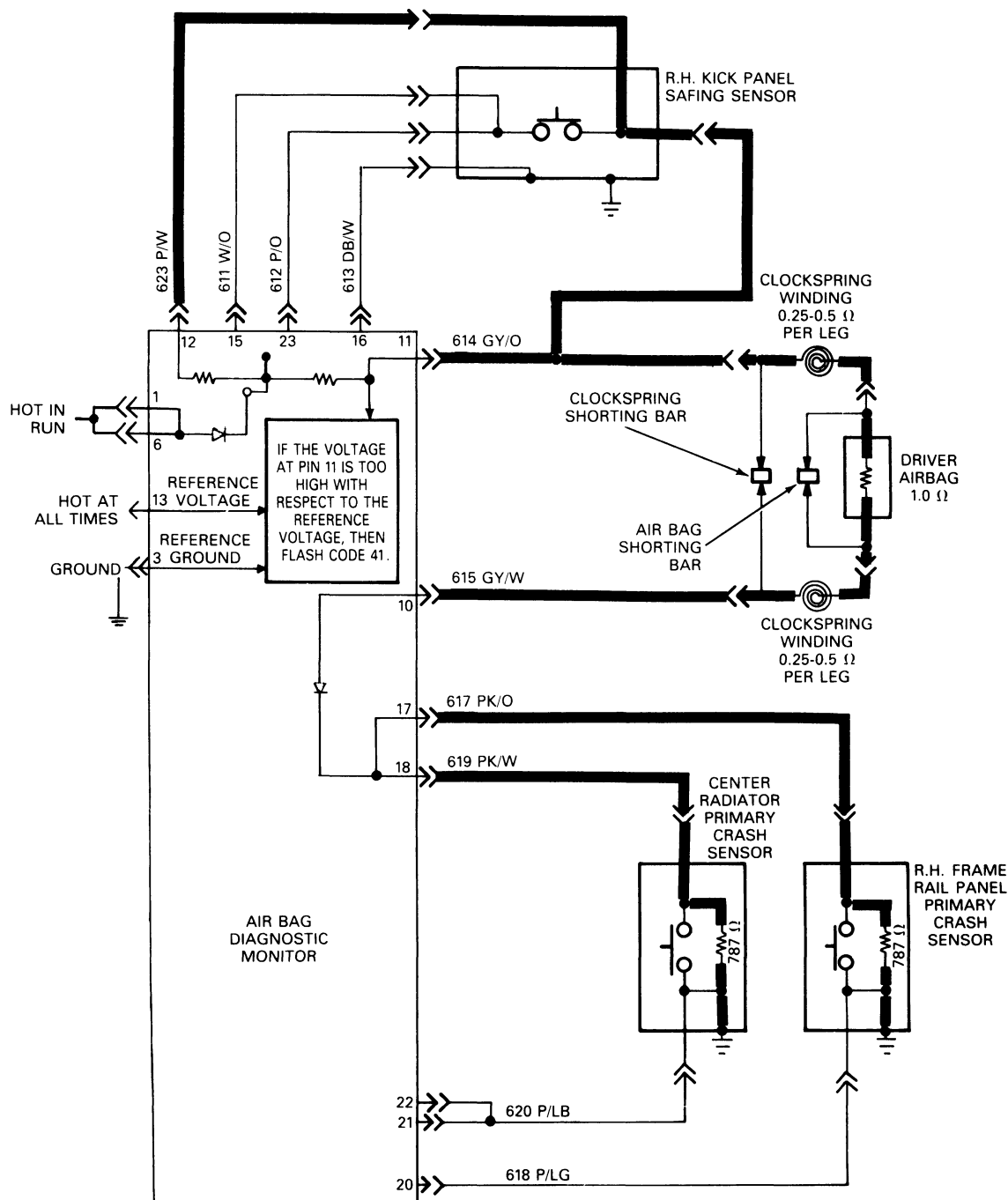
Pin # 10 and Pin # 11 Voltage	Pin # 17 and Pin # 18 Voltage	System Voltage
3.0	2.5	14.5

(Continued)

Pin # 10 and Pin # 11 Voltage	Pin # 17 and Pin # 18 Voltage	System Voltage
3.1	2.6	15.0
3.2	2.7	15.5
3.3	2.8	16.0

TR8571A

Code 41 Wiring Schematic



R9464-A

DIAGNOSIS AND TESTING (Continued)

CODE 41		
TEST STEP	RESULT	ACTION TO TAKE
41-1 VERIFY CONDITION		
<ul style="list-style-type: none"> ● Turn key to ON. ● Count fault code (if any). ● Is code 41 flashing? 	Yes No	GO to 23-2. READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with Pinpoint Test until the code is flashing! Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.
41-2 DEACTIVATE SYSTEM MEASURE PIN 11		
<ul style="list-style-type: none"> ● Deactivate system. ● Turn key off then on. ● Measure voltage between pin 13 (+) and pin 3 (-). Record the voltage as Charging System Voltage. ● Measure voltage between pin 11 (Circuit 614, GY/O) and pin 3 (ground). ● Is the voltage measured within specification? (Use the Voltage Table to determine if the voltage at pin 11 is within specification.) (± 1 volt) 	Yes No	TURN ignition ON. INSPECT all terminations and connections between the positive terminal of the battery and pin 13 of the Diagnostic Monitor. This includes the fuse terminal crimps, splices, etc. GO to 41-3. GO to 41-4.
41-3 SERVICE POOR CONNECTIONS		
<ul style="list-style-type: none"> ● During inspection of all terminator connections were any worn, loose or damaged connections found? 	Yes No	SERVICE worn, loose or damaged connections found. RECONNECT system. VERIFY system. REACTIVATE system. REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
41-4 MEASURE PRIMARY CRASH SENSOR RESISTANCE		
<ul style="list-style-type: none"> ● Turn ignition OFF. ● Disconnect Diagnostic Monitor. ● Measure the resistance of both crash sensor circuits from pins 17 and 18 of the Diagnostic Monitor harness connector to pin 3 (ground). ● Does resistance measure 787 ± 10 ohms? 	No Yes	LOCATE and DISCONNECT the crash sensor with abnormal reading. GO to 41-5. GO to 41-6.
41-5 MEASURE RESISTANCE OF PRIMARY CRASH SENSOR		
<ul style="list-style-type: none"> ● Measure the resistance across the abnormal sensor connector terminals. ● Is the reading 787 ± 10 ohms? 	Yes No	LOCATE and SERVICE the open circuit in the wiring harness for the affect sensor. RECONNECT system. VERIFY system. REACTIVATE system. REPLACE the abnormal crash sensor. RECONNECT system. VERIFY system. REACTIVATE system.

DIAGNOSIS AND TESTING (Continued)

CODE 41 (Continued)		
TEST STEP	RESULT	ACTION TO TAKE
41-6 CHECK RESISTANCE ACROSS PINS 15 AND 11		
<ul style="list-style-type: none"> Place ohmmeter on the highest ohm scale available (200,000 ohms or auto). Measure the resistance across pin 15 — Circuit 611 (W/O) and pin 11 of the Diagnostic Monitor harness connector. Is the reading infinite (open)? 	Yes	LOCATE and SERVICE the short between the air bag circuits (614, 615 and 616) and B+, in the wire harness. RECONNECT system. VERIFY system. REACTIVATE system.
	No	GO to 41-7.
41-7 MEASURE RESISTANCE OF SAFING SENSOR		
<ul style="list-style-type: none"> Disconnect the RH kick panel safing sensor. Measure the resistance across the GY/O and W/O wires in the RH kick panel safing sensor connector. Is the reading infinite (open)? 	Yes	LOCATE and SERVICE the short between Circuit 611 and 614 in the wiring harness. RECONNECT system. VERIFY system. REACTIVATE system.
	No	REPLACE the RH kick panel safing sensor. RECONNECT system. VERIFY system. REACTIVATE system.

Fault Code 44**RH Frame Rail Crash Sensor Not Mounted to Vehicle Properly****Circuit Description****Normal Operation**

The diagnostic monitor measures the resistance between pin 20 (circuit 618 P/LG) and pin 3 (diagnostic monitor reference ground). If the diagnostic monitor measures a difference of more than 2.0 ohms between pin 20 and pin 3, it will flash out code 44.

Note that Circuit 618 (P/LG) is attached to the side of the RH frame rail primary crash sensor case. In addition, the case is grounded to the vehicle.

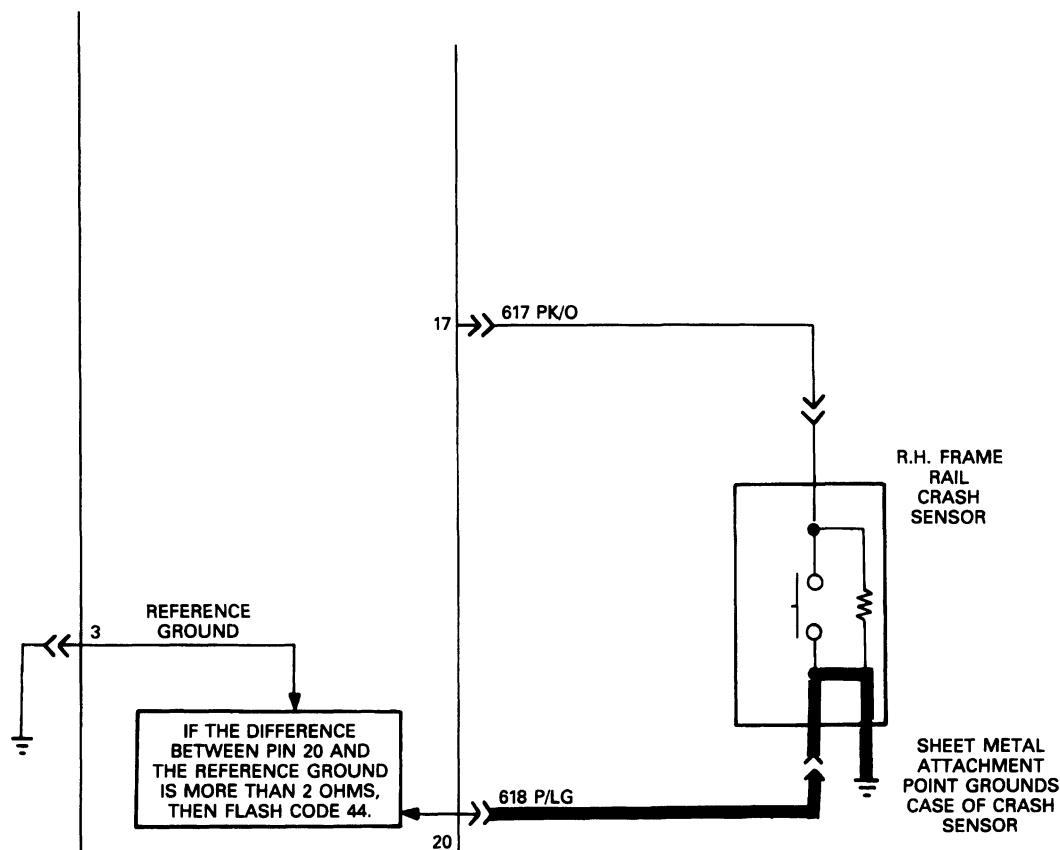
Possible Causes

High resistance on pin 20 (Circuit 618, P/LG) to ground can be caused by:

1. A poor connection due to loose mounting, dirt, or corrosion at the RH frame rail crash sensor mounting location.
2. An open or damaged wire in circuit 618 (P/LG) from pin 20 of the diagnostic monitor harness connector to RH frame rail crash sensor.
3. An open wire or loose P/LB wire attachment inside RH frame rail crash sensor.

DIAGNOSIS AND TESTING (Continued)

Code 44 Wiring Schematic



R9485-A

CODE 44

TEST STEP		RESULT	ACTION TO TAKE
44-1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Turn key to ON. Count fault code (if any). Is code 44 flashing? 	Yes No	GO to 44-2. READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with Pinpoint Test until the code is flashing! Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.

DIAGNOSIS AND TESTING (Continued)

CODE 44 (Continued)			
TEST STEP		RESULT	ACTION TO TAKE
44-2	DEACTIVATE SYSTEM		
<ul style="list-style-type: none"> Deactivate system (leave positive battery cable disconnected). Disconnect Diagnostic Monitor. Set ohmmeter on the lowest ohm scale possible (200 ohms). Zero ohmmeter. RECORD resistance reading with the two leads together. Measure the resistance between pin 20 and pin 3 (ground). Is the resistance greater than 2 ohms? 		Yes No	<ul style="list-style-type: none"> GO to 44-3. REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
44-3	CHECK CRASH SENSOR GROUND		
<ul style="list-style-type: none"> Disconnect the RH frame rail crash sensor from the harness. Measure the resistance between the P/LG "ground" wire in the sensor connector and a nearby, "good", chassis ground (be sure that this ground is clean and bare). Is the resistance less than 2 ohms? 		Yes No	<ul style="list-style-type: none"> INSPECT circuit between pin 20 and the sensor. CHECK all terminal crimps, interconnections and splices for four connections. SERVICE any poor connections. RECONNECT system. VERIFY system. REACTIVATE system. REMOVE screws retaining sensor. CLEAN mounting surface of sensor 3 chassis. REMOUNT sensor. TIGHTEN screws to proper specifications. GO to 44-4.
44-4	MEASURE RESISTANCE OF SENSOR TO GROUND.		
<ul style="list-style-type: none"> Measure the resistance between the P/LG "ground" wire in the sensor connector and the chassis ground. Is the resistance less than 2 ohms? 		Yes No	<ul style="list-style-type: none"> RECONNECT system. VERIFY system. REACTIVATE system. REPLACE RH frame rail crash sensor. RECONNECT system. VERIFY system. REACTIVATE system.

Fault Code 45**Center Radiator Crash Sensor Not Mounted to Vehicle Properly****Circuit Description****Normal Operation**

The diagnostic monitor measures the resistance between pin 21 (Circuit 620, P/LB) and pin 3 (diagnostic monitor reference ground). If the diagnostic monitor measures a difference of more than 2.0 ohms between pin 21 and pin 3, it will flash out code 45.

Note that Circuit 620 (P/LB) is attached to the side of the center radiator primary sensor case. In addition, the case is grounded to the vehicle.

Possible Causes

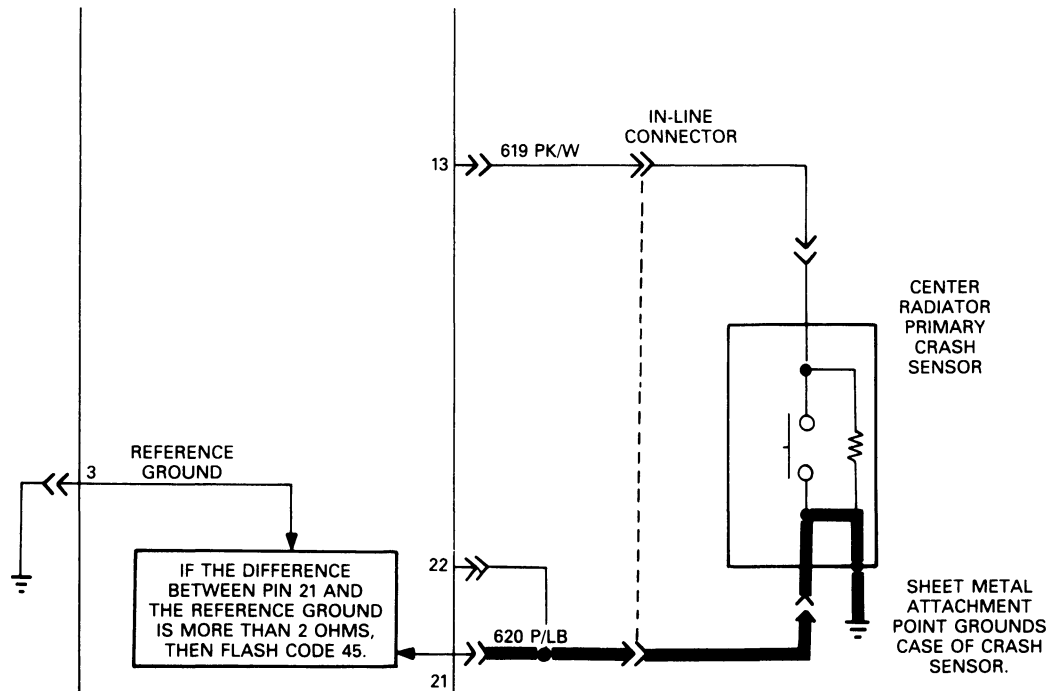
High resistance on pin 21 (Circuit 620, P/LB) to ground can be caused by:

1. A poor connection due to loose mounting, dirt, or corrosion at the crash sensor mounting location.
2. An open or damaged wire in Circuit 620 (P/LB) from pin 21 of the diagnostic monitor harness connector to center radiator crash sensor. This includes splices and in-line connectors.
3. An open wire or loose (Circuit 620 P/LB) wire attachment inside center radiator crash sensor.

Note that Circuit 620 (P/LB) is spliced into another wire going to Pin 22 of the Diagnostic Monitor. Note also that Circuit 620 (P/LB) passes through an in-line connector between the main instrument panel harness and the engine compartment harness that connects to the center radiator primary crash sensor.

DIAGNOSIS AND TESTING (Continued)**Code 45 Wiring Schematic**

NOTE: Check splice and in-line connector for poor crimps, etc.



R9448-A

CODE 45

TEST STEP		RESULT	ACTION TO TAKE
45-1	VERIFY CONDITION		
<ul style="list-style-type: none"> Turn key to ON. Count fault code (if any). Is code 45 flashing? 		Yes No	<p>GO to 45-2.</p> <p>READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with pinpoint tests until the code is flashing! Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.</p>
45-2	DEACTIVATE SYSTEM		
<ul style="list-style-type: none"> Deactivate system (leave positive battery cable disconnected). Disconnect Diagnostic Monitor. Set ohmmeter on the lowest ohm scale possible (200 ohms). Zero ohmmeter. Record resistance reading with the two leads together. Measure the resistance between pin 21 and pin 3 (ground). Is the resistance greater than 2 ohms? 		Yes No	<p>GO to 45-3.</p> <p>REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.</p>

DIAGNOSIS AND TESTING (Continued)**CODE 45 (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
45-3	CHECK CRASH SENSOR GROUND		
<ul style="list-style-type: none"> Disconnect the center radiator crash sensor from the harness. Measure the resistance between the P / LB "ground" wire in the sensor connector and a nearby, "good", chassis ground (be sure that this ground is clean and bare.) Is the resistance less than 2 ohms? 		Yes	<ul style="list-style-type: none"> INSPECT circuit between pin 21 and the sensor. CHECK all interconnects and splices for poor connections. SERVICE any poor connections. RECONNECT system. VERIFY system. REACTIVATE system.
		No	<ul style="list-style-type: none"> REMOVE screws retaining sensor. CLEAN mounting surface of sensor and chassis. REMOUNT sensor. TIGHTEN screws to proper specification. GO to 45-4.
45-4	MEASURE RESISTANCE OF SENSOR TO GROUND		
<ul style="list-style-type: none"> Measure the resistance between the P / LB "ground" wire in the sensor connector and the chassis ground. Is the resistance less than 2 ohms? 		Yes	<ul style="list-style-type: none"> RECONNECT system. VERIFY system. REACTIVATE system.
		No	<ul style="list-style-type: none"> REPLACE center radiator crash sensor. RECONNECT system. VERIFY system. REACTIVATE system.

TR9404A

Fault Code 46**Open Splice Center Radiator Primary Crash Sensor Ground Monitor****Circuit Description****Normal Operation**

The diagnostic monitor measures the resistance between Pin 22 (Circuit 620 P / LB) and Pin 3 (diagnostic monitor reference ground). If the diagnostic monitor measures a difference of more than 2.0 ohms between pin 22 and pin 3, it will flash a Code 46.

NOTE: Pin 22 is used in a three primary crash sensor system as the third sensor ground monitor. Because only two primary crash sensors are used here, pin 22 is spliced into the center radiator crash sensor's ground monitor.

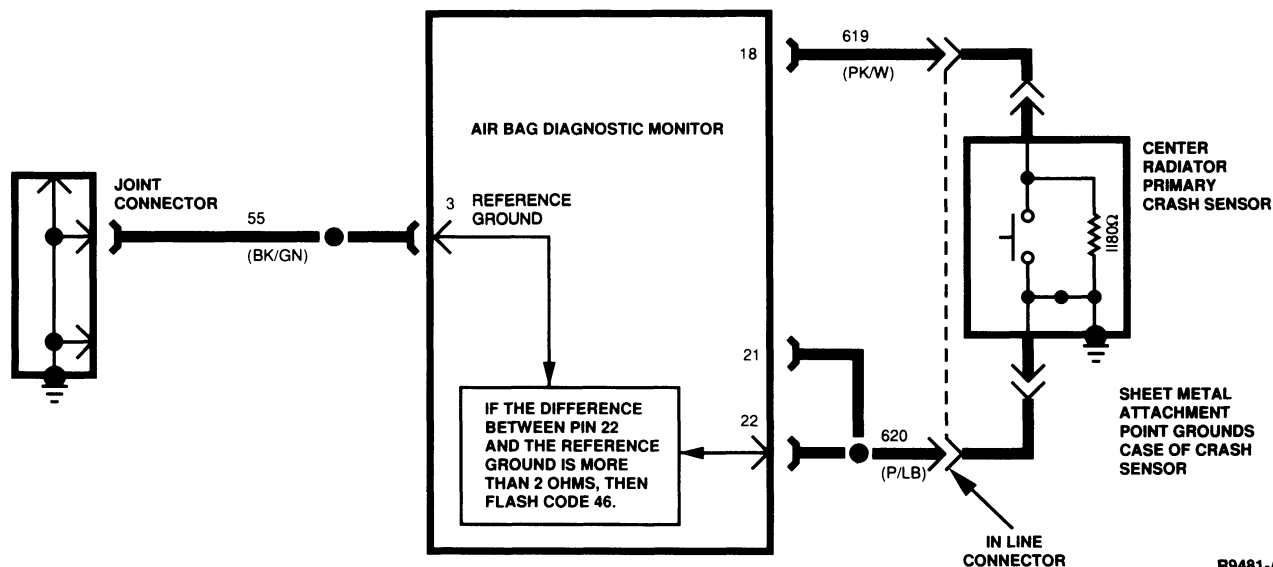
Possible Causes

High resistance on Pin 22 (Circuit 934 BR) to ground can be caused by:

1. An open or damaged wire in Circuit 620 (P / LB) from pin 22 of the diagnostic monitor harness connector to the splice which joins it to the P / LB wire coming from pin 21.

DIAGNOSIS AND TESTING (Continued)

Electrical Schematic — Fault Code 46



CODE 46

TEST STEP		RESULT	ACTION TO TAKE
46-1	VERIFY CONDITION		
<ul style="list-style-type: none"> Turn key to ON. Count fault code (if any). Is code 46 flashing? 		Yes	GO to 46-2.
		No	<ul style="list-style-type: none"> READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with pinpoint tests until the code is flashing! Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.
46-2	DEACTIVATE SYSTEM		
<ul style="list-style-type: none"> Deactivate system. Make sure positive battery cable is disconnected. Disconnect Diagnostic Monitor. Set ohmmeter on lowest ohm scale (200 ohms). Zero ohmmeter, (record resistance value with the two leads together). Measure resistance across pin 22, (Circuit 934, BR) and pin 3, (Ground). Is resistance greater than 2 ohms? 		Yes	<ul style="list-style-type: none"> SERVICE 620 P / LB splice where pin 22 connects with pin 21 of Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
		No	<ul style="list-style-type: none"> REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.

DIAGNOSIS AND TESTING (Continued)**Fault Code 51**

Diagnostic Monitor Internal Thermal Fuse Blown and Short to Ground No Longer Exists (Short to Ground Was Repaired or is Intermittent)

Circuit Description**Normal Operation**

NOTE: The diagnostic monitor contains an internal thermal fuse that is not serviceable. The thermal fuse is controlled by a computer inside the diagnostic monitor. The computer will blow the thermal fuse whenever a short on the deployment circuits occurs. The thermal fuse does not blow because of excessive current flowing through it. DO NOT attempt to jumper out the thermal fuse with a circuit breaker or any other type of fuse.

NOTE: DO NOT install a new diagnostic monitor until the short has been located and corrected. If a short to ground has not been located and corrected, then the short to ground is intermittent and IS NOT PRESENT AT THIS TIME. Installing a new diagnostic monitor with an intermittent short in the system will result in repeat blown diagnostic monitors and repeat repairs.

The diagnostic monitor measures the voltages at the diagnostic monitor connector pins. When certain air bag deployment wires are shorted to ground (heavy lines illustrated in the schematic below), the system may become susceptible to unwanted deployment of the air bag(s). The diagnostic monitor senses a short to ground on any of these circuits and helps prevent unwanted air bag deployment by blowing the diagnostic monitor thermal fuse. Blowing this fuse removes all power (battery and backup power) from the air bag deployment circuits. While the short to ground exists, the monitor will flash fault code 13. If the short to ground is intermittent and temporarily corrects itself, the diagnostic monitor will flash code 51.

NOTE: If the short to ground returns, the higher priority code 13 will flash instead of 51.

If the air bag lamp is flashing code 51 and a short to ground has not been serviced, this means that an intermittent short to ground exists in the air bag system. The diagnostic monitor should be replaced only after repairs to the intermittent short have been completed.

Some service tips for finding an intermittent short to ground are:

1. Consult OASIS (Restraint Systems Service Code 104000) for up-to-date diagnostics and descriptions of wiring concern locations for the vehicle (VIN number) you are working on. OASIS is updated daily using concern descriptions from engineering and Dealership Service sources.
2. Inspect wiring and harnesses in areas where they pass through or are located next to metal components (i.e., engine compartment bulkhead, body sheet metal, component mounting brackets, etc).

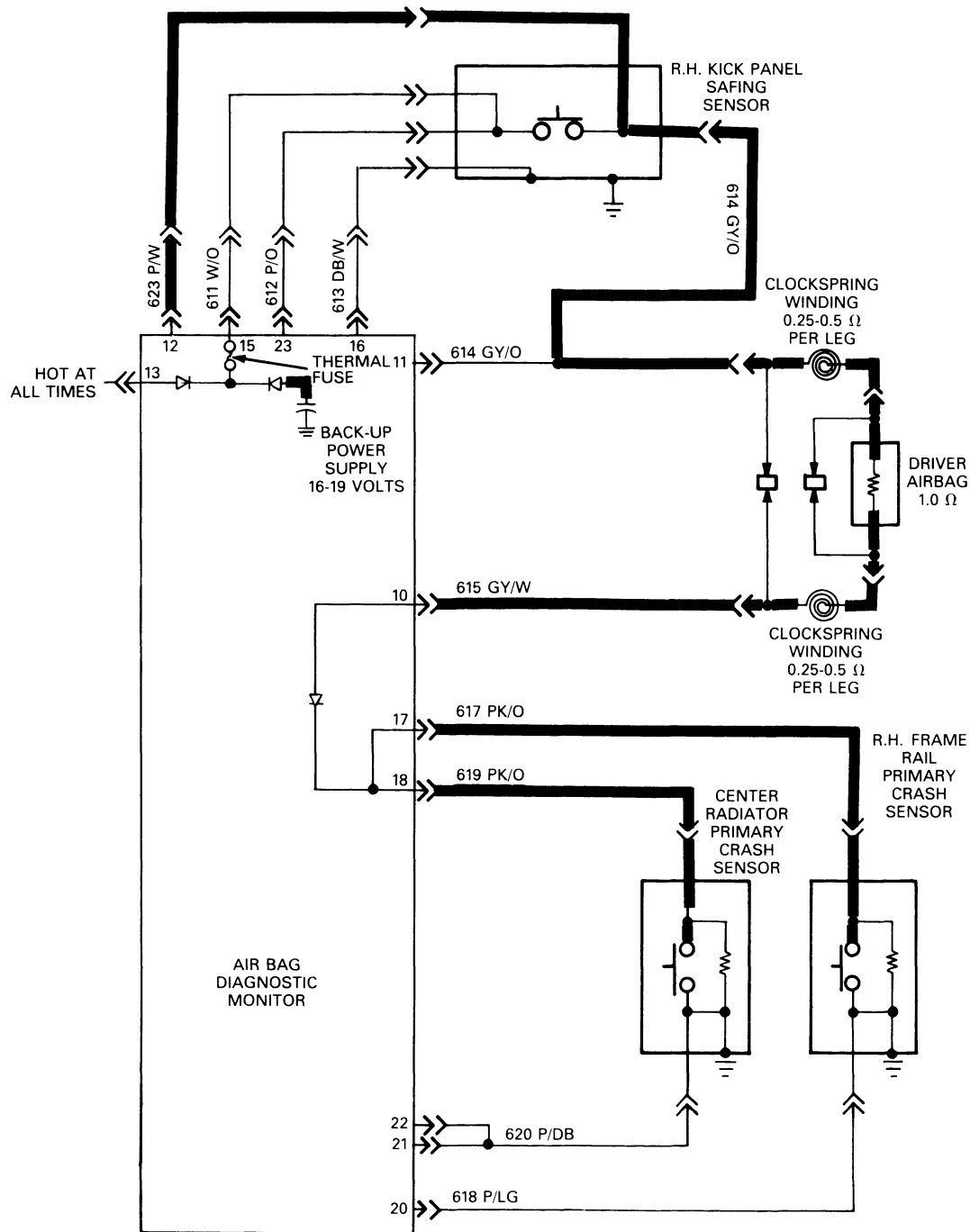
Code 51 After Air Bag Deployment

Occasionally, immediately after an air bag deploys, the internal wiring of the air bag may become shorted to the metal housings of the air bag. This internal air bag short is detected by the diagnostic monitor as short to ground in the air bag deployment wiring. Since the diagnostic monitor is still operating immediately after most deployments, the monitor will detect the shorted wiring and will flash code 13 and blow the internal thermal fuse. After the deployment, as the air bag cools off, the internal shorted wiring may correct itself, therefore the short to ground will no longer exist and the diagnostic monitor will flash code 51. If a vehicle with a deployed air bag is flashing code 51, inspect and replace all the damaged areas of the vehicle with crushed wiring, sensors, etc. If no damage is found assume that the deployed air bag was the cause for the intermittent short and replace the diagnostic monitor when the new air bag is installed.

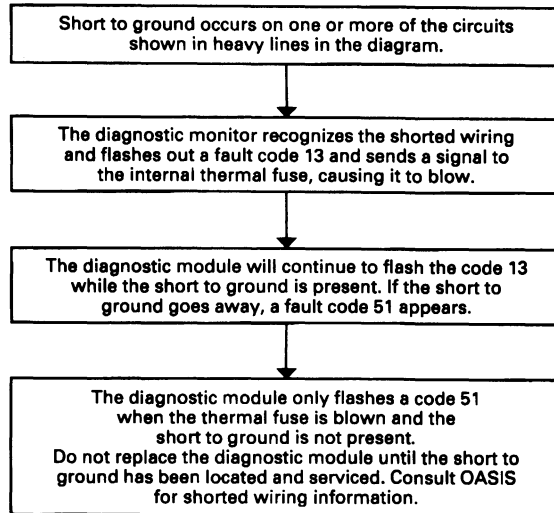
NOTE: Diagnostic monitors can withstand several air bag deployments and do not need to be replaced after every deployment. Only replace the diagnostic monitor if it is damaged.

DIAGNOSIS AND TESTING (Continued)

Code 51 Wiring Schematic



R9466-A

DIAGNOSIS AND TESTING (Continued)**CODE 51 SEQUENCE OF EVENTS**

CR9450-A

Possible Causes

Low backup power supply voltage can be caused by:

1. Resistance in Circuit 611 (W/O) to ground. Resistance to ground on Circuit 611 or Circuit 612 (P/O) will cause the backup power supply capacitors to discharge and the boost circuit will not be able to boost the voltage.
2. Boost circuit failure within the diagnostic monitor. If the voltage boost circuit in the diagnostic monitor is faulty it will not be able to raise the backup power supply voltage on the capacitor.

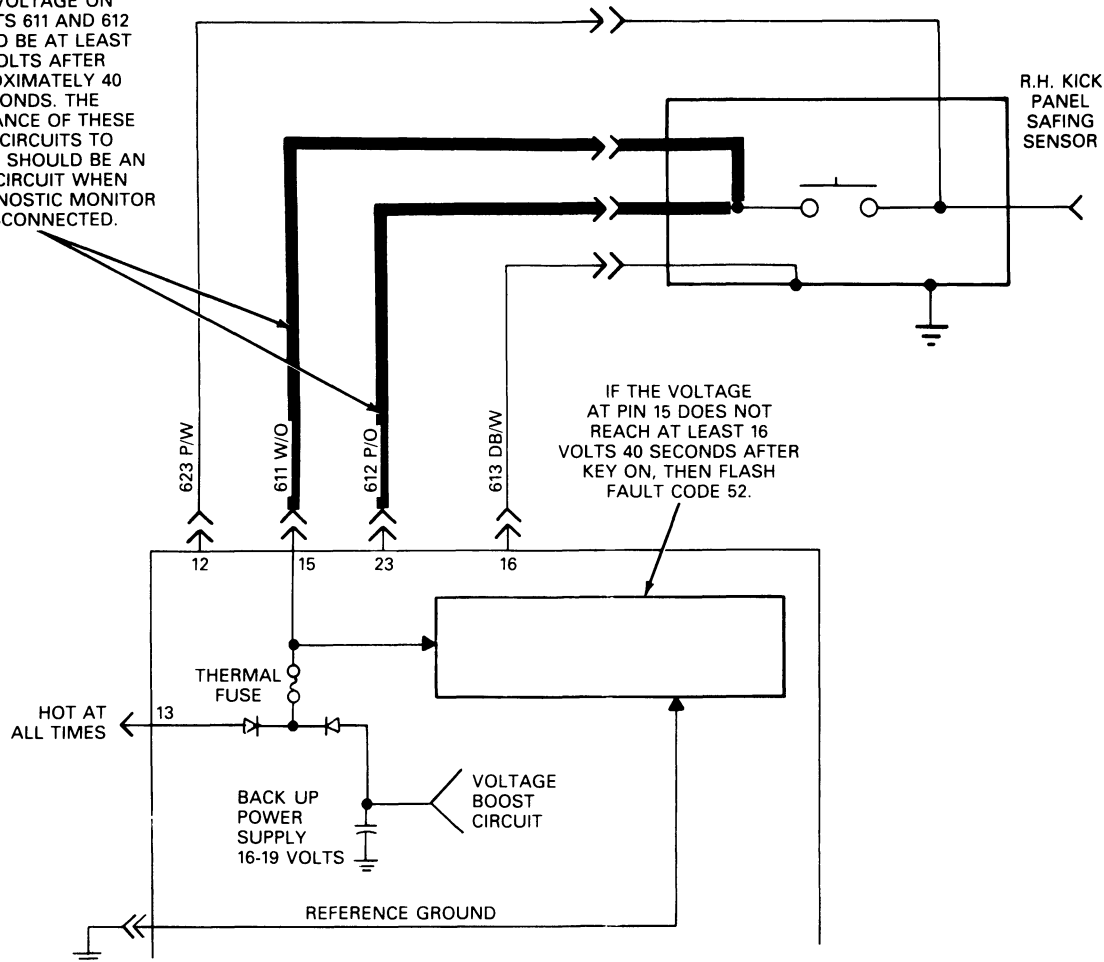
Fault Code 52**Backup Power Supply Voltage Boost Fault****Circuit Description****Normal Operation**

A backup power supply is contained within the diagnostic monitor that consists of four capacitors and a voltage boost circuit. The voltage boost circuit charges the capacitors to 16-19 volts when the ignition switch is turned to ON. The backup power supply is connected through a diode to diagnostic monitor pin 15 (Circuit 611, W/O). The resistance of Circuit 611 to ground is infinite since it is an open circuit. This open circuit allows the capacitor to maintain its higher voltage because there is no discharge path for the capacitor. The diagnostic monitor measures the voltage on the backup power supply capacitors. If the voltage on the capacitors does not reach and maintain a minimum of 16 volts after approximately 45 seconds, the diagnostic monitor will flash code 52 to indicate low voltage in the backup power supply voltage boost circuit.

DIAGNOSIS AND TESTING (Continued)

Code 52 Wiring Schematic

THE VOLTAGE ON CIRCUITS 611 AND 612 SHOULD BE AT LEAST 16 VOLTS AFTER APPROXIMATELY 40 SECONDS. THE RESISTANCE OF THESE TWO CIRCUITS TO GROUND SHOULD BE AN OPEN CIRCUIT WHEN THE DIAGNOSTIC MONITOR IS DISCONNECTED.



R9467-A

CODE 52

TEST STEP		RESULT	ACTION TO TAKE
52-1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Turn key to ON. Count fault code (if any). Is code 52 flashing? 	Yes No	GO to 52-2. READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with pinpoint tests until the code is flashing! Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.

DIAGNOSIS AND TESTING (Continued)

CODE 52 (Continued)			
TEST STEP		RESULT	ACTION TO TAKE
52-2	DEACTIVATE SYSTEM		
<ul style="list-style-type: none"> Deactivate system. Turn ignition off then on. Wait 30 seconds. Measure voltage between pin 15 — Circuit 611 (W/O) and pin 3 (ground). Is the voltage measured within 16-19 volts? 		Yes	REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
		No	GO to 52-3.
52-3	CHECK FOR OPEN IN CIRCUIT 611		
<ul style="list-style-type: none"> Turn ignition OFF. Disconnect Diagnostic Monitor. Set ohmmeter on 200,000 or auto scale. Measure resistance of pin 15 — Circuit 611 (W/O) to pin 3 (ground). Is the resistance measured infinite (open)? 		Yes	REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.
		No	GO to 52-4.
52-4	MEASURE RESISTANCE OF CIRCUIT 611		
<ul style="list-style-type: none"> Disconnect the RH kick panel safing sensor. Measure resistance between pin 15 (Circuit 611, W/O) and pin 3 (ground). Is the resistance measured infinite (open)? 		Yes	GO to 52-5.
		No	LOCATE and SERVICE the short to ground in Circuit 611, W/O. RECONNECT system. VERIFY system. REACTIVATE system.
52-5	CHECK FOR SHORT IN SENSOR		
<ul style="list-style-type: none"> Measure resistance of the (Circuit 611 W/O) wire in the safing sensor connector to sheet metal ground. Is the resistance measured infinite (open)? 		Yes	LOCATE and SERVICE the short to ground in Circuit 612 (P/O). RECONNECT system. VERIFY system. REACTIVATE system.
		No	REPLACE RH kick panel safing sensor. RECONNECT system. VERIFY system. REACTIVATE system.

Fault Code 53**Internal Diagnostic Monitor Failure****Circuit Description****Normal Operation**

The diagnostic monitor performs several self-tests every time the ignition switch is turned on. If any of these tests fail, the diagnostic monitor will flash code 53.

Possible Causes

1. Internal diagnostic monitor self-test failure.

DIAGNOSIS AND TESTING (Continued)

CODE 53

TEST STEP		RESULT	ACTION TO TAKE
53-1	VERIFY CONDITION		
	<ul style="list-style-type: none"> ● Turn key to ON. ● Count fault code (if any). ● Is code 53 flashing? 	Yes No	GO to 53-2. READ the normal operation description for this fault code. EXAMINE the fault code schematic and look for areas where intermittent problems would occur (connectors, splices, crimps, etc.). Do not proceed with pinpoint tests until the code is flashing. Failure to do so will result in needless replacement of the Diagnostic Monitor and repeat repairs.
53-2	DEACTIVATE SYSTEM		
	<ul style="list-style-type: none"> ● Deactivate system. 		REPLACE Diagnostic Monitor. RECONNECT system. VERIFY system. REACTIVATE system.

TR9405A

Rapid Continuous Flashing**All Crash Sensors Disconnected****Circuit Description****Normal Operation**

Each crash sensor has two wires. One wire is used for air bag deployment and monitoring the sensor's connection to the diagnostic monitor (See code 41 diagnosis for details). The other wire is used for monitoring the mounting (ground) of the sensor to sheet metal (see codes 44 and 45 diagnosis for details). If the code 41 diagnosis reveals that both sensors are not connected **AND** if the code 44 and 45 diagnosis reveals that both sensors are not properly grounded, then the diagnostic monitor will flash the air bag lamp continuously at a fast rate.

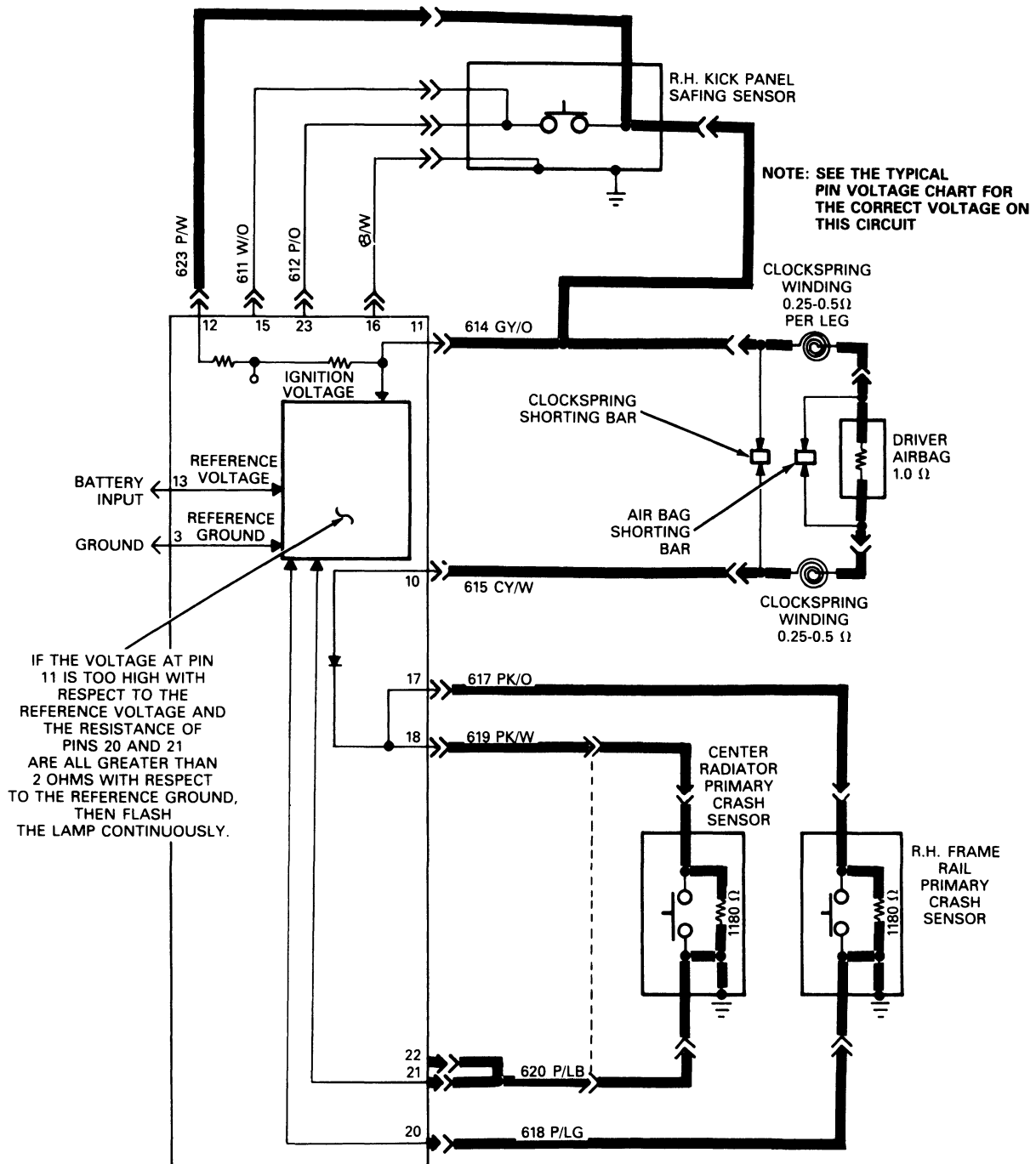
Possible Causes

Rapid continuous flashing of the air bag lamp can be caused by:

1. Both primary crash sensors disconnected from wiring harness or main wiring harness not connected with engine compartment wiring harness.

DIAGNOSIS AND TESTING (Continued)

Rapid Continuous Flashing Wiring Schematic



R9468-A

REMOVAL AND INSTALLATION

Sensor, Front Center Primary Crash Sensor (Upper Radiator Support)**Removal**

WARNING: THE ELECTRICAL CIRCUIT NECESSARY FOR SYSTEM DEPLOYMENT IS POWERED DIRECTLY FROM THE BATTERY AND BACKUP POWER SUPPLY. TO AVOID ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY, THE POSITIVE BATTERY CABLE MUST BE DISCONNECTED PRIOR TO SERVICING OR REPLACING ANY SYSTEM COMPONENTS.

NOTE: To service stripped center sensor retaining screws, replace screws with N802455. Tighten to 12.8-17.2 N·m (91-111 in-lb).

1. Disconnect positive battery cable and wait one minute for backup power supply energy to be depleted.
2. Disconnect front sensor electrical connector.
3. Remove two screws retaining front center sensor to radiator support and remove sensor.

Installation

1. Position front sensor and wire lead in vehicle and secure sensor to radiator support with retaining screws. Tighten screws to 10.2-13.8 N·m (91-122 in-lb).
2. Connect front sensor wire lead connector to wiring assembly connector and secure wiring retainers.
3. Connect battery positive cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

4. Verify air bag system readiness.

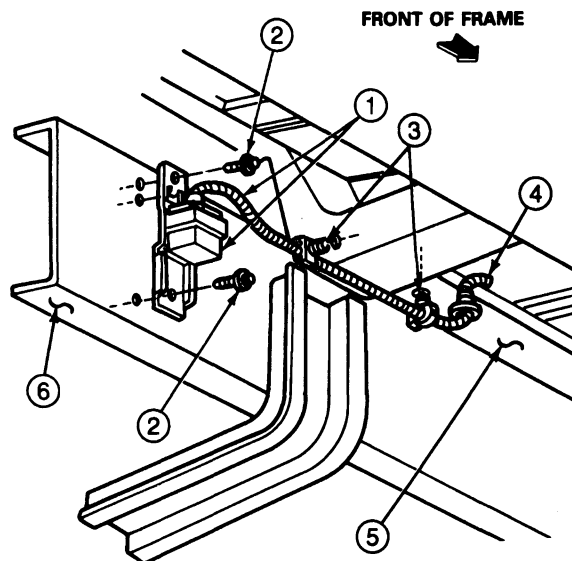
Sensor Rear Crash Sensor (Right Frame)**Removal**

WARNING: THE ELECTRICAL CIRCUIT NECESSARY FOR SYSTEM DEPLOYMENT IS POWERED DIRECTLY FROM THE BATTERY AND BACKUP POWER SUPPLY. TO AVOID ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY, THE POSITIVE BATTERY CABLE MUST BE DISCONNECTED PRIOR TO SERVICING OR REPLACING ANY SYSTEM COMPONENTS.

NOTE: To service stripped outboard sensor retaining screws replace screws with 13mm screw (part no. N802455. Tighten to 12.8-17.2 N·m (114-152 in-lb).

1. Disconnect positive battery cable and wait one minute for backup power supply energy to be depleted.
2. Disconnect rear sensor electrical connector.

3. Remove three screws retaining rear sensor to frame and remove sensor.



INSTALLATION OF AIR BAG SENSOR MODULE AND WIRE ROUTING (RIGHT REAR SIDE OF FRAME)

R8207-A

Item	Part Number	Description
1	14A685	Air Bag Sensor and Wiring Assembly
2	N806327-S190	Screw and Washer Assembly 10.2-13.8 N·m (91-122 in-lb)
3	—	Locator
4	—	Wiring Assembly in Right Stepwell
5	—	Stepwell
6	—	Right Frame (Front)

Installation

1. Position rear sensor and wire lead in vehicle and secure sensor to frame support with retaining screws. Tighten screws to 10.2-13.8 N·m (91-122 in-lb).
2. Connect rear sensor wire lead connector to wiring assembly connector and secure wiring retainer.
3. Connect battery positive cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

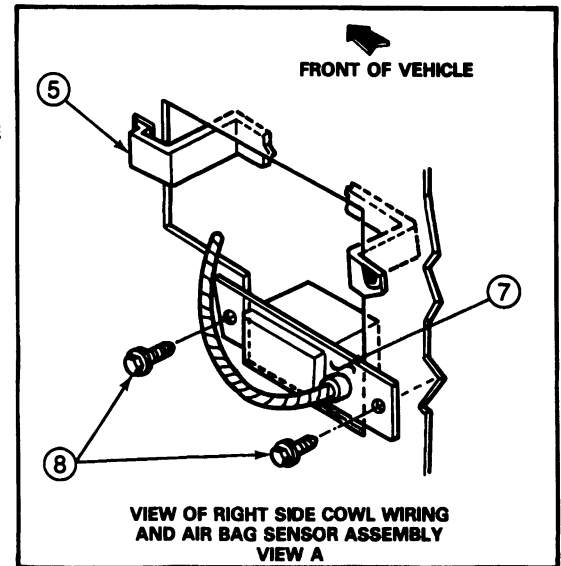
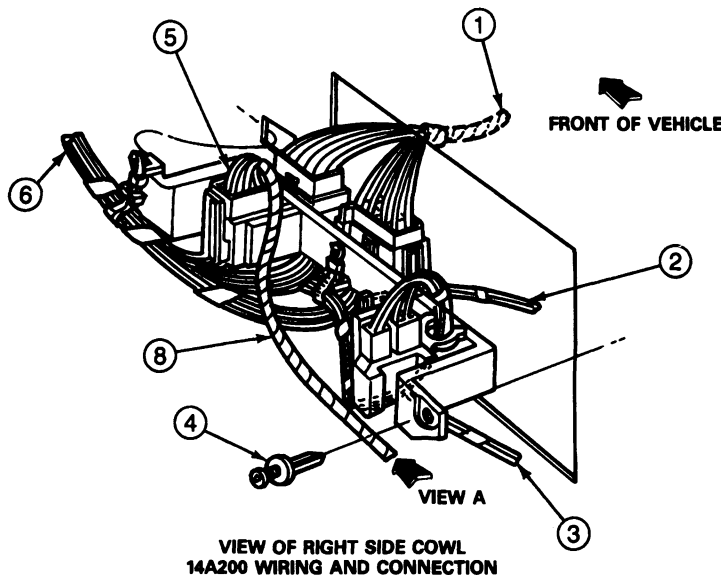
4. Verify air bag system readiness.

REMOVAL AND INSTALLATION (Continued)**Sensor Right Cowl Side (Safing) Sensor****Removal**

WARNING: THE ELECTRICAL CIRCUIT NECESSARY FOR SYSTEM DEPLOYMENT IS POWERED DIRECTLY FROM THE BATTERY AND BACKUP POWER SUPPLY. TO AVOID ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY, THE POSITIVE BATTERY CABLE MUST BE DISCONNECTED PRIOR TO SERVICING OR REPLACING ANY SYSTEM COMPONENTS.

NOTE: To service stripped rear sensor retaining screws, replace old screws with N802455-S190 M8. Tighten to 12.8-17.2 N·m (114-152 in·lb).

1. Disconnect positive battery cable and wait one minute for backup power supply energy to be depleted.
2. Remove right cowl side trim panel. Refer to Section 01-05B.
3. Disconnect sensor wiring connector from wiring assembly connector.
4. Remove two screws retaining rear sensor to right cowl side panel and remove sensor.



R8209-A

Item	Part Number	Description
1	14631	Wiring Assembly
2	—	To Courtesy Lamp Switch
3	14014	Wiring Assembly
4	387843-S	Pin

(Continued)

Item	Part Number	Description
5	—	Bracket
6	14A200	Wiring Assembly
7	14A686	Sensor and Wiring Assembly
8	N806327-S190	Screw and Washer Assembly 7.6-10.4 N·m (68-92 In·Lb)

Installation

1. Position sensor to cowl side panel.
2. Secure sensor with two retaining screws. Tighten to 7.6-10.4 N·m (68-92 in·lb).
3. Connect rear sensor wiring connector to wiring assembly connector.
4. Install cowl side trim panel.

5. Connect positive battery cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

6. Verify air bag indicator.

REMOVAL AND INSTALLATION (Continued)**Diagnostic Monitor**

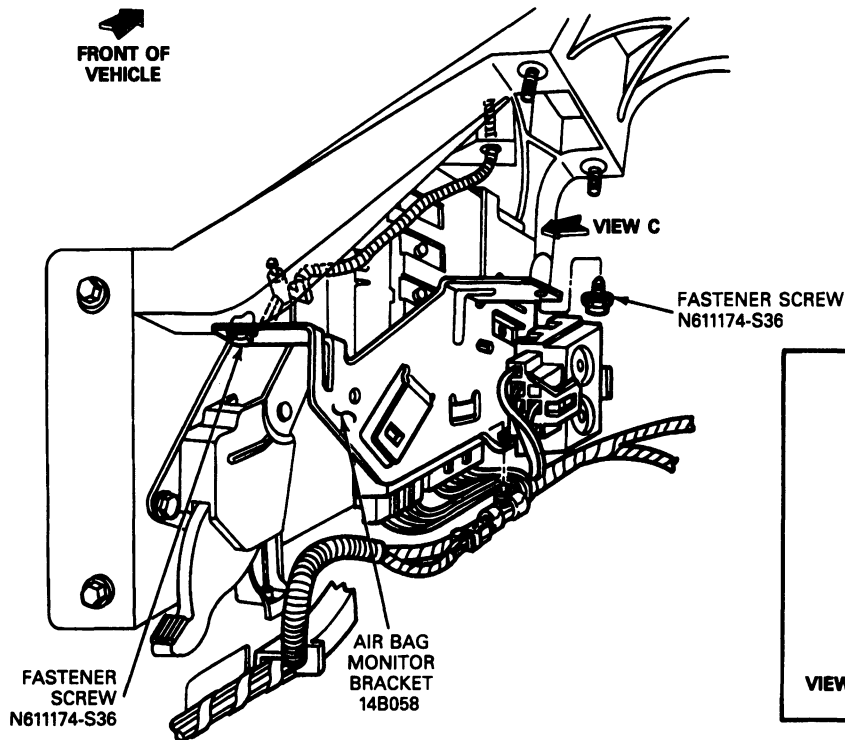
CAUTION: When servicing the diagnostic monitor with a blown internal fuse (fault code 51), find and repair all wire damage or shorts. A blown diagnostic monitor can be used to find electrical faults without replacing components unnecessarily. The Diagnosis and Testing portion of this section is written to give safety first priority.

The following steps may be taken to find the root cause that initiated a blown fuse:

1. Verify the system using the old diagnostic monitor and verify the wiring repairs success before proceeding. Repeat as many times as required.
2. Replace the diagnostic monitor when all wire repairs are complete.
3. If the fault code returns after making all wiring repairs, then replace the indicated component.

Removal

WARNING: THE ELECTRICAL CIRCUIT NECESSARY FOR SYSTEM DEPLOYMENT IS POWERED DIRECTLY FROM THE BATTERY AND BACKUP POWER SUPPLY. TO AVOID ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY, THE POSITIVE BATTERY CABLE MUST BE DISCONNECTED PRIOR TO SERVICING OR REPLACING ANY SYSTEM COMPONENTS.

Air Bag Diagnostic Monitor Location

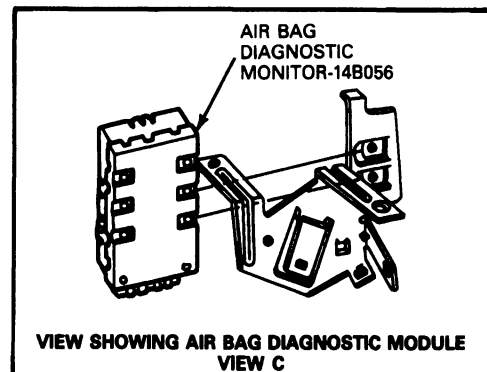
1. Disconnect positive battery cable and wait one minute for backup power supply energy to be depleted.
2. Locate diagnostic monitor beneath and to the left of the steering column and disconnect the two connectors.
3. Depress tabs on diagnostic monitor retaining monitor to mounting bracket and slide monitor off bracket.
4. Disconnect diagnostic monitor electrical wiring connectors and remove monitor.

Installation

1. Connect electrical wiring connectors to the diagnostic monitor.
2. Position diagnostic monitor to mounting bracket and slide monitor into place. Make sure that tabs are locked in place.
3. Connect positive battery cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

4. Verify air bag system readiness.



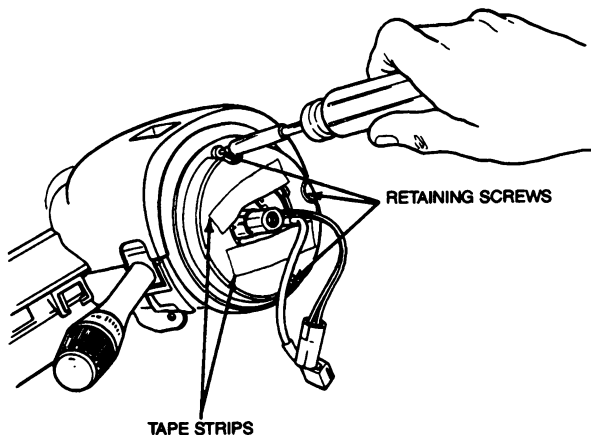
R8211-B

REMOVAL AND INSTALLATION (Continued)**Clockspring Assembly**

WARNING: THE BACKUP POWER SUPPLY ENERGY MUST BE DEPLETED BEFORE ANY AIR BAG COMPONENT SERVICE IS PERFORMED. TO DEplete THE BACKUP POWER SUPPLY ENERGY, DISCONNECT THE POSITIVE BATTERY CABLE AND WAIT ONE MINUTE.

Removal

1. Disconnect the positive battery cable and wait one minute for the backup power supply energy to be depleted.
2. Make sure that the vehicle's front wheels are in the straight ahead position.
3. Remove the air bag module as described in this section.
4. Remove the steering wheel. Refer to section 11-04A.
5. Remove lower right and left mouldings from instrument panel by pulling up and snapping out of retainer.
6. Remove instrument panel lower trim panel and lower steering column shroud.
7. Apply two strips of tape across the clockspring and housing to prevent accidental rotation.
8. Remove three clockspring assembly retaining screws and pull clockspring assembly off the steering column shaft.
9. Remove the clockspring ground wire screw.
10. Disconnect the clockspring electrical connector.
11. Remove the clockspring assembly.



G5555-A

Installation

CAUTION: If the clockspring has been accidentally rotated, the clockspring alignment must be adjusted. Refer to procedure under ADJUSTMENTS in this section.

NOTE: If a new clockspring assembly is being installed, the alignment is already set.

1. Make sure that the vehicle's front wheels are in the straight ahead position.
2. Install the clockspring ground wire screw.
3. Position the clockspring assembly on the steering column shaft.
4. Connect the clockspring electrical connector.
5. Install the three clockspring screws. Tighten the clockspring screws to 2-3 N·m (18-26 in·lb).
6. Remove the tape strips from the clockspring and housing.
7. Install lower shroud and instrument panel cover.
8. Install the steering wheel. Refer to section 11-04A.
9. Install the air bag module as described in this section.
10. Connect the negative battery cable.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

11. Verify that the air bag lamp is operative.

Module, Driver Air Bag

NOTE: If the air bag did not deploy in an accident, it may not have been needed. Complete all diagnosis before replacing the air bag module.

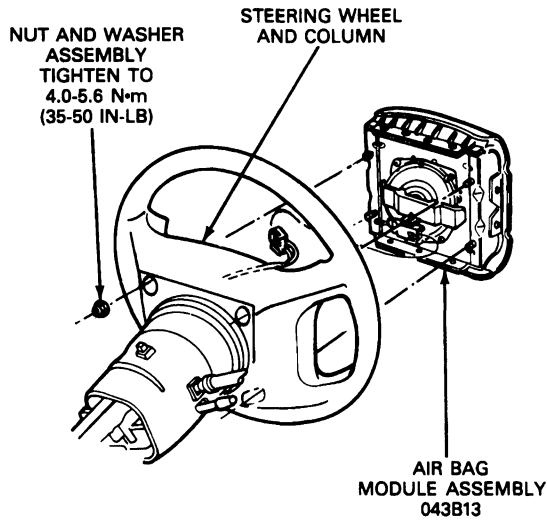
Removal

WARNING: THE ELECTRICAL CIRCUIT NECESSARY FOR SYSTEM DEPLOYMENT IS POWERED DIRECTLY FROM THE BATTERY AND BACKUP POWER SUPPLY. TO AVOID ACCIDENTAL DEPLOYMENT AND POSSIBLE PERSONAL INJURY, THE POSITIVE BATTERY CABLE MUST BE DISCONNECTED PRIOR TO SERVICING OR REPLACING ANY SYSTEM COMPONENTS.

1. Disconnect positive battery cable and wait one minute for backup power supply energy to be depleted.

REMOVAL AND INSTALLATION (Continued)

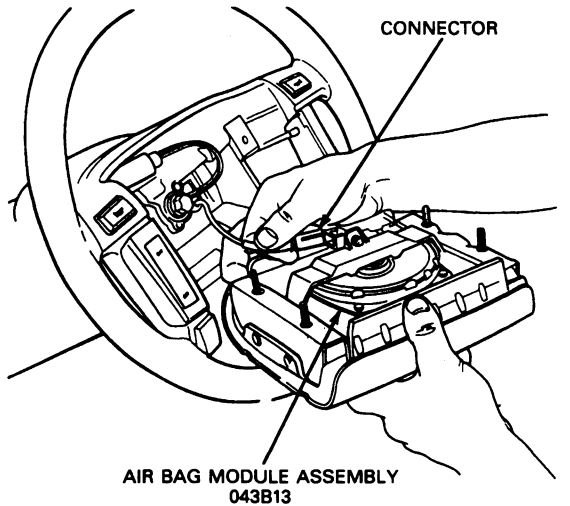
2. Remove four nut and washer assemblies retaining air bag module to steering wheel.



R8217-B

3. Disconnect the air bag electrical connector from contact assembly connector. Remove air bag assembly.

WARNING: PLACE AIR BAG MODULE ON BENCH WITH TRIM COVER FACING UP.



G8334-A

Installation

1. Fill out the traceability postcard supplied with the new air bag and return it to Ford Motor Company. Note the fault code.
2. Connect air bag module wiring connector to contact assembly connector.
3. Position air bag module to steering wheel and secure with four nut and washer assemblies. Tighten to 4.0-5.6 N·m (36-49 in-lb).
4. Connect positive battery cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

5. Verify air bag system readiness.

Trim Panel and Steering Column Opening

Refer to Section 11-04A.

DISPOSAL PROCEDURES

Several situations may arise which require some form of disposal action: scrapping a vehicle containing a deployed air bag, scrapping a vehicle with a live air bag, disposal of a live but electrically inoperative air bag module or scrapping a deployed module. Disposal recommendations for these situations are shown in the following chart and discussed in detail below.

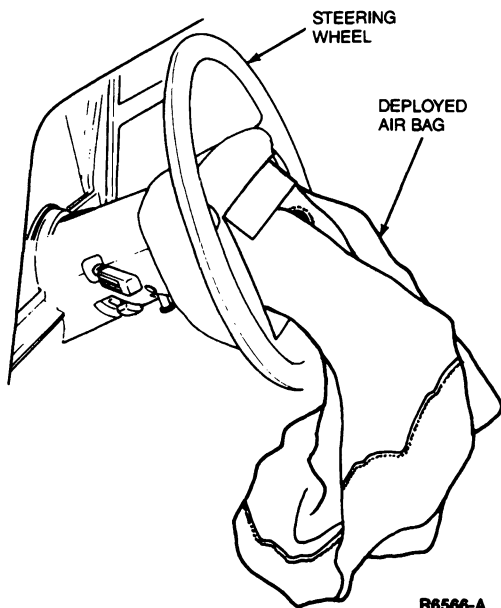
AIR BAG DISPOSAL RECOMMENDATIONS

Condition	Instructions
1. Vehicle to be Scrapped; — Live Air Bags.	Electrically Deploy Using Procedures 1 or 2 as Required.
2. Vehicle to be Scrapped; — Deployed Air Bags.	Scrap Vehicle in the Usual Manner.
3. Module Replaced; — Damaged but Live Air Bags.	Package and Label Property. Return to Ford.
4. Module Replaced; — Deployed Air Bags.	Scrap Air Bags in the Usual Manner.

DISPOSAL PROCEDURES (Continued)

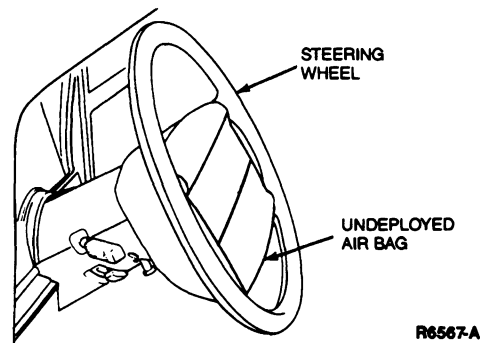
Deployed Air Bag

To service a vehicle in which the air bag has deployed, the deployed air bag must be replaced with a new air bag. The deployed air bag can be disposed of in the same manner as any part to be scrapped.



Scrapped Vehicle

Some vehicles that are damaged or inoperable to the point that service cannot be made may contain undeployed air bags. This condition could occur by side or rear impact, rollover or if the vehicle is simply past its useful lifetime. **THE AIR BAGS SHOULD BE DEPLOYED USING PROCEDURE 1 OR 2 AS FOLLOWS PRIOR TO SCRAPPING VEHICLE.**



Undeployed Air Bag, Faulty

In the event that an air bag is diagnosed as faulty (refer to Diagnostic Procedures), the faulty air bag must be replaced by a new air bag. The faulty air bag **CANNOT BE DISPOSED OF IN THE USUAL MANNER**. It must be returned intact to Ford Motor Company for proper disposal. Return the carton to the following address for warranty claim credit:

Warranty Parts Return Center
1285 S. Mill Street
Plymouth, MI 48170

NOTE: All faulty live air bags have been placed on the Mandatory Return List. All discolored or damaged modules should be treated the same as any faulty live air bag being returned.

The air bag must be packaged and shipped according to the U.S. Department of Transportation regulations. Retain packaging used for replacement air bag, including the labeling. **Do not deploy air bag.** Properly package the module in the original service replacement carton and securely tape shut. Affix Flammable Solid label and shipping exemption to package.

Air Bag Disposal

Procedure 1

Electronic Deployment with Wiring Intact

This procedure is to be used in the event that a vehicle with a live air bag is to be scrapped. Scrapping a vehicle may be required due to severe damage in a non-air bag deployable accident or at the end of the vehicle's useful life. This procedure assumes that the air bag wiring remains intact; this is, no fault codes are indicated by the readiness indicator, the system proves out correctly and the vehicle's battery is still in place (or one has been provided). This procedure is to be performed outdoors, away from other personnel, since the deploying air bag makes a loud report upon actuation.

1. Check and clear the front seat of all loose objects.
2. Do not permit any occupants to remain inside the vehicle.
3. Open the hood and check for an operational vehicle battery. If no battery is found, supply one and connect it in the usual manner.
4. Turn the ignition switch to the RUN position and observe the air bag readiness indicator. If the indicator illuminates for six seconds and then stops, the system is intact and may be deployed. Continue with Procedure 1. If a series of fault codes appear, go to Procedure 2 to deploy the unit.
5. Turn ignition to the OFF position.
6. Locate and disconnect the rear sensor connector.

DISPOSAL PROCEDURES (Continued)

7. Jump Circuits 611 (W/O) and 614 (GY/O) using a 152mm (6-inch) length of bared wire.

WARNING: MAKE SURE THERE ARE NOT OCCUPANTS IN THE VEHICLE.

8. Locate and disconnect either the right or left front crash sensor located on the radiator support.
9. Using a 152mm (6-inch) length of bared wire, short the 617 (PK/O) or 621 (W/Y) wire-to-ground. The air bag should deploy. If the air bag does not deploy, go to Procedure 2.
10. If successful, a loud report will be heard and the bag material will be visible in the center of the steering wheel. Allow at least 10 minutes before approaching the air bag to allow for cooling.

The air bag is now inoperative and the vehicle may be scrapped in the usual manner.

Procedure 2**Remote Deployment of Air Bag**

This procedure is to be used in the event that a vehicle with a live air bag is to be scrapped, but the vehicle does not contain an intact wiring harness or certain system components are inoperative. This procedure can also be used if Step 7 of Procedure 1 was unsuccessful.

WARNING: REMOTE DEPLOYMENT IS TO BE PERFORMED OUTDOORS WITH ALL PERSONNEL AT LEAST 20 FEET AWAY TO ENSURE PERSONAL SAFETY AND DUE TO THE LOUD REPORT WHICH OCCURS WHEN DRIVER AIR BAGS ARE DEPLOYED.

- Remove the driver air bag from the vehicle as described in this section.
- Cut the two module connector wires and strip 25mm (1 inch) of insulation from the ends. Obtain two wires at least 20 feet long. Connect one end of each wire to each of the air bag module wires.
- Place the air bag with the trim cover facing upward on a flat surface in a remote area such as a parking lot or field.

WARNING: DO NOT PLACE THE AIR BAG WITH THE TRIM COVER FACING DOWN, AS THE FORCES OF THE DEPLOYING AIR BAG MAY CAUSE IT TO RICOCHET AND CAUSE PERSONAL INJURY.

- Remaining at least 20 feet away from the air bag, deploy it by touching the other ends of the two wires to the terminals of a 12 volt vehicle battery.
- If successful, a loud report will be heard and the air bag material will be visible. Allow at least 10 minutes before approaching the air bag to allow for cooling.

The air bag is now deployed and may be scrapped in the usual manner.

ADJUSTMENTS**Clockspring Alignment**

WARNING: THE BACKUP POWER SUPPLY ENERGY MUST BE DEPLETED BEFORE ANY AIR BAG COMPONENT SERVICE IS PERFORMED. TO DEplete THE BACKUP POWER SUPPLY ENERGY, DISCONNECT THE POSITIVE BATTERY CABLE AND WAIT ONE MINUTE.

- Disconnect the positive battery cable and wait one minute for the backup power supply energy to be depleted.
- Make sure that the vehicle's front wheels are in the straight ahead position.
- Remove the air bag module as described in this section.
- Remove the steering wheel. Refer to Section 11-04.

CAUTION: Do not apply excessive force to the clockspring.

- Turn the clockspring clockwise until it stops.
- Rotate the clockspring counterclockwise 2.75 turns.
- Align the marks on the clockspring with the marks on the outer housing.
- Install the steering wheel. Refer to Section 11-04.
- Install the air bag module as described in this section.
- Connect the positive battery cable.

NOTE: On vehicles equipped with EEC, when the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

- Verify that the air bag lamp is operative.

SPECIFICATIONS**MAJOR SYSTEM COMPONENT PART NUMBERS**

Tool Number	Description
043B13-A	Driver Air Bag
14688-A	Sensor and Bracket Assy, Front Center
14686-A	Sensor and Bracket Assy, Right Cowl
14685-A	Sensor and Bracket Assy, Right Frame
14B056-A	Diagnostic Monitor

TORQUE SPECIFICATIONS

Description	N-m	In-Lb
Driver Air Bag Module-to-Steering Wheel Nuts	4.0-5.6	36-49
Front Sensor-to-Radiator Support Screws	10.2-13.8	91-122

(Continued)

SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS (Cont'd)		
Description	N-m	In-Lb
Rear Sensor-to-Right Frame Screws	12.8-17.2	114-152
Safing Sensor-to-Right Cowl Side Panel Screws	7.6-10.4	68-92
Clockspring Screws	2-3	18-26

SPECIAL SERVICE TOOLS/EQUIPMENT

ROTUNDA EQUIPMENT	
Tool Number	Description
059-00010	Dwell-Tach-Volts-Ohms Tester
105-00010	Air Bag Simulator

GROUP

02

I

FRAME AND MOUNTING

(70000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
BODY MOUNTING.....	02-02-1	FRAME.....	02-01-1

SECTION 02-01 Frame

SUBJECT	PAGE	SUBJECT	PAGE
INSPECTION		REPAIR OPERATIONS	
Diagonal or X Frame Checking Method.....	02-01-1	Frame Extension	02-01-3
Frame Inspection.....	02-01-1	Frame Repair	02-01-2
REMOVAL AND INSTALLATION		Frame Side Rail to Rear Shock Bracket	
Frame and Crossmembers	02-01-6	Repair	02-01-3
E-150-250-350	02-01-7	Steering Gear Frame Liner Repair, F-350.....	02-01-4
F-150-250-350, F-Super Duty Chassis Cab		SPECIFICATIONS	02-01-10
and Bronco	02-01-6	VEHICLE APPLICATION	02-01-1
F-Super Duty Commercial Chassis and			
Motorhome Chassis	02-01-7		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco Vehicles

INSPECTION

Frame Inspection

Frame misalignment is the result of damaged frame components.

Before checking frame alignment, inspect all frame members for damage, cracks, twists, or bends. Check all welded connections for cracks. Inspect all rivets, bolts, and body support brackets for looseness. Make all necessary repairs or replacements.

Diagonal or X Frame Checking Method

Frame alignment can be checked without removing the body from the frame by using the diagonal or X checking method.

NOTE: This procedure can NOT be performed on the E-Series vehicles.

This method should be used to identify misalignment prior to any attempt to straighten a frame.

1. Place the vehicle on a clean level floor and set the parking brake.

INSPECTION (Continued)

2. Select at least four points along one frame side member and transfer these points to the floor with a plumb bob. If desired, paper can be taped on the floor along both sides of the vehicle below the frame. Mark the points on the floor as accurately as possible.
3. Locate the corresponding points along the opposite frame side member and transfer these points to the floor in the same manner.
4. Move the vehicle away from the marks on the floor, and measure diagonally between all points on the floor. Both measurements should be equal within 6.35mm (1/4 inch).
5. Measure between corresponding points parallel to the frame side members. These measurements should be within 3.18mm (1/8 inch) of each other.

The squareness of the frame side member web to the floor at the spring hangers and at the steering gear mounting location should be within 1.59mm (1/16 inch). The squareness of the frame side member web to the floor at all other points should be within 3.18mm (1/8 inch). The web and flange should be square at all other points within 3.18mm (1/8 inch).

Any point on one side member should be within 3.18mm (1/8 inch) ahead, behind, above, or below the corresponding point on the opposite side member. The frame side member should not be bowed more than 3.18mm (1/8 inch) for each 2540mm (100 inches) of frame length. The overall width of the frame should not vary more than 3.18mm (1/8 inch).

NOTE: An alternate method of checking frame alignment is to use a frame gauge.

REPAIR OPERATIONS

Frame Repair

Drilling Precautions

Do not drill holes in the frame flanges, since this will reduce the frame strength.

If a hole must be drilled in the frame, make sure that it meets all the following requirements:

1. The hole is located in the upper half of the frame.
2. The edge of the drilled hole and the edge of the nearest hole are at least 25mm (1 inch) apart.
3. The edge of the drilled hole is at least 25mm (1 inch) from the edge of the flange.
4. The drilled hole is not adjacent to any other existing frame brackets or components.

Welding Precautions

CAUTION: Disconnect the negative battery ground cable before using any electric welding equipment.

All frame welding **must** be done with electric welding equipment, and the heat should be kept in a small area to prevent change in hardness of the metal. **Do not use gas welding equipment. A double reinforcement must be added to frames where heat or weld is applied to the area to be repaired. The welds are to run lengthwise along the reinforcement when a reinforcement is to be welded to a side member.**

Frame Straightening

Frame misalignment can be corrected by straightening the out-of-line parts or by replacing the crossmembers, braces, or brackets if they are badly damaged.

WARNING: STRAIGHTENING OF FRONT FRAME RAIL CONVOLUTIONS IS PROHIBITED. REPAIR KITS ARE AVAILABLE TO REPLACE THE FRONT CONVOLUTIONS FOR BOTH FRAME RAILS.

Straightening should be attempted on frames that fail to meet specifications of the diagonal checking method or where damage is visually apparent.

However, to prevent internal stresses in the metal, frame straightening should be limited to parts which are not severely bent. **If heat is needed to straighten a frame member, keep the temperature below 649°C (1200°F) (a dull red glow). Excessive heat may weaken the metal in the frame members and cause permanent damage.**

Frame Reinforcing

After a bent frame member has been straightened, inspect the member closely for cracks. If any cracks show, the frame member should be reinforced or replaced.

Reinforcements should be made from angle or flat stock of the same material and thickness as the frame member being reinforced, and should extend a minimum of 152.40mm (6 inches) to either side of the crack. Ideally, the reinforcement should be cut from the corresponding area of a similar frame.

Weld Attachment

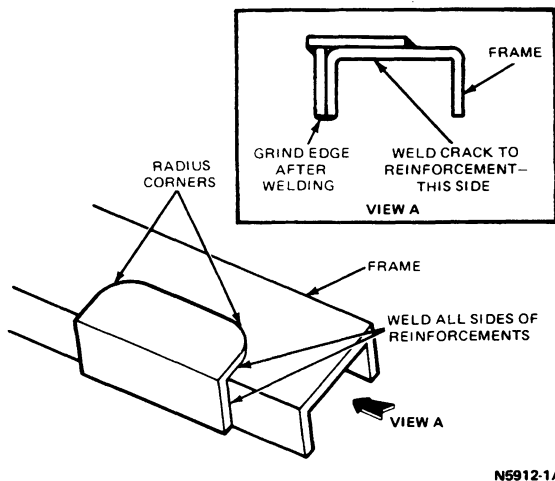
The following procedure must be adhered to if it is deemed necessary to weld reinforcements to the frame and make sure of a quality repair.

The crack should be prepared before welding the reinforcement to the cracked frame member by wire brushing the area around the crack to remove the paint, grease, mud, etc. to completely expose the crack and assure good weld adhesion. To stop the crack from spreading, drill a 6.35mm (1/4-inch) hole at a point 12mm (0.50 inch) beyond the root of the crack. Grind out the full length of the crack to the hole to form a V-shaped slot with the base of the "V" contacting the reinforcement. The base of the "V" should have at least 1.52mm (.06 inch) opening to insure weld penetration to the reinforcement when welding the crack. Drill clearance holes in the reinforcements, to clear rivet heads and bolt heads or nuts where necessary.

REPAIR OPERATIONS (Continued)

In the event that repair is required to more than one frame surface (i.e., a flange crack which extends into the web) two pieces of flat stock (one for each surface) should be utilized and welded together where they join. The web reinforcement should be a minimum of 76.20mm (3.0 inch) high and have 63.50mm (2.5 inch) radius at each of the two corners.

Completely clean the frame surface under and around the reinforcements. Clamp the reinforcements securely to the frame prior to welding. Weld the reinforcement all around after welding the crack "V" to the reinforcement. The flange edge weld should be ground smooth after all pit holes have been filled by the weld.



If a damaged, bolted-on frame bracket is to be replaced, the new bolts, washers, and nuts should be of the same specifications and bolt torques as the original parts.

In cases where it is necessary to remove rivets, replace them with Property Class 9.8 metric (Grade 8) nuts, bolts and washers of the next larger size (i.e., for 3/8 diameter rivets use 7/16-inch bolts, for 7/16 diameter rivets use 1/2-inch bolts). This requires line drilling of the holes to the same diameter as the new bolt (i.e., either 0.437 diameter or 0.500 diameter).

Frame Member Replacement

If a damaged frame member is to be replaced, new bolts, Property Class 9.8 metric (Grade 8) fasteners, and rivets required for replacement of parts should be of the same specifications as the original bolts or rivets. In cases where it is necessary to substitute a bolt for a rivet, use the next larger size bolt.

Frame Extension

For the recommended installation of frame extensions for mounting optional longitudinal spacers, refer to the 1992 Ford Truck Body Builders Layout Book.

Frame Side Rail to Rear Shock Bracket Repair

Cracks may develop in the frame side rail at the rear gas shock bracket rivets if the vehicle is used for continuous off-road service. If it is determined that a repair must be made, a frame reinforcement kit (FOTA-5L005-BA) is available for this type of repair.

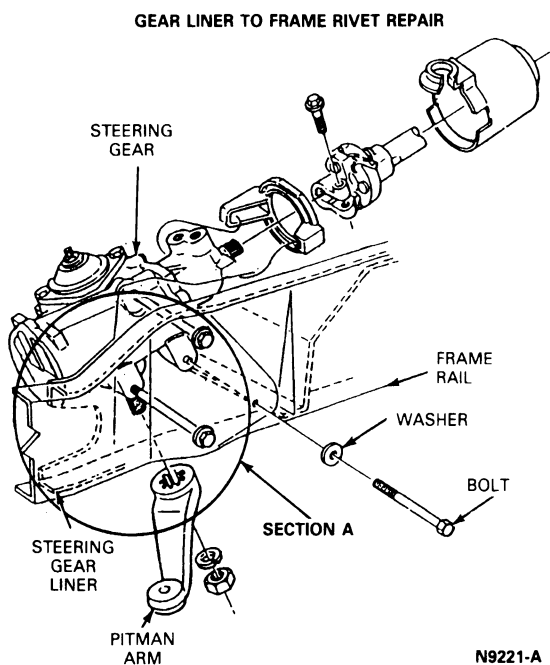
1. Position the vehicle on supports. Remove rear wheels and inspect rear shock bracket areas for cracks and/or damage.
2. Disconnect shock absorber from upper and lower mounting points. Locate the crack and clean the surface. A crack which has traveled past the midpoint of the siderail bend radius should not be repaired; a new frame assembly is required. Refer to Frame Member Replacement in this section. If the crack has not traveled past the midpoint of the siderail bend radius, the frame can be repaired. Use the following procedure for frame siderail repair.
3. Remove any fuel and brake lines in the damaged area.
4. Remove three rivets attaching shock absorber bracket to side rail. Use the following procedure to remove rivets.
 - a. Drill 1/8-inch hole through rivet.
 - b. Drill same hole with 11/32-inch drill through shank.
 - c. Use air-chisel to remove head.
 - d. Drive out rivet with punch.
5. Clean affected area with a wire brush.
6. To repair, drill a 3/16-inch hole at the crack termination into the siderail.
7. Grind out a groove, top and bottom, one quarter of metal thickness deep along the crack.
8. Run a continuous weld along groove. Weld direction is away from hole. Weld both sides and fill crack termination hole.
9. Grind all weld deposits flush with siderail metal.
10. Place the reinforcement plate over the outside of the siderail.
11. Drilling from the inside out, use the shock bracket holes in the frame rail as a guide and line drill through the rail and plate with 12mm drill bit. Drill the shock absorber bracket mounting holes to 12mm.
12. Install the shock bracket using 12mm fasteners and nuts. Place bolt head to outside, nut to inside of frame rail. Tighten to 120 N·m (88.5 ft-lb).
13. Weld plate to rail.

NOTE: Refer to the instruction sheet in the frame reinforcement kit for proper weld locations.
14. Paint repaired area after cooling. Reinstall the shock absorber. Install the wheel and remove vehicle from supports.

REPAIR OPERATIONS (Continued)

Steering Gear Frame Liner Repair, F-350

Cracks may appear in the frame at the rail near the steering gear or steering gear bolt heads, or in the steering gear frame liner.

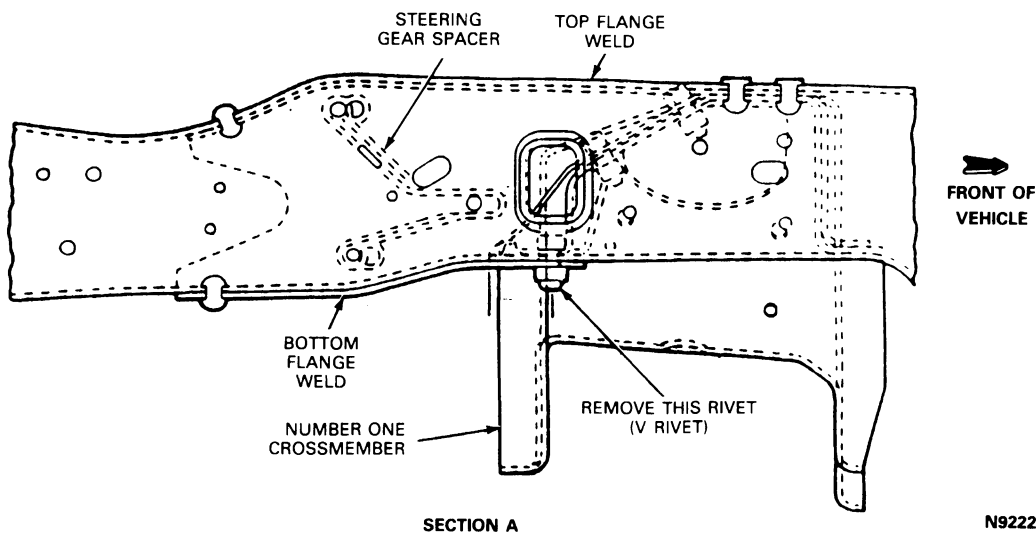


N9221-A

The following areas of the frame should be checked before performing a steering gear frame liner repair: the frame rail near the steering gear top and bottom flanges, and the frame rail at the steering gear bolt heads. If there are cracks in these areas of the frame, the frame must be replaced. Inspect the mounting surface of the steering gear for signs of motion, loose rivets or cracks. Removal of the steering gear may be necessary to check for cracks in the frame liner. Refer to Section 11-02C for procedure. If the frame liner is cracked or has loose rivets, repair the liner by using Frame Repair Kit E6TZ-5K130-A. If necessary a steering gear liner to frame, rivet repair can be made by using the following procedures:

Rivet Removal and Replacement

1. Drill a 1/8-inch hole through rivet.
2. Redrill the hole through the shank of the rivet with an 11/32-inch drill.
3. Use an air chisel to remove rivet head.
4. Drive out rivet with a punch or other suitable tool.

Rivet Removal

SECTION A

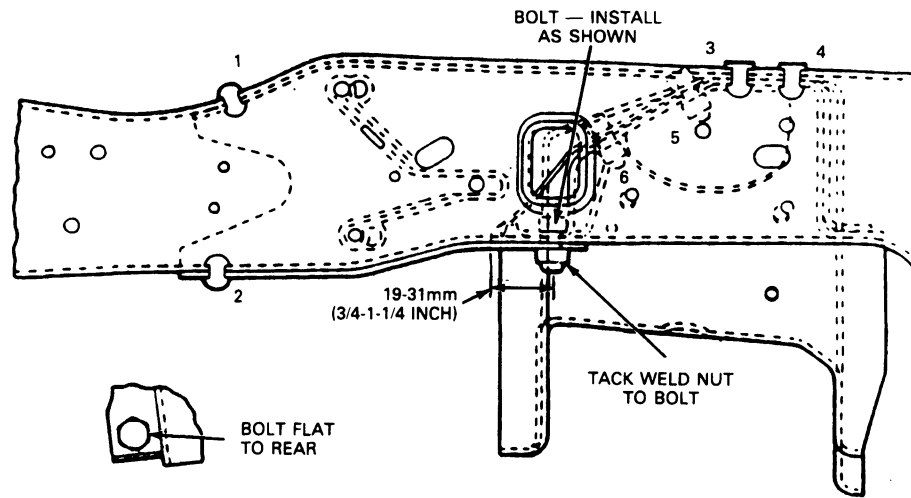
N9222-A

5. Line drill one 7/16-inch hole marked "V" to 9/16-inch diameter.

6. Install one 9/16-inch bolt in the direction shown in the following illustration.

REPAIR OPERATIONS (Continued)

Rivet Replacement



7. Position bolt head on top (next to crossmember) with hex head flat to the rear to provide best clamping.

8. Install one 9 / 16-inch washer nut side only and one 9 / 16-inch nut. Tighten to 190 N-m (140 ft-lb).
NOTE: Tack weld the nut to the bolt as shown in the above illustration.

Rivet Replacement with Bolts

BOLT SELECTION CHART

Rivet Diameter	Bolt Size	Bolt Part Number	Washer Part Number	Nut Part Number	Torque Specs.
3 / 8-Inch & 10mm	7 / 16-14x1.25	56561-S2	Not Req.	382400-S2	33-50 Lb-Ft (45-68 N-m)
3 / 8-Inch & 10mm	7 / 16-14x1.75	56563-S2	Not Req.	382400-S2	33-50 Lb-Ft (45-68 N-m)
7 / 16-Inch	1 / 2-13x1.5 (Grade 5)	56783-S100	Not Req.	33773-S2	53-75 Lb-Ft (72-102 N-m)
7 / 16-Inch	1 / 2-13x2.0 (Grade 8)	383896-S2	44879-S2	33773-S2	75-105 Lb-Ft (102-142 N-m)

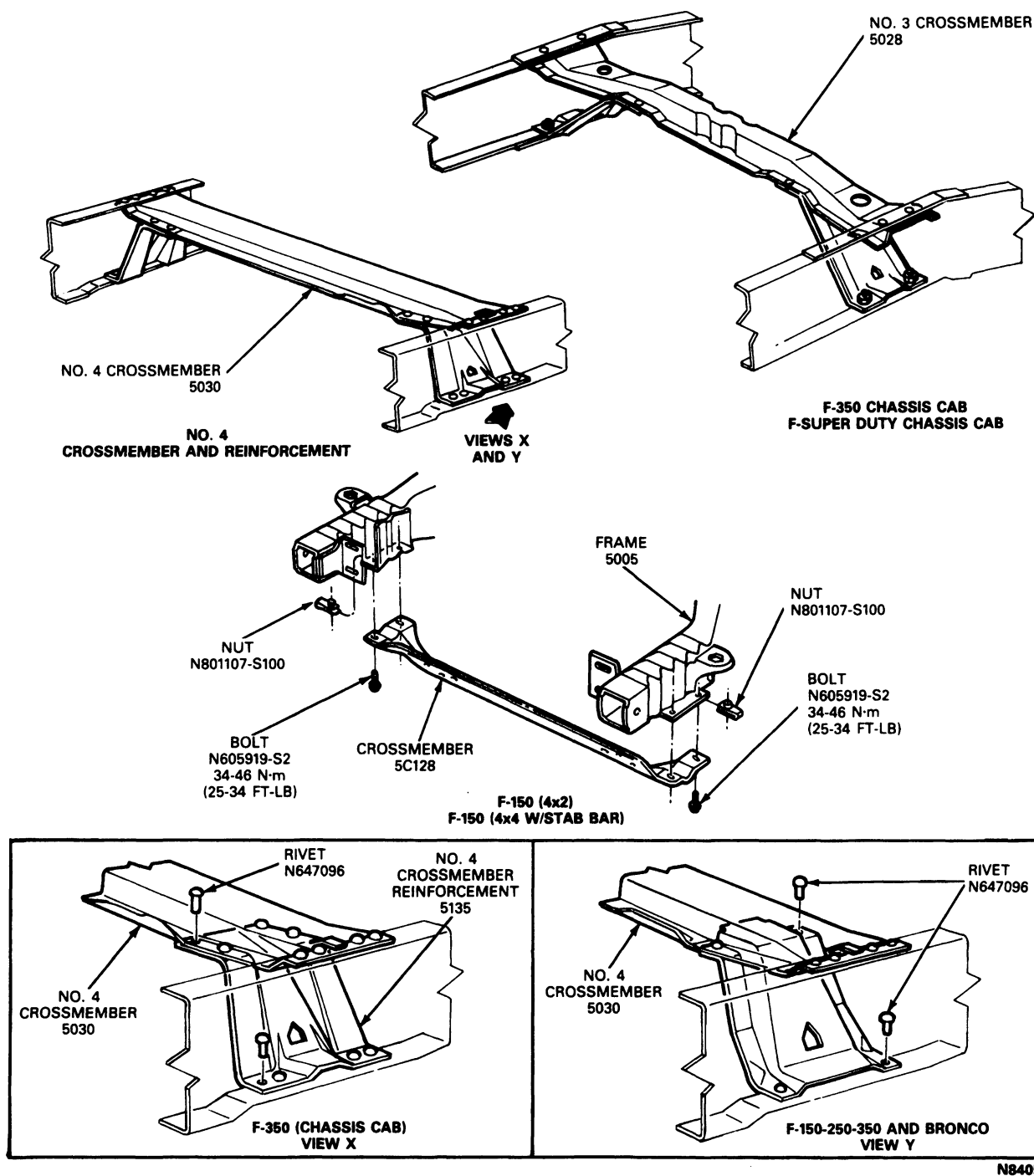
Part Number	Part Name	Class
56561-S2	Bolt — (7 / 16-14x1.25)	S
56563-S2	Bolt — (7 / 16-14x1.75)	C
56783-S100	Bolt — (1 / 2-13x1.5)	C
383896-S2	Bolt — (1 / 2-13x2.0)	BS
382400-S2	Nut	RG
33773-S2	Nut	S
44879-S2	Washer	BS

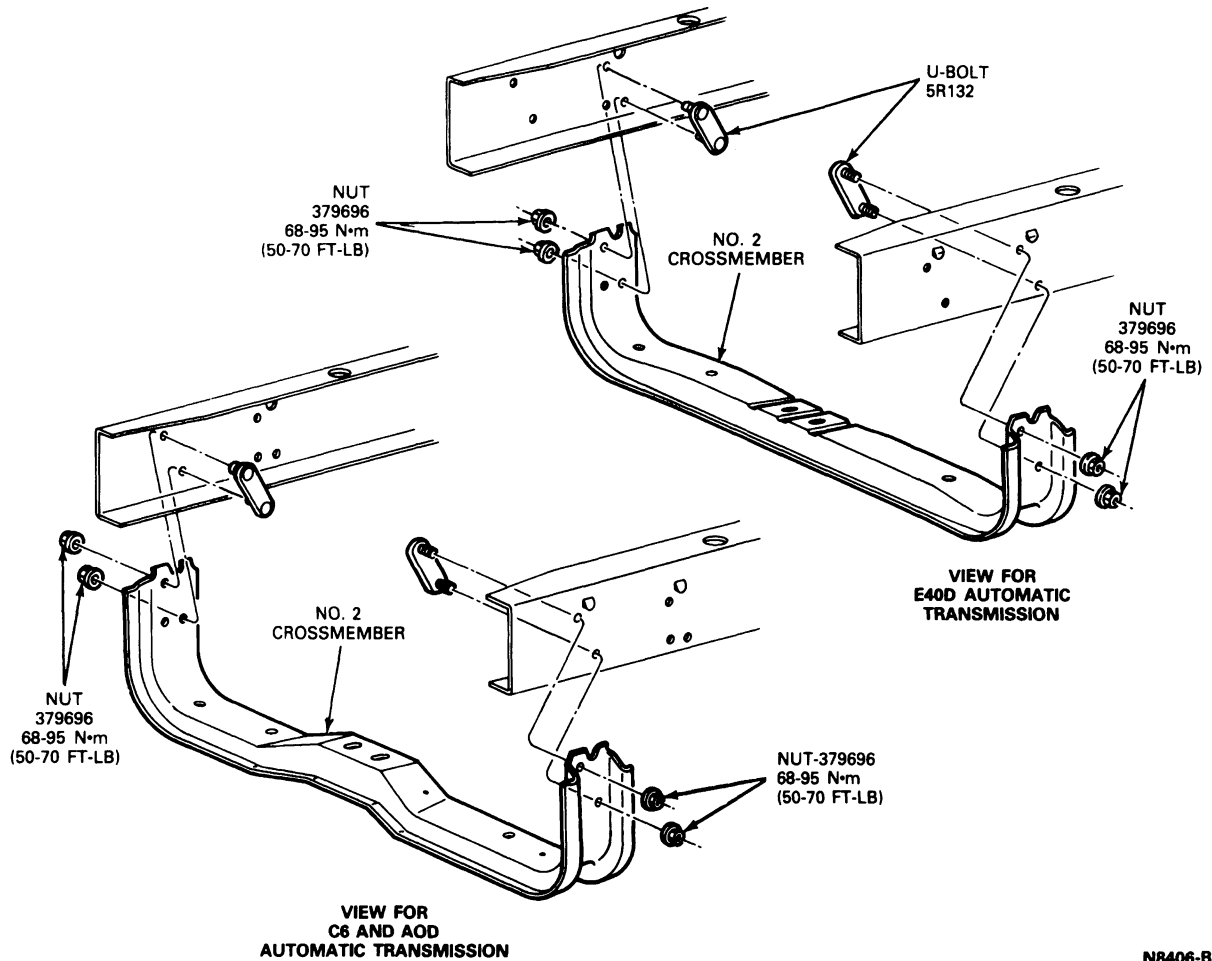
NOTE: If a flange head nut and bolt are not available, Grade 5 hex heads may be substituted with one flatwasher required under the nut and one flatwasher required under the bolt head. Grade 8 bolts may be substituted for any application.

REMOVAL AND INSTALLATION

Frame and Crossmembers

F-150-250-350, F-Super Duty Chassis Cab and Bronco



REMOVAL AND INSTALLATION (Continued)**E-150-250-350**

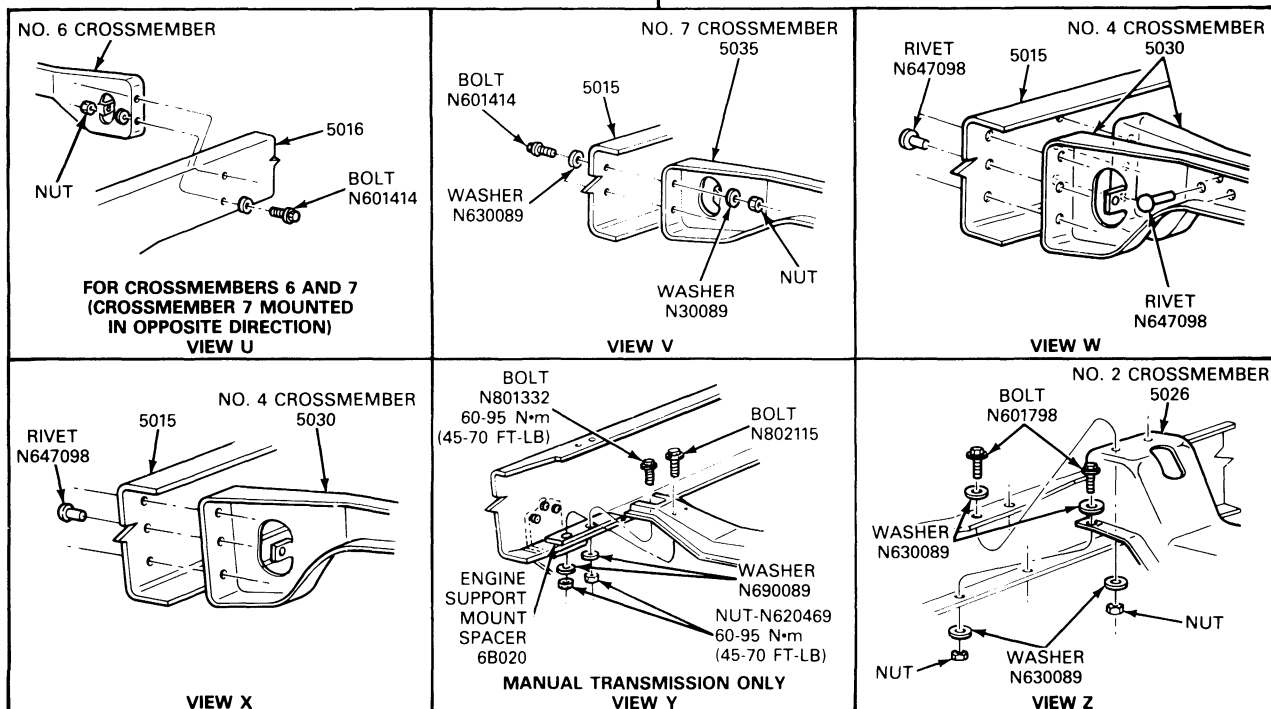
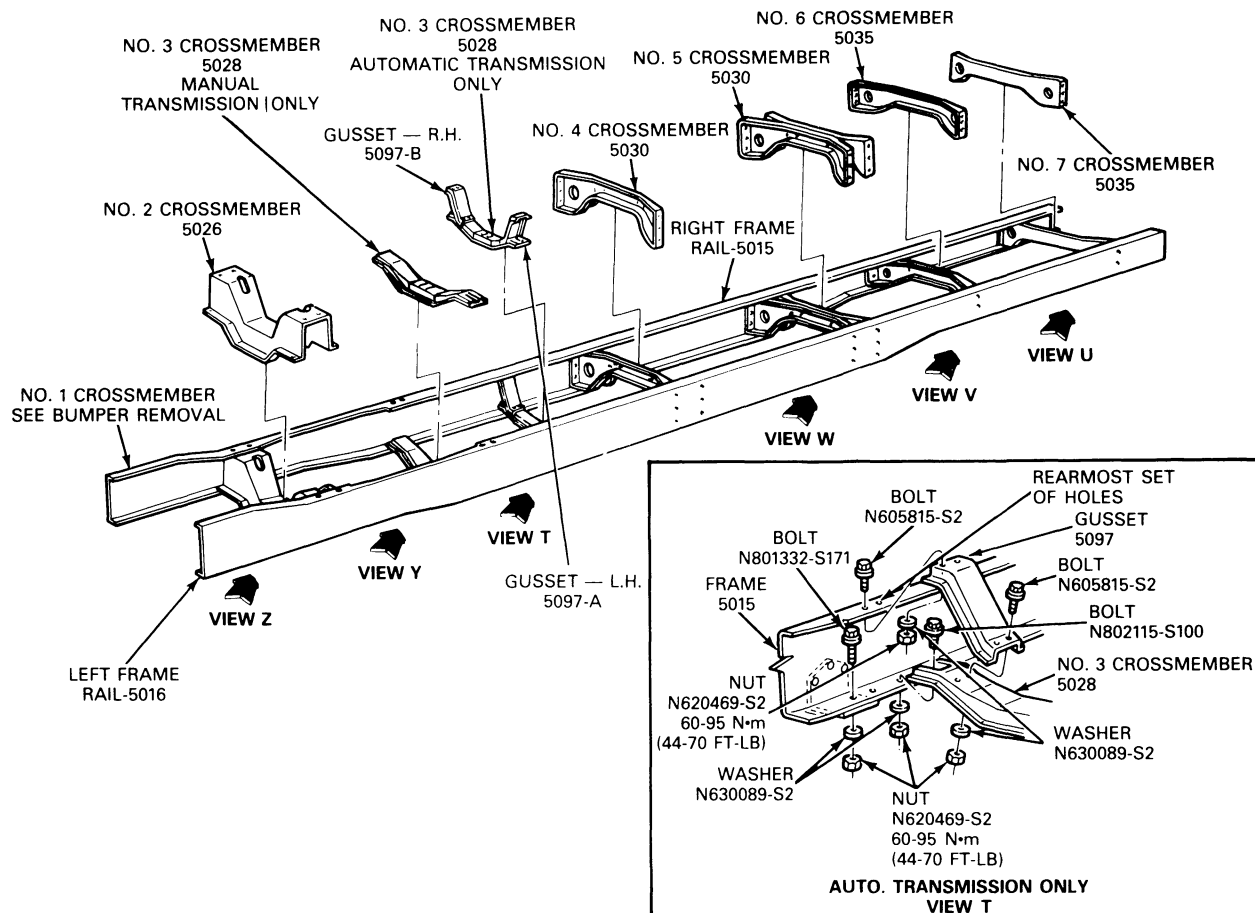
N8406-B

F-Super Duty Commercial Chassis and Motorhome Chassis

NOTE: F-Super Duty Commercial Chassis and Motorhome Chassis crossmember numbering differs from F-150-250-350 crossmember numbering. When replacing crossmembers on these vehicles, make sure that you specify the correct crossmember location. For crossmember part numbers, refer to the Light Truck Master Parts and Accessories Catalog.

REMOVAL AND INSTALLATION (Continued)

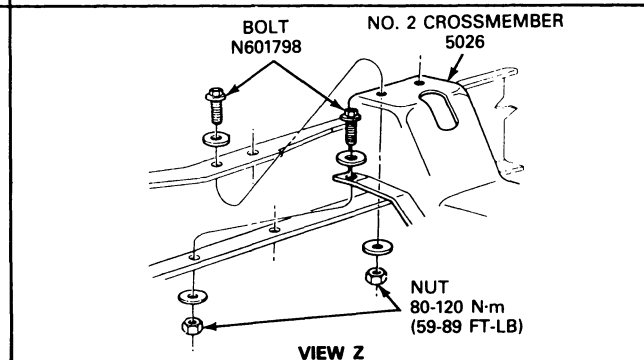
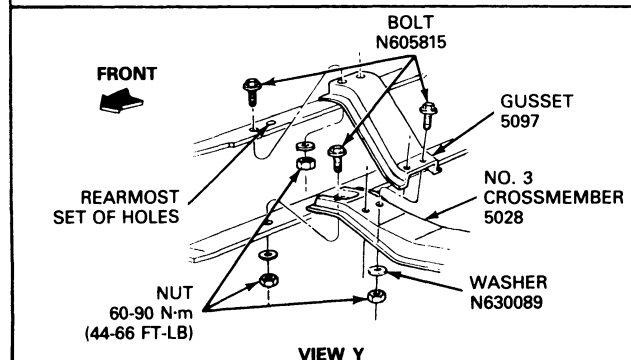
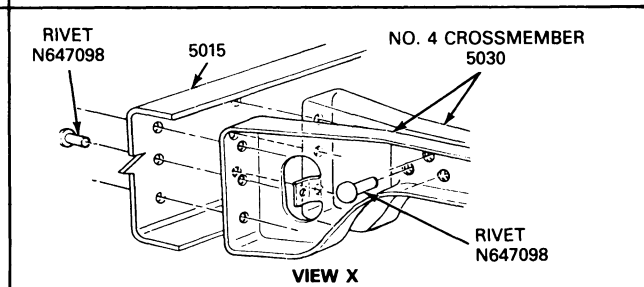
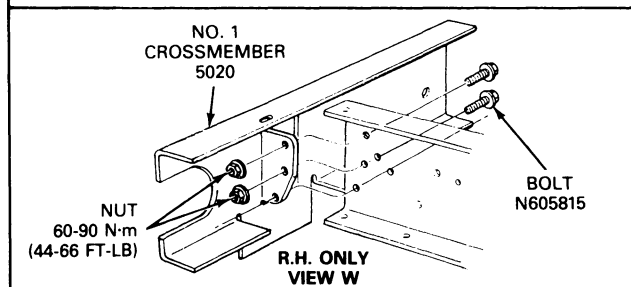
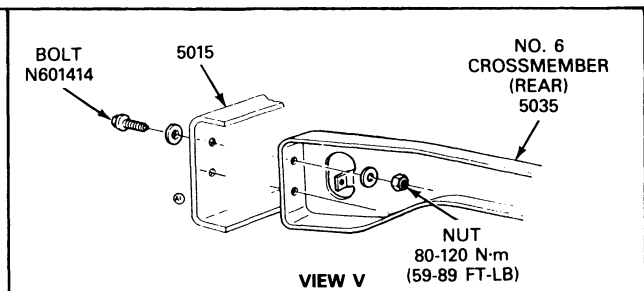
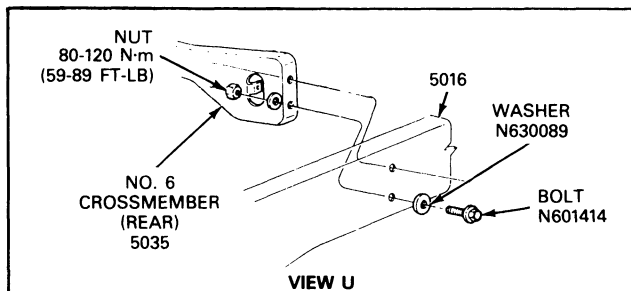
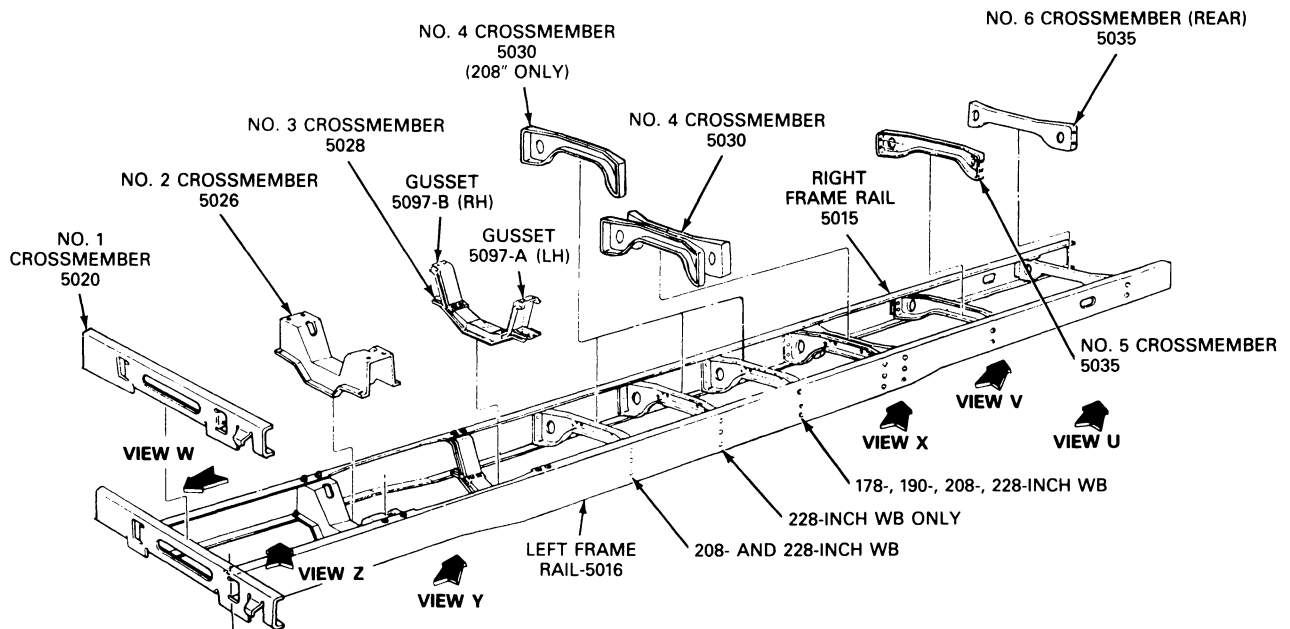
Frame and Crossmember Installation, F-Super Duty Commercial Chassis (158-inch)



N5332-D

REMOVAL AND INSTALLATION (Continued)

Frame and Crossmember Installation, F-Super Duty Motorhome Chassis (178-, 190-, 208-, and 228-Inch)



N5692-C

SPECIFICATIONS

BOLT SELECTION CHART

Rivet Diameter	Bolt Size	Bolt Part Number	Washer Part Number	Nut Part Number	Torque Specs.
3/8-Inch & 10mm	7 / 16-14x1.25	56561-S2	Not Req.	382400-S2	33-50 Lb-Ft (45-68 N-m)
3/8-Inch & 10mm	7 / 16-14x1.75	56563-S2	Not Req.	382400-S2	33-50 Lb-Ft (45-68 N-m)
7 / 16-Inch	1/2-13x1.5 (Grade 5)	56783-S100	Not Req.	33773-S2	53-75 Lb-Ft (72-102 N-m)
7 / 16-Inch	1/2-13x2.0 (Grade 8)	383896-S2	44879-S2	33773-S2	75-105 Lb-Ft (102-142 N-m)

Part Number	Part Name	Class
56561-S2	Bolt — (7 / 16-14x1.25)	S
56563-S2	Bolt — (7 / 16-14x1.75)	C
56783-S100	Bolt — (1/2-13x1.5)	C
383896-S2	Bolt — (1/2-13x2.0)	BS
382400-S2	Nut	RG
33773-S2	Nut	S
44879-S2	Washer	BS

NOTE: If a flange head nut and bolt are not available, Grade 5 hex heads may be substituted with one flatwasher required under the nut and one flatwasher required under the bolt head. Grade 8 bolts may be substituted for any application.

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
Bolt, Shock Bracket	118-122	88-89
Nut, Crossmember Number 1	188-192	138-141
Bolt, Crossmember Number 4 Reinforcement (F-150)	34-36	25-34
Nut, Crossmembers Number 2, 3, 4, 6, and 7 (Where Required)	68-95	50-70

SECTION 02-02 Body Mounting

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Checking Body For Misalignment.....	02-02-12	Body Mounts, E-150-250-350.....	02-02-5
DISASSEMBLY AND ASSEMBLY		Body Mounts, F-150-250-350 Regular Cab, SuperCab and F-Super Duty Chassis	
Body Mounts, All.....	02-02-12	Cab	02-02-1
REMOVAL AND INSTALLATION		VEHICLE APPLICATION	02-02-1
Body Mounts, Bronco.....	02-02-3		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab and Bronco

REMOVAL AND INSTALLATION

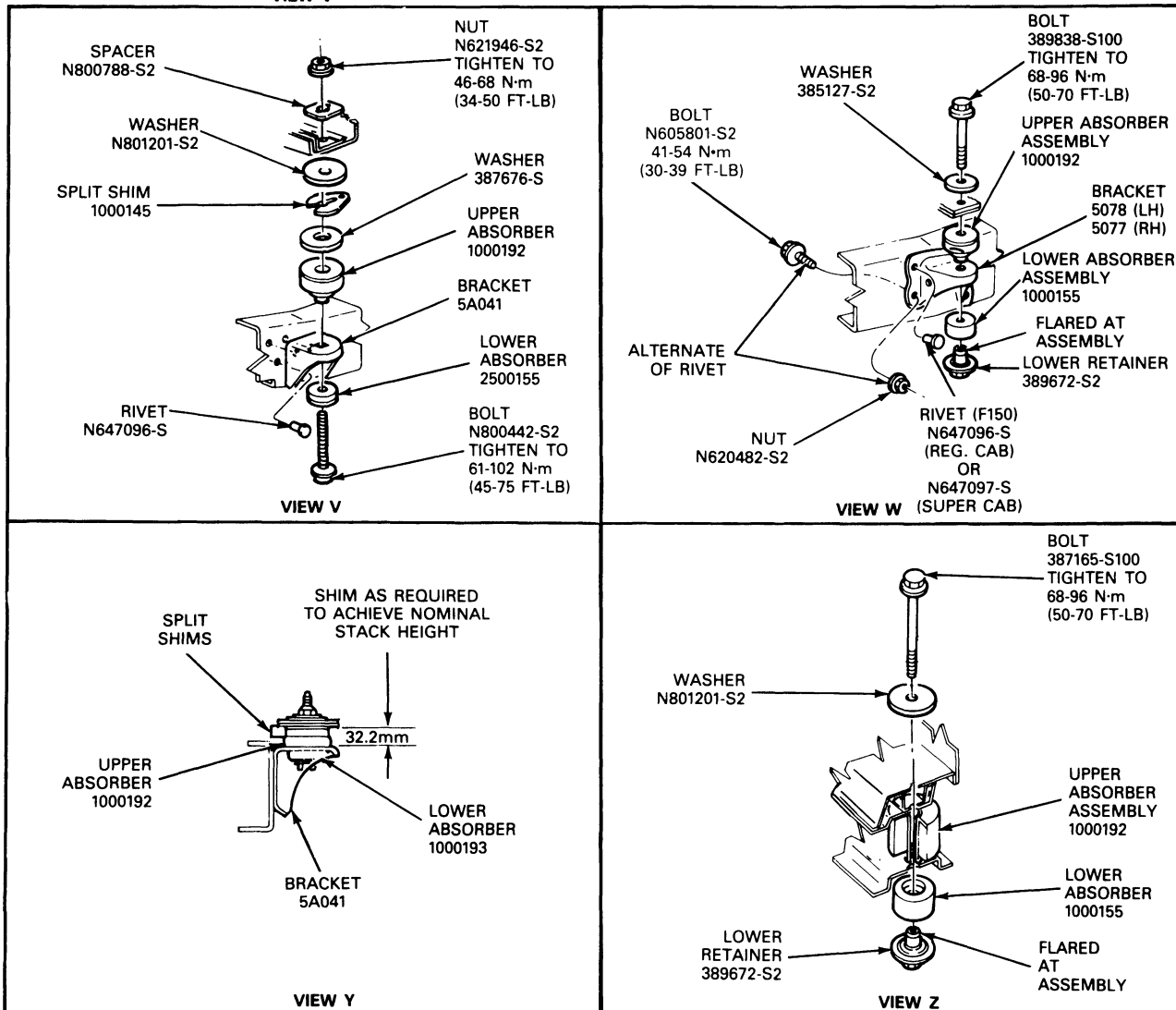
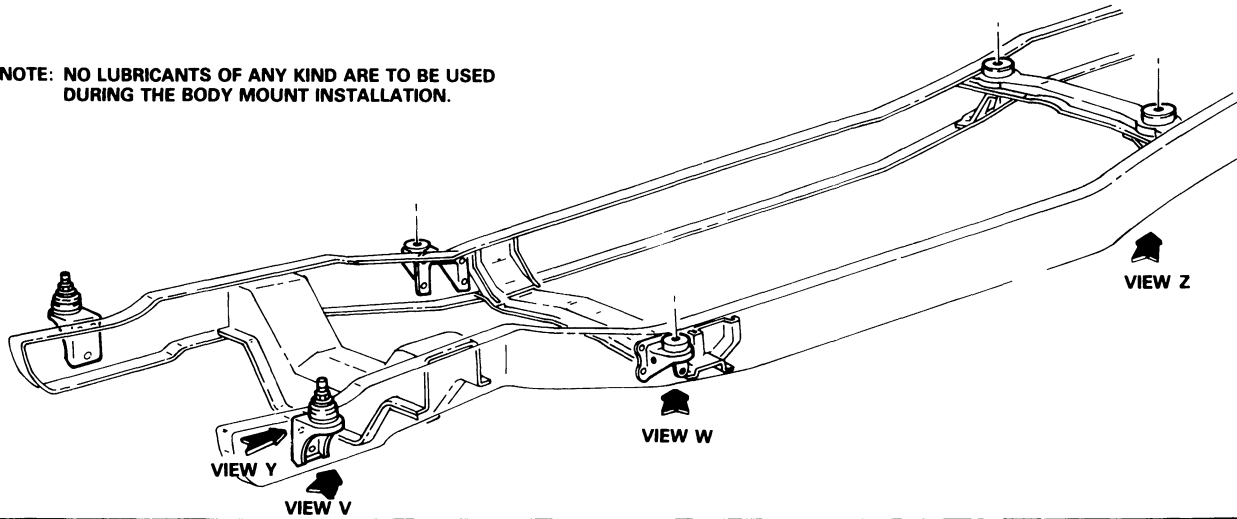
Body Mounts, F-150-250-350 Regular Cab, SuperCab and F-Super Duty Chassis Cab

The body mounts for F-150-250-350 Regular Cab,
SuperCab and F-Super Duty Chassis Cab are shown in
the following illustrations.

REMOVAL AND INSTALLATION (Continued)

Body Mounts, F-150-250-350, F-Super Duty Chassis Cab

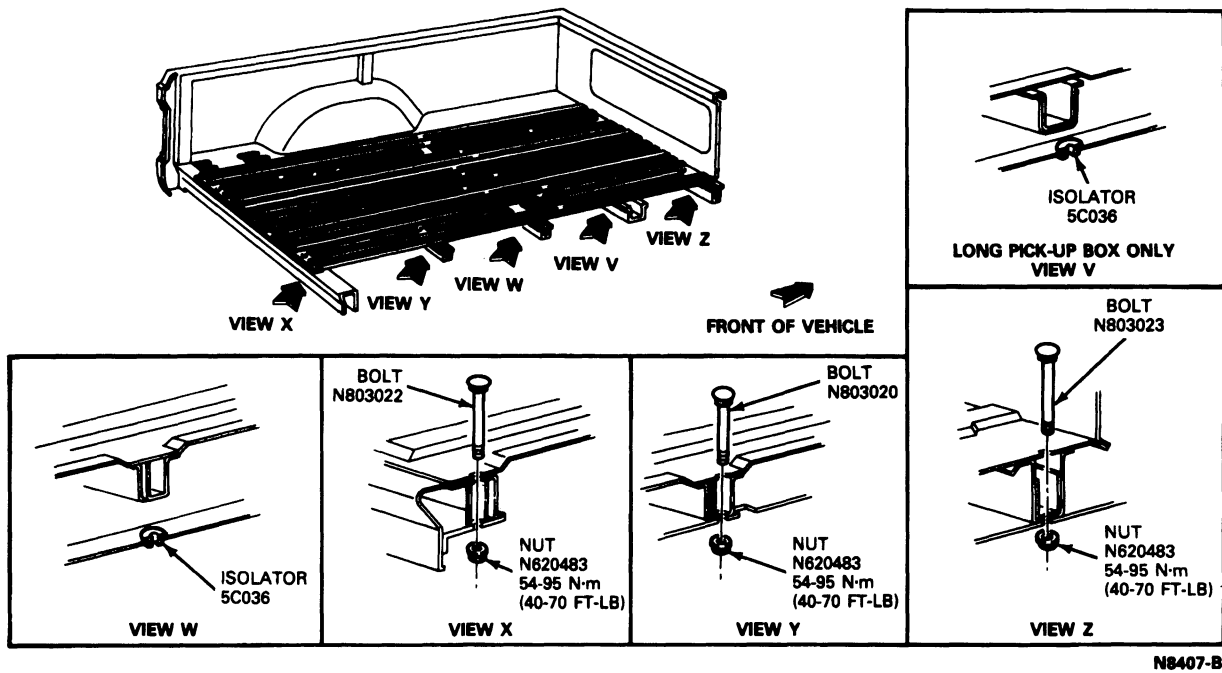
NOTE: NO LUBRICANTS OF ANY KIND ARE TO BE USED DURING THE BODY MOUNT INSTALLATION.



N5120-H

REMOVAL AND INSTALLATION (Continued)

Body Mounts, F-150-250-350, Styleside Box to Frame, F-150 Flareside Box Similar

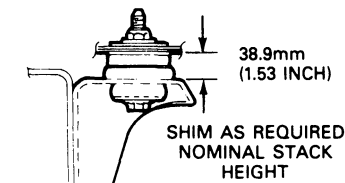
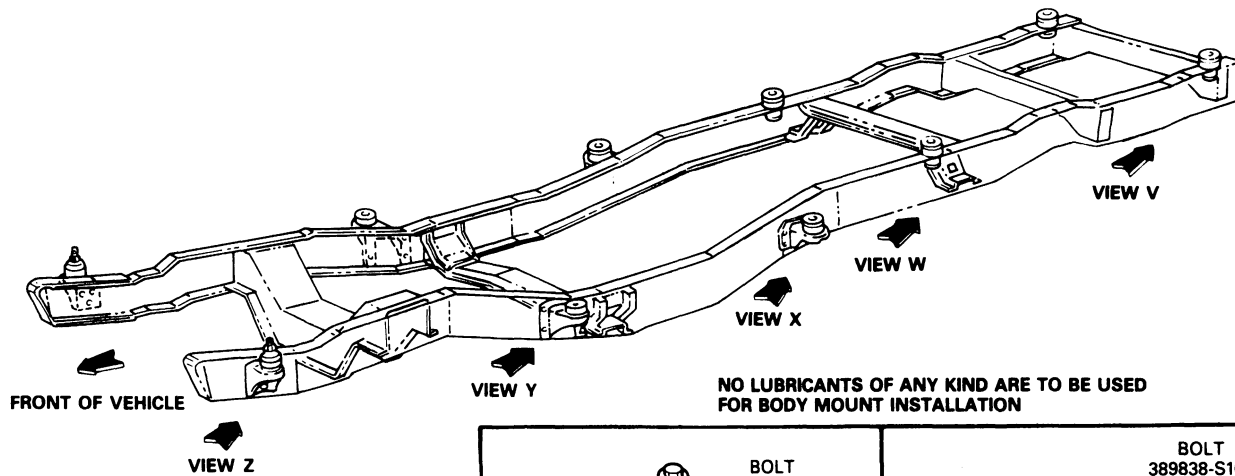


Body Mounts, Bronco

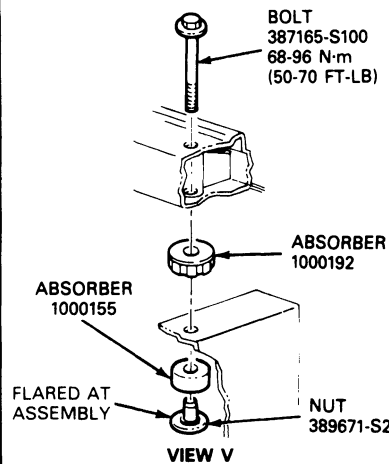
The body mounts for Bronco are shown in the following illustration.

REMOVAL AND INSTALLATION (Continued)

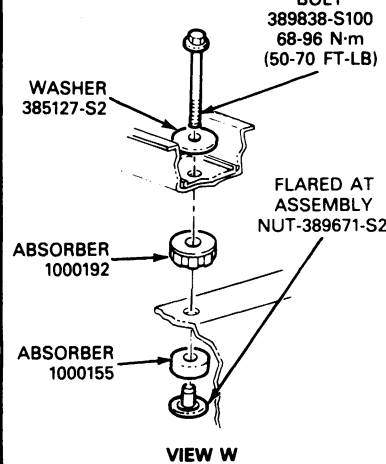
Body Mounts, Bronco



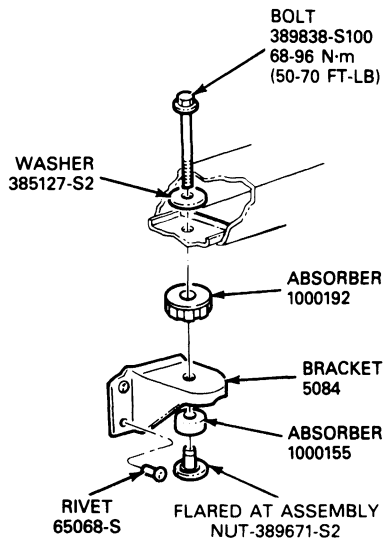
VIEW U



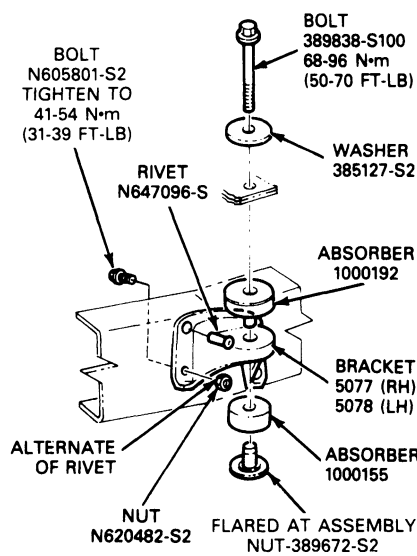
VIEW V



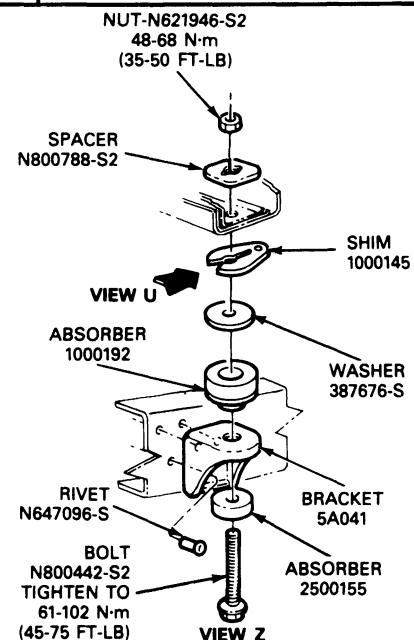
VIEW W



VIEW X



VIEW Y

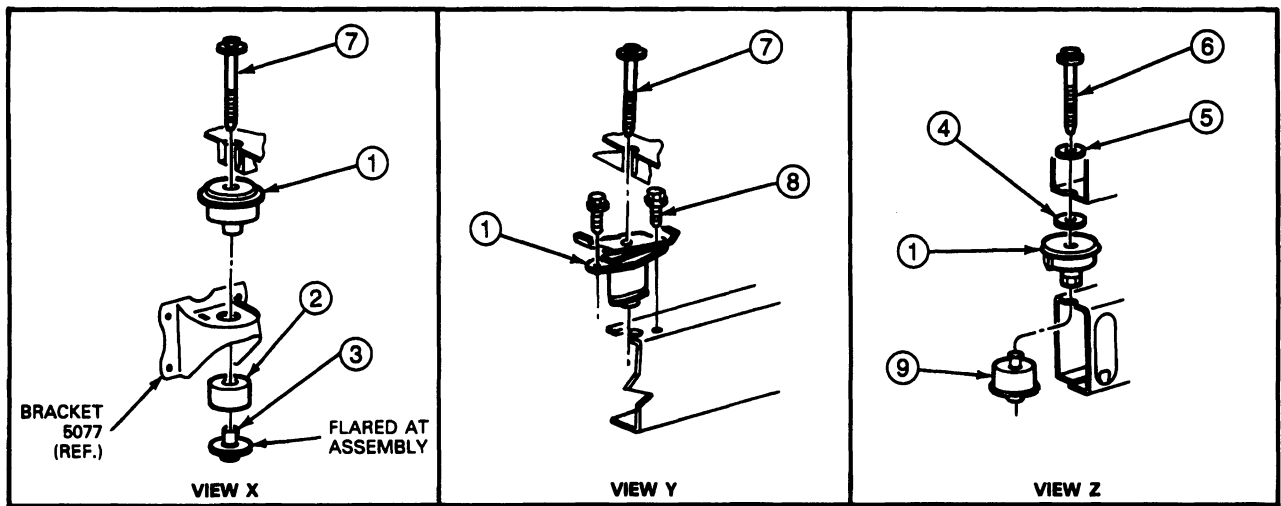
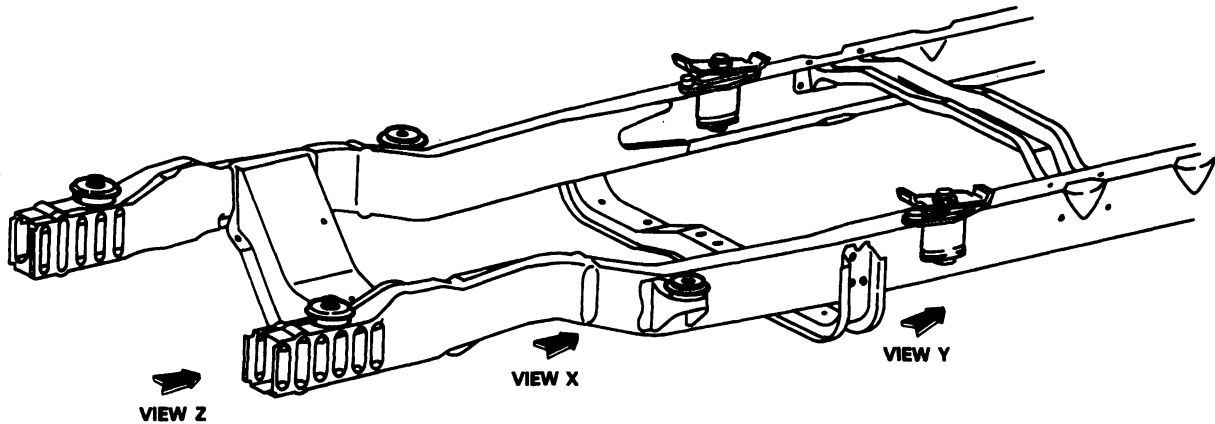


VIEW Z

N4777-K

REMOVAL AND INSTALLATION (Continued)**Body Mounts, E-150-250-350****Removal and Installation**

The E-150-250-350 body mounts are shown in the following illustrations.

Body Mounts, E-150 Vans and Club Wagons

N8736-B

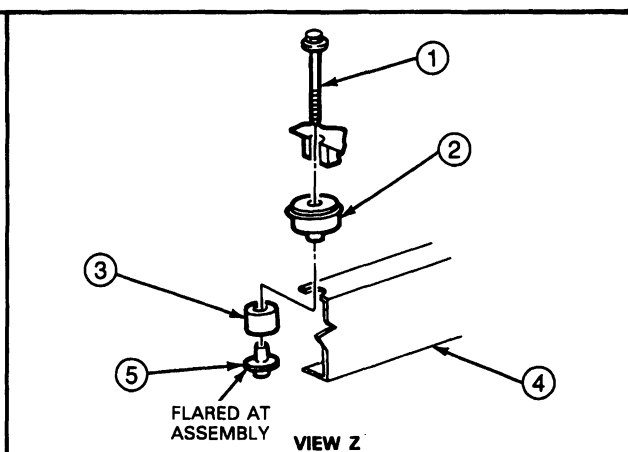
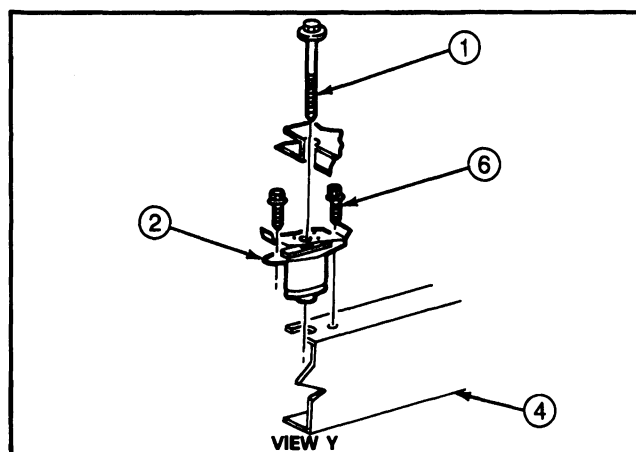
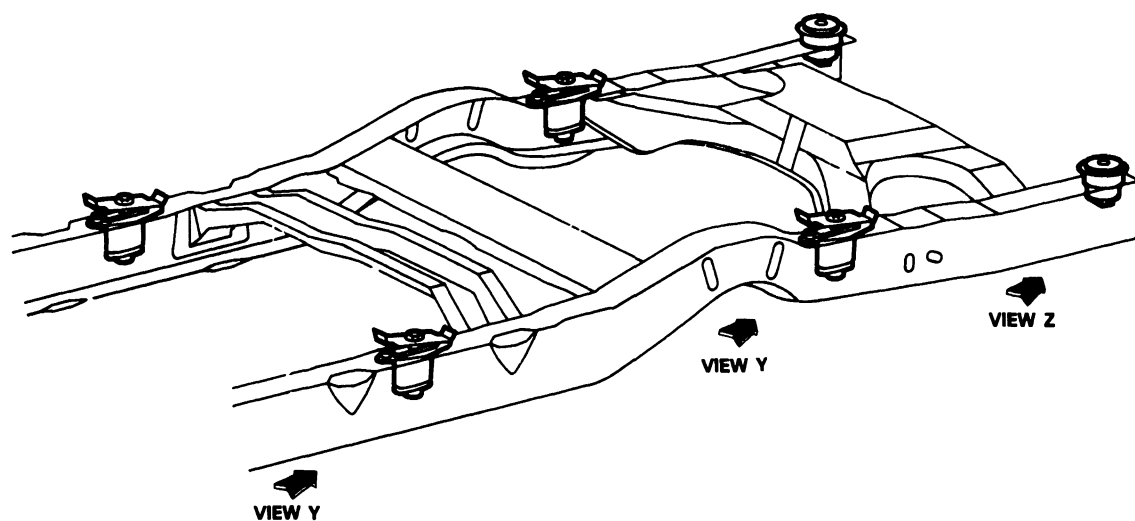
Item	Part Number	Description
1	1000192	Upper Insulator Assembly
2	1000155	Lower Absorber
3	1000151	Lower Retainer
4	6200145	Shims

(Continued)

Item	Part Number	Description
5	388235-S2	Washer
6	N807248-S100	Bolt 40-68 N-m (30-50 Ft-Lb)
7	N807249-S100	Bolt 40-68 N-m (30-50 Ft-Lb)
8	N801954-S2	Screw 40-55 N-m (30-40 Ft-Lb)
9	1000193	Lower Insulator Assembly

REMOVAL AND INSTALLATION (Continued)

Body Mounts, E-150 Vans and Club Wagons (Continued)



N9738-B

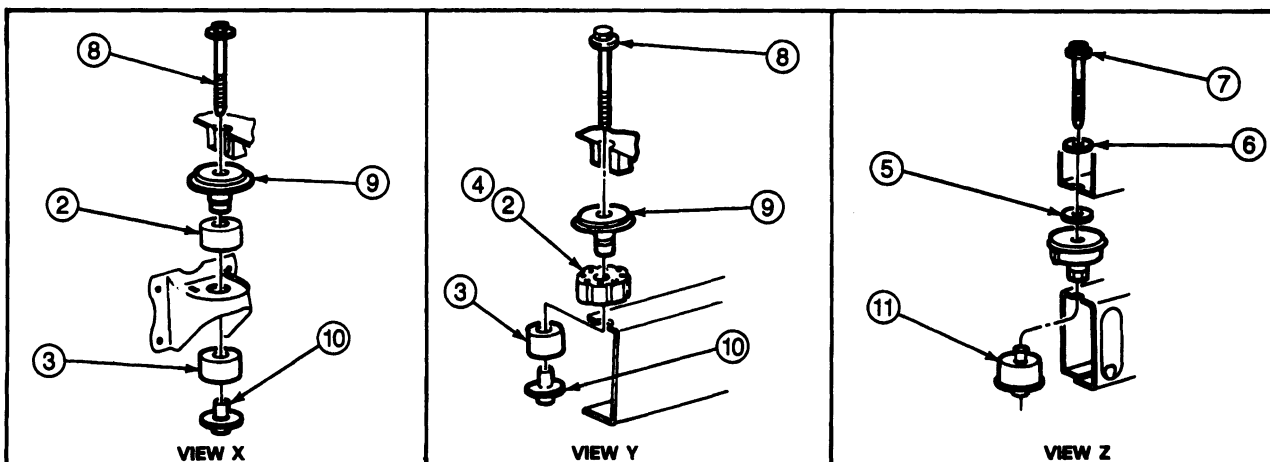
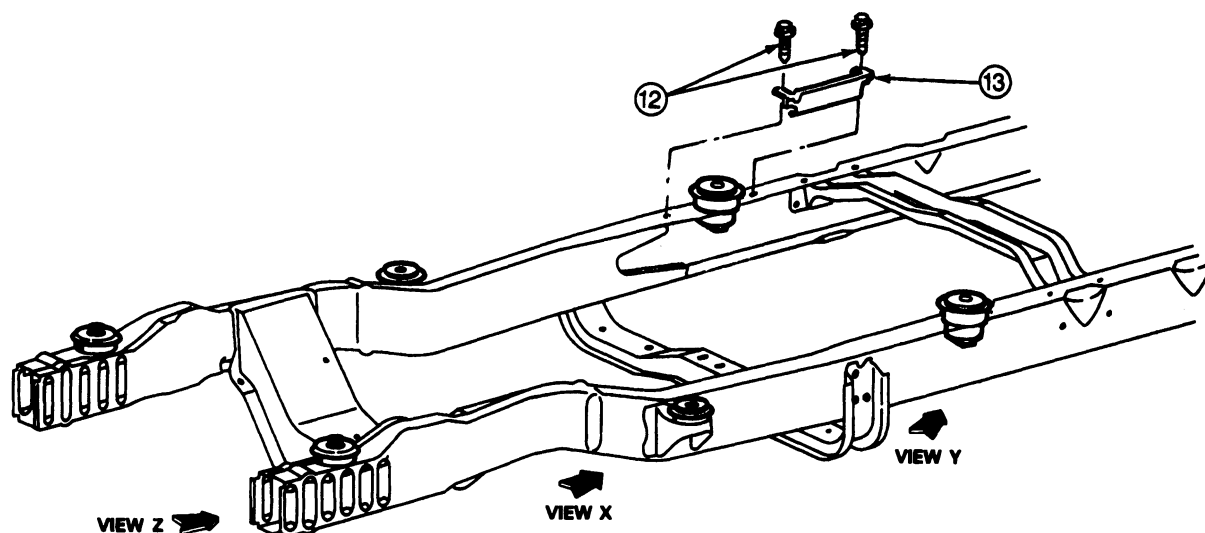
Item	Part Number	Description
1	N807249-S100	Bolt 40-68 N·m (30-50 Ft-Lb)
2	1000192	Upper Absorber Assembly
3	1000155	Lower Absorber

(Continued)

Item	Part Number	Description
4	Ref.	Frame Assembly
5	1000151	Lower Retainer
6	N801954-S2	Screw 40-55 N·m (30-40 Ft-Lb)

REMOVAL AND INSTALLATION (Continued)

Body Mounts, Super Vans and Super Wagons



N9740-A

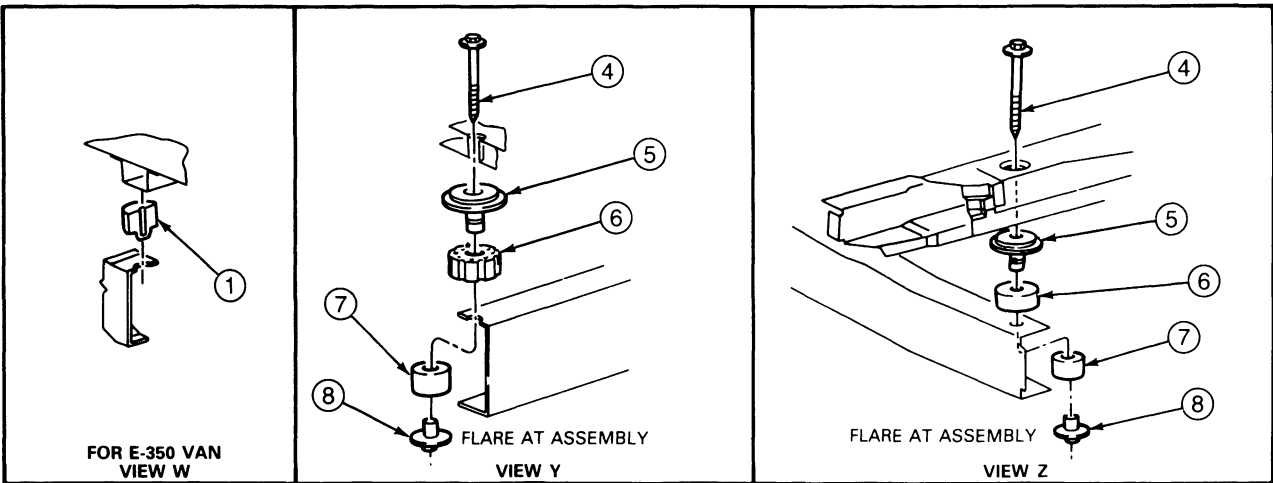
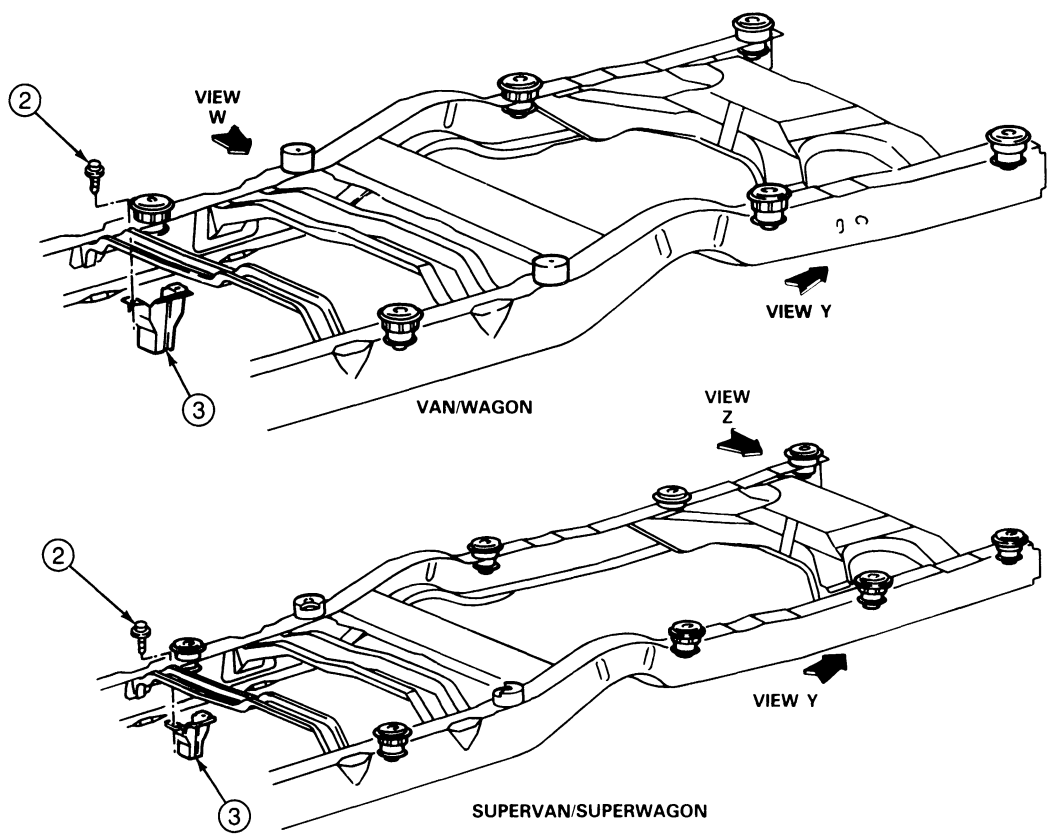
Item	Part Number	Description
1	1000192	Upper Insulator Assembly
2	1000154	Lower Absorber
3	1000155	Lower Absorber
4	1000154	Upper Absorber
5	6200145	Shims
6	388235-S2	Washer

(Continued)

Item	Part Number	Description
7	N807248-S100	Bolt 40-68 N-m (30-50 Ft-Lb)
8	N807249-S100	Bolt 40-68 N-m (30-50 Ft-Lb)
9	10001A42	Upper Retainer
10	1000151	Lower Retainer
11	1000193	Lower Insulator Assembly
12	40923-S2	Screw 8-12 N-m (70-106 In-Lb)
13	5C076	Shield Assembly

REMOVAL AND INSTALLATION (Continued)

Body Mounts, E-250-350 Super Vans and Super Wagons (Continued)



N9742-B

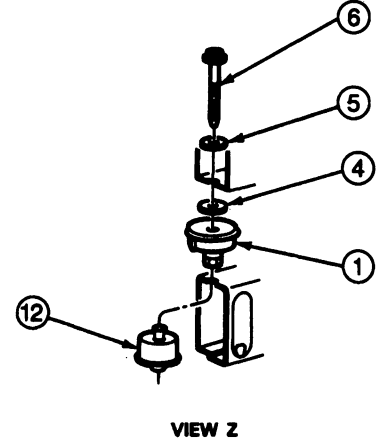
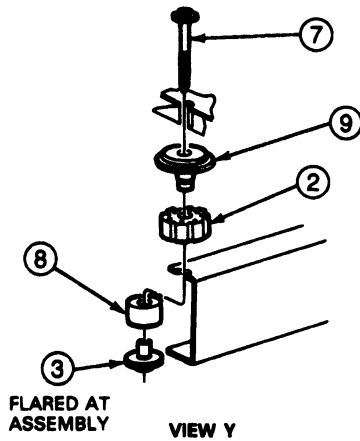
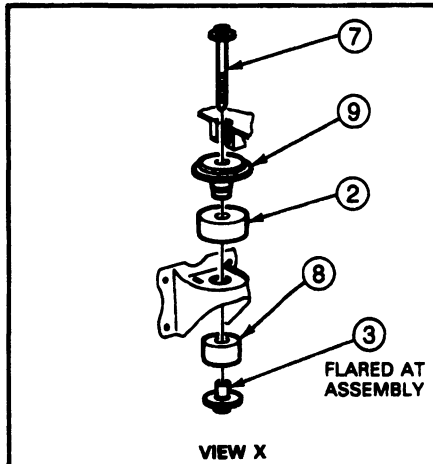
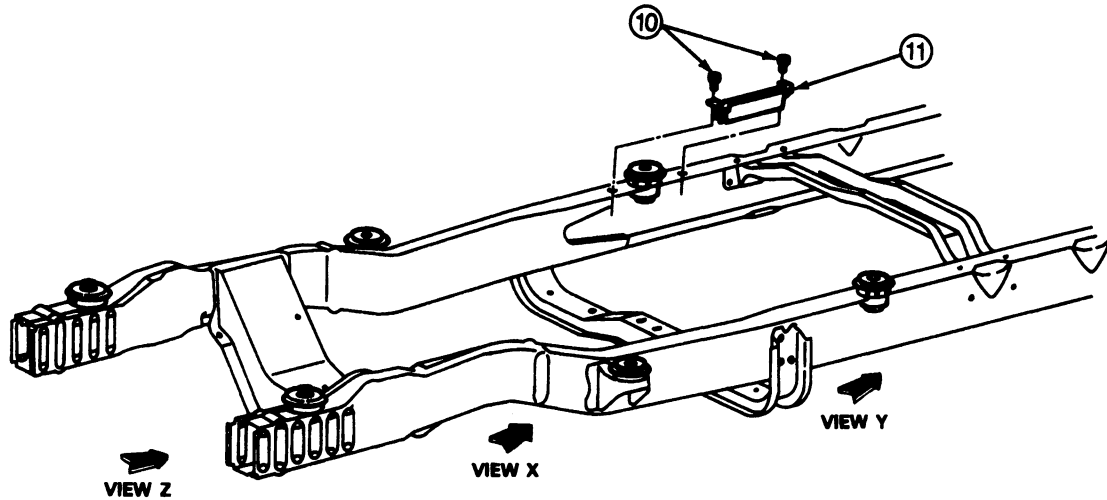
Item	Part Number	Description
1	5B097	Bumper Assembly
2	W611624-S2	Screw 3.4-5.0 N·m (30-44 In·Lb)
3	5C076	Shield Assembly

(Continued)

Item	Part Number	Description
4	N807249-S100	Bolt 40-68 N·m (30-50 Ft·Lb)
5	10001A42	Upper Retainer
6	1000154	Upper Absorber
7	1000155	Upper Absorber
8	1000151	Lower Retainer

REMOVAL AND INSTALLATION (Continued)

Body Mounts, E-350 Commercial and RV Cutaway



N8744-A

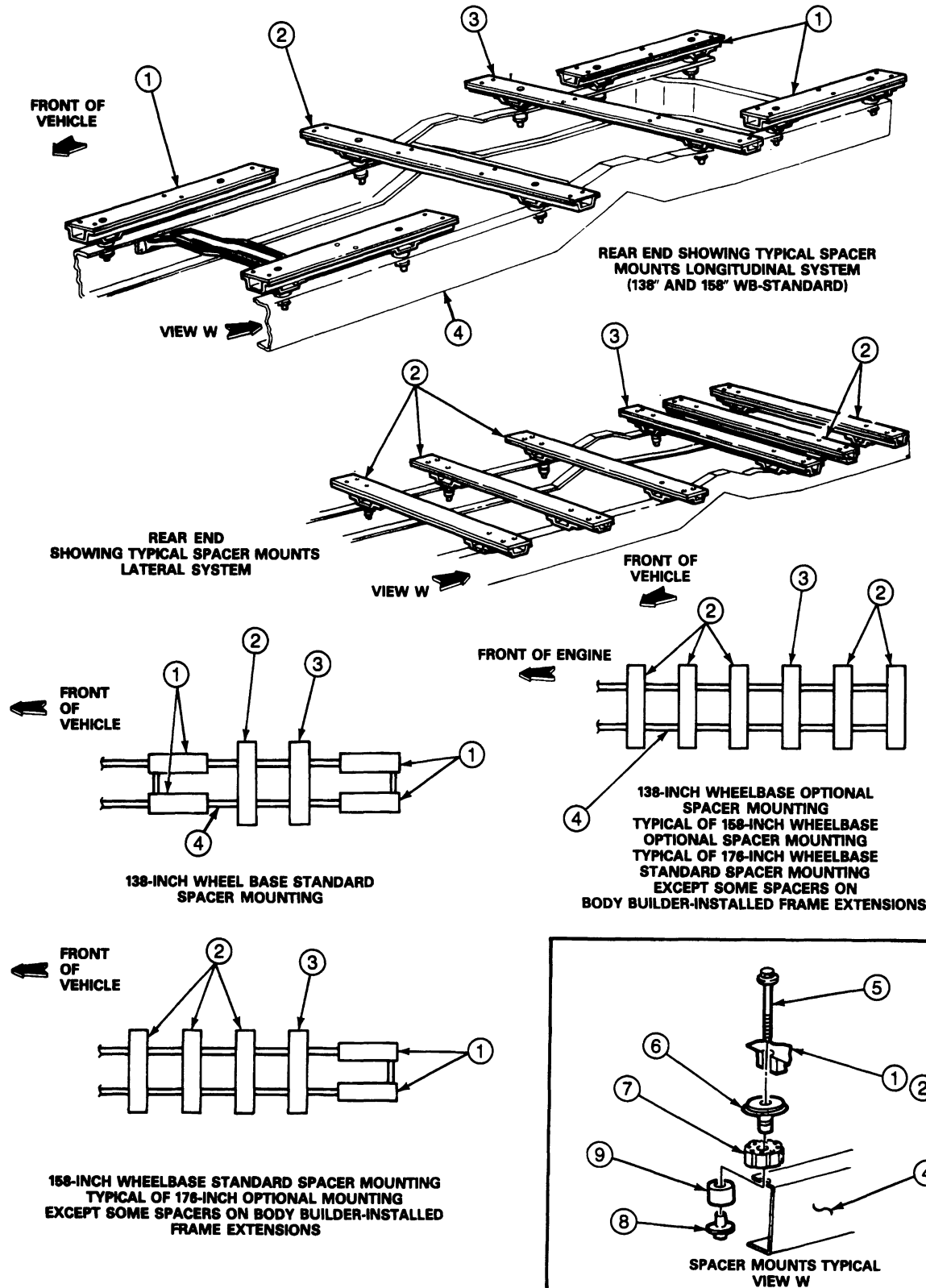
Item	Part Number	Description
1	1000192	Upper Absorber Assembly
2	1000154	Upper Absorber
3	1000151	Lower Retainer
4	6200145	Shims
5	388235-S2	Washer
6	N807248-S100	Bolt 40-68 N-m (30-50 Ft-Lb)

(Continued)

Item	Part Number	Description
7	N807249-S100	Bolt 40-68 N-m (30-50 Ft-Lb)
8	1000155	Lower Absorber
9	10001A42	Upper Retainer
10	40923	Screw 8-11 N-m (70-97 In-Lb)
11	5C076	Shield
12	1000193	Lower Insulator Assembly

REMOVAL AND INSTALLATION (Continued)

Spacers, E-350 Commercial and RV Cutaway



N9856-A

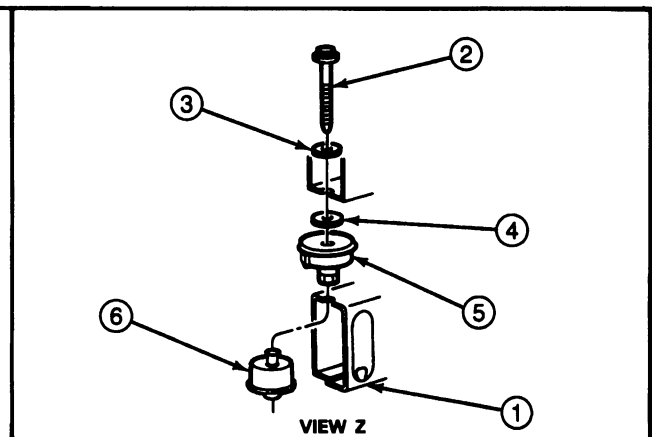
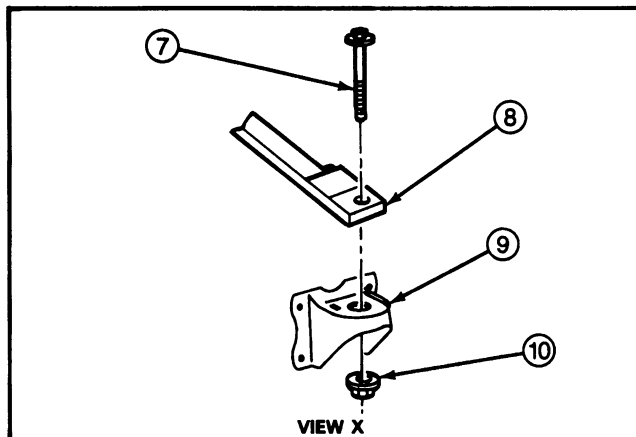
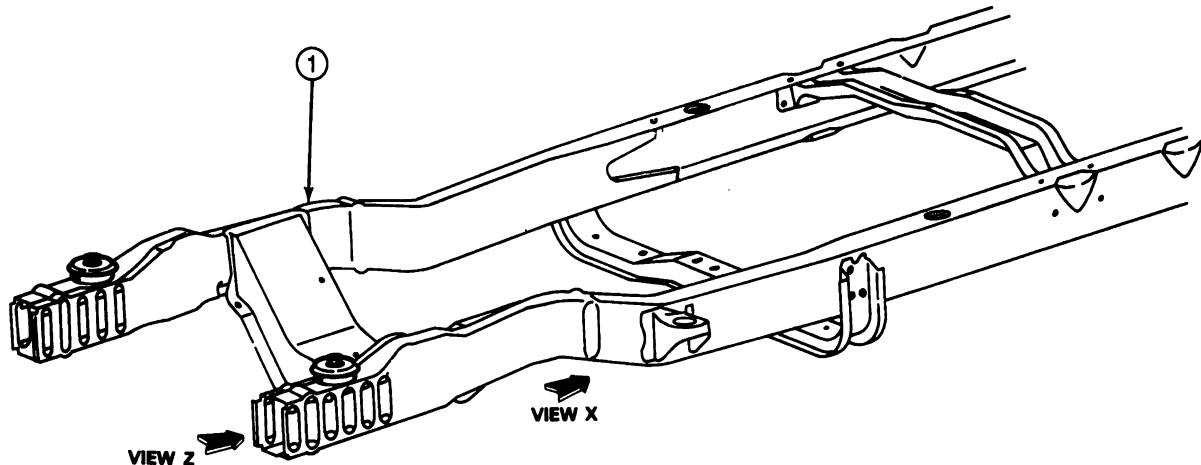
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	5C052	Spacer Assembly — Longitudinal
2	5C050	Spacer Assembly — Lateral
3	5C051	Spacer Assembly — Lateral
4	5001	Frame Assembly

(Continued)

Item	Part Number	Description
5	N807248-S100	Bolt M12-1.75 x 126.3 40-68 N·m (30-50 Ft·Lb)
6	10001A42	Upper Retainer
7	1000154	Upper Absorber
8	1000151	Lower Retainer
7	1000155	Lower Absorber

Body Mounts, E-350 Commercial Chassis



N9858-A

Item	Part Number	Description
1	5005	Frame Assembly
2	N807248-S100	Bolt M12-1.75 x 126.3 40-68 N·m (30-50 Ft·Lb)
3	388235-S2	Washer
4	6200145	Shims (As Required)
5	1000192	Upper Absorber Assembly

(Continued)

Item	Part Number	Description
6	1000193	Lower Absorber Assembly
7	N807249-S100	Bolt M12-1.75 x 128.8
8	—	Subframe
9	—	Bracket (Part of 5005 Frame)
10	1000151	Retainer Assembly, Body Bolt Attaching

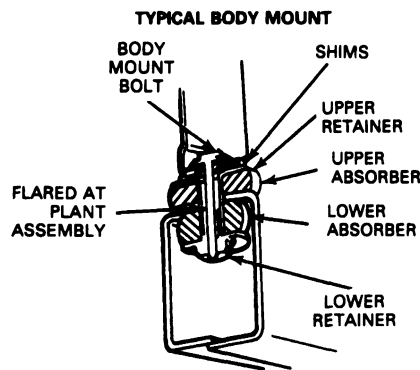
DISASSEMBLY AND ASSEMBLY

Body Mounts, All

Disassembly

1. Remove interior trim as required.
2. Back out body mount bolt four or five turns and strike with a hammer to drive out the lower retainer.
3. For locations with flared lower retainers, if the body mount bolt is not long enough to drive out the lower retainer, then install a longer bolt or drift and strike with a hammer to drive out the retainer.

NOTE: On Econoline vehicles it may be necessary to remove front bumper to replace front lower absorber assembly.



N9220-B

Assembly

1. Position the upper retainer and absorber assembly on top of the frame or frame bracket and install any shims that were removed during disassembly.
2. Position the body on the upper absorbers and install the body mount bolts.
3. Position the lower absorber and retainer assembly to the bottom of the frame or frame bracket and install the lower retainer on the body mount bolt.

NOTE: If the original body mounts are being installed back into the vehicle, it may be necessary to remove the flare on the lower retainer using a file or other suitable tool. It is not necessary or desirable to flare the lower retainer for repair.

4. Tighten the body mount bolts, refer to the appropriate illustration for the correct bolt torque specification.

ADJUSTMENTS

Checking Body For Misalignment

NOTE: Refer to the 1992 Body Builders Book for dimensional data when performing repair operations on the body cab or frame.

To align or square up a body, take two opposite diagonal measurements between pillars. Use a measuring tram for these measurements. Take the measurements between reference points such as crease lines or weld joints which are diagonally opposite each other on the two pillars being measured. Since all measurements should be made from the bare metal, remove all interior trim from the checking points.

In some cases, it is difficult to obtain proper body alignment when repairing a body that is damaged on both sides. In these cases, horizontal and vertical measurements can be taken from a body of the same body style. Once these basic dimensions are taken and established on the damaged body, alignment can be made by diagonal measurements taken from points on the two pillars.

Do not attempt to correct any serious misalignment with one jacking operation. This is particularly true if other sections of the body also require aligning. Align each section proportionately until the proper dimensions are obtained.

Door openings are checked in the same manner as the body. Horizontal, vertical, and diagonal checking points are established on all four sides of the door opening that is being measured.

GROUP

SUSPENSION 04

SECTION TITLE	PAGE	SECTION TITLE	PAGE
SUSPENSION, FRONT, 4-WHEEL DRIVE	04-01B-1	SUSPENSION, REAR.....	04-02-1
SUSPENSION, FRONT, 4X2.....	04-01A-1	WHEELS AND TIRES.....	04-04-1
SUSPENSION, GENERAL	04-00-1		

SECTION 04-00 Suspension, General

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		CLEANING AND INSPECTION (Cont'd.)	
Caster and Camber Adjustment	04-00-10	Front Wheel Bearing End Play Inspection	04-00-8
Bronco and F-150-250 4x4 Vehicles	04-00-12	Steering Linkage Inspection	04-00-8
E-150-250-350, F-150-250-350 Ball Joint		Tire Rotation.....	04-00-9
System	04-00-10	Upper and Lower Ball Joint Inspection	04-00-9
F-350 Monobeam Front Drive Axle and		DESCRIPTION AND OPERATION	
F-Super Duty Monobeam Non-Driving		Front Wheel Alignment	04-00-1
Axle	04-00-13	Front Wheel Alignment Specifications	04-00-4
Checking and Adjusting Toe Alignment	04-00-13	DIAGNOSIS AND TESTING	
Front Wheel Alignment Adjustments	04-00-10	Diagnosis Guides.....	04-00-5
Steering Stop	04-00-13	Vehicle Lean Check	04-00-7
Vehicle Lean Correction.....	04-00-14	SPECIAL SERVICE TOOLS	04-00-15
CLEANING AND INSPECTION		SPECIFICATIONS	04-00-14
Front End General Inspection	04-00-7	VEHICLE APPLICATION	04-00-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and
Bronco Vehicles

DESCRIPTION AND OPERATION

Front Wheel Alignment

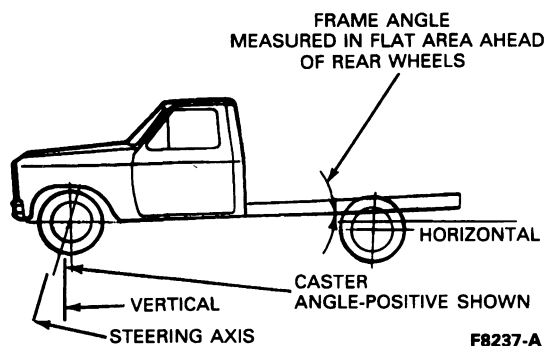
Caster, camber and toe are the three major, measurable alignment parameters. Camber and toe affect tire wear and directional stability, whereas caster affects directional stability without causing tire wear. A description of these and other alignment-related parameters follows.

NOTE: The values of these change when a vehicle is loaded and driven. Therefore, the specifications shown in this section reflect the static measurement of alignment required so the vehicle will have an alignment when driven that is most favorable for tire wear and directional stability.

DESCRIPTION AND OPERATION (Continued)

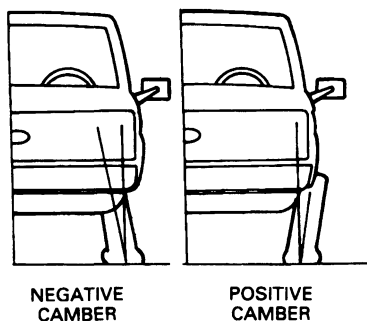
Caster

Caster is a term used to describe the vertical fore-aft tilt of the steering axis. This axis is defined by a line drawn through the centers of the spindle ball joints and is measured relative to the ground. Because of this, raising (or lowering) the rear, without changing front ride height, will subsequently decrease (or increase) the caster angle by the same amount the frame angle changes.

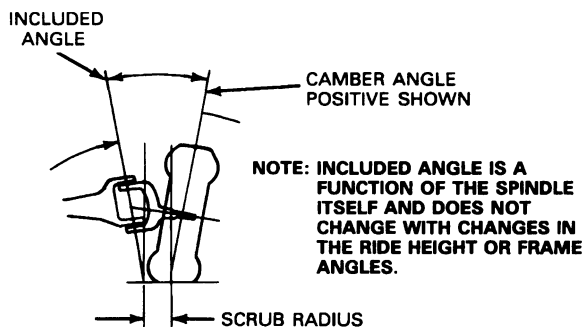


Camber

Camber is a term used to describe the vertical tilt of the wheel as viewed from the front.



Steering axis inclination (S.A.I.) or king pin inclination (K.P.I.) is the line of the axle drawn through the spindle ball joint when viewed from the front. Scrub radius is the offset of the center of the tire tread at the ground to the point where the steering axis contacts the ground.



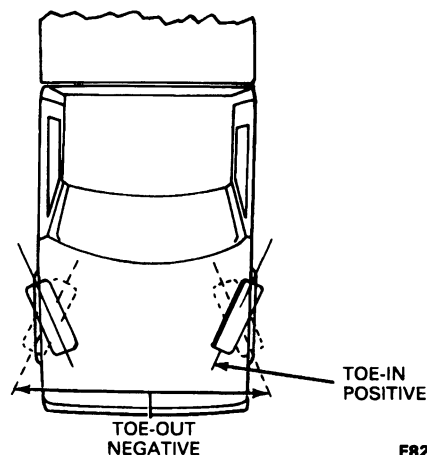
Toe

Toe-in and toe-out is the difference in the distance between the extreme front and extreme rear of the tires. Toe-in occurs when the dimension taken at the front of the tires is less than that taken at the rear of the tires — positive toe. Toe-out occurs when the dimension taken at the front of the tires is greater than that taken at the rear of the tires — negative toe.

NOTE: However, if aftermarket equipment that significantly affects the ride height (i.e., snowplow, second unit bodies, tool boxes) is added, the toe may need to be adjusted. Toe should be maintained at the specified setting with the vehicle in the loaded condition experienced for more than 50 percent of use.

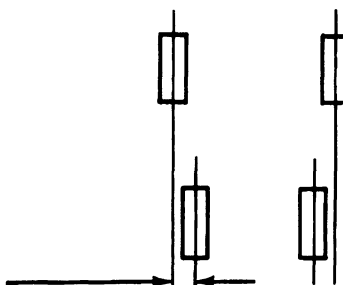
For correct toe setting, refer to the following charts.

NOTE: Toe should only be checked and adjusted after the caster and camber have been adjusted to specification.



DESCRIPTION AND OPERATION (Continued)**Dogtracking**

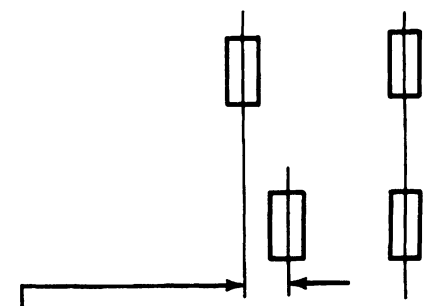
All F-150-250-350, 4x2, 4x4, Bronco and E-150-250-350 vehicles with single rear wheels (SRW) have, by design, a front tread that is wider than the rear tread. Front tread is the distance between the two front tires, and likewise for the rear. The illustration below shows these differences.



F-150, Bronco	9 mm (0.35 Inch)
F-250 (4x2)	18 mm (0.71 Inch)
F-350 (4x2)	18 mm (0.71 Inch)
F-250 (4x4)	32 mm (1.25 Inch)
E-150	32 mm (1.25 Inch)
F-350 (4x4)	46 mm (1.81 Inch)
E-250 — E-350	37 mm (1.47 Inch)

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When a vehicle with these tread differences is driven on a crowned road, the front may tend to ride higher up the crown than the rear, making these vehicles appear to dogtrack, as illustrated below. Refer to Diagnosis Chart in this section for dogtracking diagnosis.



F-150, Bronco	18 mm (0.71 Inch)
F-250 (4x2)	36 mm (1.42 Inch)
F-350 (4x2)	36 mm (1.42 Inch)
F-250 (4x4)	64 mm (2.52 Inch)
E-150	64 mm (2.52 Inch)
F-350 (4x4)	92 mm (3.62 Inch)
E-250 — 350	75 mm (2.94 Inch)

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DESCRIPTION AND OPERATION (Continued)

Front Wheel Alignment Specifications

The following charts reflect vehicle alignments after shipment from the assembly plant and prior to any aftermarket and/or body-builder modifications. Alignment can be checked at any time to help diagnose a problem. Always perform an inspection of the front end components and repair where necessary prior to attempting to adjust the alignment to specification. Refer to Front End General Inspection in this section.

FRONT WHEEL ALIGNMENT SPECIFICATIONS

Vehicle condition for checking this alignment										
<ul style="list-style-type: none"> No driver, passengers or cargo Full Fluids No aftermarket equipment or body/chassis modifications All tire sizes comparable to original equipment and set to specified pressure. 										
Average Camber, Caster and Toe Settings					Maximum Side-to-Side Difference			Lean (Side-to-Side Height Differences)		
Model	Avg. Camber*	Avg. Caster** Minimum	Avg. Caster** Maximum	Toe	Model	Alignment	Optimum Settings	Front Wheel-House Opening	Rear Wheel-House Opening	Rear End of Pick-Up Box
Bronco	0.25	2.00	6.00		All	Toe	+0.03° or +0.06°			
F-150 4X2	0.25	2.00	6.00		Bronco	Caster Split (LH Caster - RH Caster)	0.0°			
F-250 4X2	0.25	2.00	6.00							
F-350 4X2 SRW	0.50	2.00	6.00							
F-350 4X2 DRW	0.50	2.00	4.50							
F-150 4X4	0.25	2.00	6.00	.8mm	All Other Models	Caster Split (LH Caster - RH Caster)	-0.5°	15 mm maximum (5/8 inch)	20 mm maximum (3/4 inch)	20 mm maximum (3/4 inch)
F-250 4X4	0.25	2.00	5.00	±3.2mm						
F-350 4X4	0.00	2.00	4.75	1/32" In.						
F-Super Duty	0.00	2.00	5.00	±4/32" In.	All	Camber Split	0.0°			
Super Duty Strip	0.60	2.00	5.50							
E-150	0.25	2.00	7.00			(LH Camber - RH Camber)				
E-250	0.50	2.00	7.00							
E-350	0.50	2.00	7.00							
								Dogtrack		
								Centerline of Front Tires Compared to Centerline of Rear Tires		
								30 mm maximum (1-1/4 inch)		

NOTE: This represents the preferred alignment for optimum tire life and vehicle performance with original equipment tires.

* Defined as (LH camber + RH camber) divided by 2. Vehicles set to this specification, as measured with vehicle loaded to normal loading conditions will result in optimum tire wear.

** Defined as (LH caster + RH caster) divided by 2. These are not recommended values for settings. They are only maximum and minimum limitations.

• Vehicles which exceed the maximum average caster value shown above can result in shimmy concerns.

• Vehicles operated below the minimum average caster value shown may result in wander and poor steering returnability concerns.

CF6652-D

FRONT WHEEL ALIGNMENT SPECIFICATIONS — MOTORHOME AND COMMERCIAL CHASSIS

Vehicle condition for checking this alignment										
<ul style="list-style-type: none"> No driver, passengers or cargo Full Fluids No aftermarket equipment or body/chassis modifications (Includes body for stripped chassis models.) All tire sizes comparable to original equipment and set to specified pressure. 										
				Maximum Side-to-Side Difference		Lean (Side-to-Side Height Differences)			Dogtrack	
Model		Camber	Caster	Camber	Caster	Toe	Front Wheel-House Opening	Rear Wheel-House Opening	Rear End of Pick-Up Box	Centerline of Front Tires Compared to Centerline of Rear Tires
Motorhome and Commercial Chassis	4x2	0.0° ± 1.0°	4.7°	0.7°	1.0°	1/16" In (3/16" In to 0" Out)	15mm Maximum (5/8 In)	20mm Maximum (3/4 In)	20mm Maximum (3/4 In)	0

NOTE: If caster is below specification, a caster wedge should be installed only if the vehicle exhibits poor steering returnability.

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DIAGNOSIS AND TESTING**Diagnosis Guides**

Refer to the following Diagnosis Guides for front suspension problems. For driveline noise, refer to Section 00-04. For additional Diagnostic Guides related to alignments, refer to Section 00-05.

CONDITION	POSSIBLE SOURCE	ACTION
Vehicle leans to one side.	<ul style="list-style-type: none"> ● Incorrect tire pressure. ● Improper tire / wheel usage. ● Vehicle overloaded or unevenly loaded. ● Loose, worn or damaged front or rear suspension components. ● Improper spring usage or improperly installed and seated. ● Incorrect front axle ride height. <ul style="list-style-type: none"> ● Lateral tilt out of specification. ● Incorrect rear axle ride height. <ul style="list-style-type: none"> ● Lateral tilt out of specification 	<ul style="list-style-type: none"> ● Assure specified tire pressure for all tires. ● Install correct tire / wheel combination. ● Correct as required. ● Visually inspect suspension systems. Repair or replace as required. Refer to Section 04-02. ● Correct as required. Refer to appropriate section in Group 04. ● To adjust, refer to "Vehicle Lean Correction" in this section. ● To adjust, refer to "Vehicle Lean Correction" in this section.
Front bottoming or riding low.	<ul style="list-style-type: none"> ● Incorrect tire pressure. ● Improper tire / wheel usage. ● Vehicle overloaded or unevenly loaded. ● Broken or incorrectly installed front springs. ● Loose or broken shackles. ● Distorted or split jounce bumper. ● Incorrect springs. 	<ul style="list-style-type: none"> ● Correct as required. ● Install correct tire / wheel combination. ● Correct as required. ● Repair or replace as necessary. Refer to appropriate Section in Group 04. ● Tighten or replace as necessary. ● Correct as required. ● Replace springs.
Dogtracking of rear wheels.	<ul style="list-style-type: none"> ● Loose or damaged front or rear suspension components. ● Loose rear spring U-bolts. ● Rear spring improperly installed on axle. ● Rear spring center bolt bent. ● Improperly installed front leaf springs (4x4). 	<ul style="list-style-type: none"> ● Inspect, repair or replace as required. Refer to appropriate Section in Group 04. ● Tighten to specification. Refer to Section 04-02. ● Repair as required. ● Replace center bolt. ● Repair as necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Shimmy or wheel tramp.	<ul style="list-style-type: none"> ● Loose front axle pivot bracket attaching parts. ● Incorrect tire pressure. ● Excessive tire sidewall deflection. ● Irregular tire wear or tire sizes not uniform. ● Loose wheel lug nuts. ● Front wheel bearing adjustment. ● Out-of-round wheels. ● Out-of-round tires. ● Wheel and tire lateral runout not to specifications. ● Incorrect wheel and tire balance. ● Front wheel alignment (toe-in and caster) out-of-specification. ● Deteriorated radius arm bushing. ● Loose, worn or damaged shock absorbers. ● Loose, worn or damaged steering linkage and idler arm connections. ● Broken or sagging springs. ● Loose steering gear mounting. ● Incorrect steering gear adjustment. ● Worn ball joints. ● Worn spindle (king) pins. 	<ul style="list-style-type: none"> ● Tighten to specification. Refer to appropriate section in the Powertrain / Drivetrain Manual, Group 05. ● Adjust air pressure in tires. ● Inspect, adjust air pressure and replace as necessary. ● Check front wheel alignment, adjust and replace with same size tires. ● Tighten to specifications. ● Adjust to specifications. ● Replace as required. ● Replace as required. ● Follow tire and wheel runout check. Refer to Section 04-04. ● Balance wheels and tires. ● Set toe to specifications. Set caster to specifications on vehicles with front leaf springs. ● Replace. Refer to appropriate Section in Group 04. ● Tighten and replace as necessary. Refer to appropriate section in Group 04. ● Tighten or replace as necessary. Refer to Section 11-03. ● Replace as required. Refer to Section 04-02. ● Tighten to specifications. Refer to Section 11-02. ● Adjust to specifications. ● Replace ball joints. ● Replace spindle pins and spindle pin bushings.
Sway or roll.	<ul style="list-style-type: none"> ● Unequal load distribution (side-to-side). ● Excessive load or body height. ● Incorrect tire pressure. ● Loose wheel lug nuts. ● Worn or loose stabilizer assembly. ● Broken or sagging spring. ● Incorrect steering gear adjustment. ● Loose steering gear mounting. ● Excessive front or rear overhang. ● Broken toe bolts on rear spring. 	<ul style="list-style-type: none"> ● Correct as necessary. ● Correct as necessary. ● Adjust air pressure in tires. ● Tighten to specifications. ● Tighten or replace as required. ● Replace as required. ● Adjust to specifications. Refer to Section 11-02. ● Tighten to specifications. ● Correct as necessary. ● Replace as required.

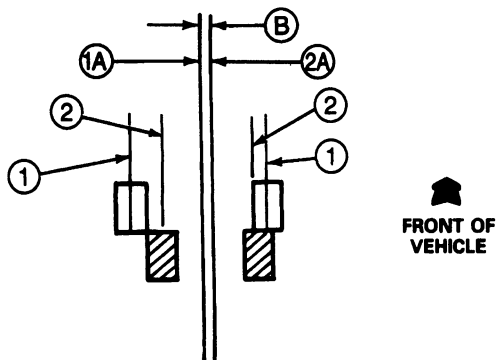
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Dogtracking

1. Find a stretch of empty road or an empty parking lot.
2. Drive the vehicle while sighting down the hood (use a hood ornament or a body style line to be able to see if the vehicle is going in a straight line or if it is dogtracking).
3. Stop the vehicle when you notice the vehicle dogtracking.
4. Have an assistant mark the position of the center tread of both front tires with chalk on the ground.
5. Slowly pull the vehicle forward until the rear tires are at the same position as the marks made for the front tires.

6. Have your assistant mark the ground as he did for the front tires, identifying which marks are for the front tires and which ones are for the rear tires.
7. Move the vehicle out of the way so all marks can be seen.
8. Proceed to measure the total amount of dogtracking as follows:
 - a. Measure the distance between the front tire marks.
 - b. Mark the ground exactly half way between these marks.
9. Do the same for the rear tire marks. The difference between the two center marks is the amount of dogtracking present in the vehicle.

DIAGNOSIS AND TESTING (Continued)



F7561-A

Item	Part Number	Description
1	—	Centerline of Front Tire Tread
1A	—	Centerline Between Front Tires
2	—	Centerline of Rear Tire Tread
2A	—	Centerline Between Rear Tires
B	—	Dimension "B" Equals Total Amount of Dogtracking

TF7561A

Vehicle Lean Check

F-150-250-350 4x2, F-150 4x4 and Bronco

Side-to-side vehicle lean should be verified by measuring the fender lip-to-ground dimension before beginning diagnosis and service actions. Normal acceptable limits are:

- Maximum of 16mm (5/8 inch) variance between left and right front wheel lips to ground.
- Maximum of 19mm (3/4 inch) variance between left and right rear wheel lips to ground.

Once a lean condition has been verified, the following procedure should be followed to resolve the condition:

1. Place the vehicle on a flat, smooth surface. Inspect vehicle for any heavy add-ons that may cause excessive weight on any corner of the vehicle. In cases where the excess weight is a snow plow, a rear tailgate lift, etc., the vehicle must be diagnosed with the equipment in place. Measure corner weights if necessary. Vehicle should be empty, fuel tanks full, no cargo such as tools, equipment or debris in the pick-up box or rear body section of Bronco. Vehicle must be sitting on the wheels and tires and not a hoist, jack or jack stands.

2. Check all wheels and tires:

- Wheels must be same size and design, right and left side on each axle.
- Wheel size and design, tire size and tire design should be as indicated on the Vehicle Certification Label.
- Check air pressure of all tires; inflate to specifications indicated on the Vehicle Certification Label.

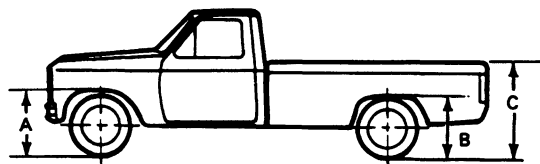
3. Check front and rear suspension. Make sure the same spring is on the left / right front and left / right rear. The front springs have I.D. tags indicating the part number. The rear springs have the part number stamped on the bottom just behind the U-bolt attachment.

4. Jounce the vehicle's front and rear suspension to normalize the vehicle static ride height.

5. Measure the height of the right and left fender lip openings for both front (dimension A) and rear (dimension B). Calculate the side-to-side differences for each dimension. If these differences are greater than 16mm (5/8 inch) between left or right front and / or 19mm (3/4 inch) between left and right rear, adjustment can be performed following the procedure under Adjustments in this section.

NOTE: All vehicles are expected to exhibit a slight lean caused by differences in-side-to-side weight distribution generated by various option content. The following flow chart has been developed to help diagnose lean concerns due to possible suspensions involvement.

SIDE-TO-SIDE LEAN



F6657-1A

CLEANING AND INSPECTION

Front End General Inspection

CAUTION: Do not attempt to adjust front wheel alignment without first making a preliminary inspection of the front end parts, and correcting where necessary.

Pre-inspection

1. Fill all fluids to specification.
2. Make sure spare tire or wheel, and related equipment are properly stored.
3. Remove any excessive accumulation of mud, dirt or road deposits from the chassis and underbody.

CLEANING AND INSPECTION (Continued)

4. Retain all normal loads in the vehicle. Inflate all tires to the pressure specified on the Safety Compliance Certification Label (usually located on the inside driver's door pillar).
5. Check both front tires and make sure they are the same size, ply rating, and load range.

NOTE: Codes identifying the front and rear spring options and springs are printed on the Safety Standard Certification Label. Replace springs in pairs if one is found to be damaged or worn. If a spring should require replacement because it is damaged, worn or due to a leaning conditioning, replace only with the same part as specified on the label. In rare instances, the spring codes will not reflect the springs as installed due to a DSO option or assembly plant substitution. If a DSO option number is shown on the certification label, the District Office can establish whether springs are affected. If the factory-installed springs do not agree with the code printed on the Safety Standard Certification Label (right and left spring part number should match), replace the damaged or worn spring with a new spring of the same part number as the damaged or worn spring. It will not be necessary to replace the matching, non-worn or undamaged spring.

Inspection

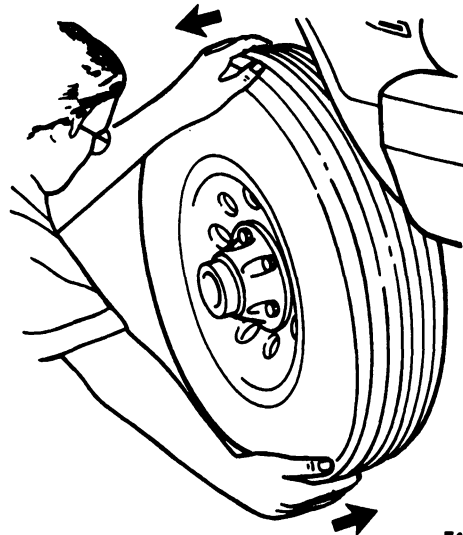
1. Inflate all tires to specified pressure (cold). Check both front tires for the same size, ply rating and load range. Refer to Section 04-04.
2. Check for excessive wheel bearing end play. Refer to the procedure in this section. Adjust and / or replace the wheel bearings as described in the appropriate section in Group 04.
3. Check for worn or damaged spindle ball joints. Replace the ball joints. Refer to Section 04-01A (4x2) and Section 04-01B (4x4).
4. Check for bent steering linkage or excessively worn joints. Refer to Section 11-03.
5. Check the steering gear mounting bolts and tighten to the specified torque. Refer to appropriate section in Group 11.
6. Inspect the radius arm if bent or damaged. Inspect the bushings at the radius arm-to-frame attachment for wear and looseness. Repair or replace parts as required. Refer to appropriate section in Group 04.
7. Check other suspension components for damage.
8. Check for aftermarket changes to steering, suspension, wheel and tire components (i.e., competition, heavy duty, etc.).

NOTE: Specifications in this manual do not apply to vehicles with these changes.

Front Wheel Bearing End Play Inspection

1. Raise the vehicle until the tire clears the floor.

2. Grasp each front tire at the top and bottom and push the wheel inward and outward while lifting the weight of the tire off the bearings.
3. Make sure the wheel rotates freely and the brake pads are retracted sufficiently to allow movement of the wheel assembly.
4. If the wheel / hub-rotor is loose on the spindle or does not rotate freely, adjust the wheel bearings as outlined in the appropriate section in Group 04.



F4604-B

Steering Linkage Inspection

1. With the vehicle resting on the ground and parking brake fully applied, have someone turn the steering wheel back and forth 360 degrees and watch for relative motion of the studs in the steering linkage ball sockets. Excessive **vertical** motion of the studs relative to the sockets may indicate excessive wear. Also watch for a loose steering gear attachment to the frame.
2. Another method is to raise the front tires off the ground, grasp the tire at the front and rear and watch for excessive play in the joints while trying to steer the wheels.
3. Steel, greasable joints can be checked for excessive wear by measuring the torque it takes to turn the stud.
4. Remove the tapered stud from its seat and thread the attaching nut back onto the stud. Turn the stud with an inch-pound torque wrench and note the torque to turn the stud.

Torque to Turn Stud in Socket	N-m	In-Lb
New Steel Joints	3	26.5
Good Used Joints	0.5-3	5-26.5
Joint with Excessive Play	0.5	5

CLEANING AND INSPECTION (Continued)

NOTE: Some joints turning torque will become nearly as little as 0.5 N·m (5 in-lb) within the first 1000 miles, and remain there for the life of the joint.

- Only replace a ball joint that requires less than 0.5 N·m (5 in-lb).
- Tighten or replace loose, worn or damaged parts as outlined in the Section 11-03.

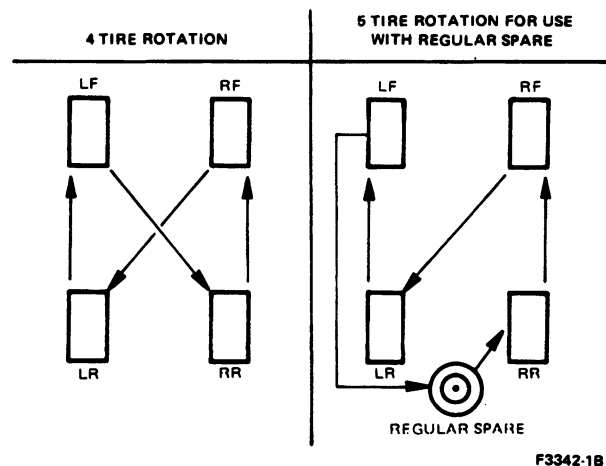
NOTE: Improper removal of the tapered stud will cause premature failure of the ball socket.

Tire Rotation

To equalize tire wear, tires may be rotated, but not until the cause of unusual or uneven tire wear is determined and corrected. Tire rotation is recommended every 8,000-12,000 km (5,000-7,500 miles).

When vehicles have tires that differ from front to rear or are equipped with dual rear wheels (DRW), tires are to be rotated side-to-side, not in a criss-cross pattern.

NOTE: Tire tread wears fastest in the first 5,000 miles. Therefore it is very important to perform the first rotation within the specified mileage range to minimize uneven wear.



F3342-18

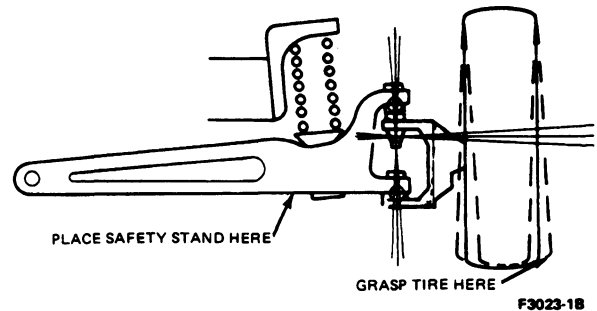
Upper and Lower Ball Joint Inspection

F-Series Twin I-Beam Front Axle Equipped with Joints

Prior to performing any ball joint inspection, adjust the front wheel bearings as described in the appropriate section of Group 04.

1. Raise the vehicle and place safety stands under the I-beam axle beneath the spring as shown below.
2. Have an assistant grasp the lower edge of the tire and move the wheel in and out.
3. While the wheel is being moved, observe the lower spindle arm and the lower part of the axle jaw.

4. A 0.794mm (1/32-inch) or greater movement between the lower portion of the I-beam and the lower spindle arm indicates that the lower ball joint must be replaced.
5. For checking the upper ball joints, grasp the upper edge of the tire and move the wheel in and out. A 0.794mm (1/32-inch) or greater movement between the upper spindle arm and the upper portion of the I-beam indicates that the upper ball joint must be replaced.



CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kPa (135 psi) for 1 inch and 1-3/16 inch bore, and 1034 kPa (150 psi) for 1-3/8 inch bore. Do not attempt to open puncture or apply heat to the shock absorbers.

Before replacing a shock absorber, check the action of the shock absorbers as follows:

On-Vehicle Tests

1. Make sure the shock absorber is securely and installed properly.
2. Check the shock absorber insulators for damage and wear.
3. Replace any worn or damaged insulators and tighten attachments to the specified torque (on a shock absorber which incorporates internal insulators, replace the shock absorbers).
4. Tighten shock absorber attachments to specified torque. Refer to appropriate section in Group 04.
5. Inspect the shock absorber for evidence of fluid leakage. A light film of fluid is permissible. Be sure any fluid observed is not from sources other than the shock absorber.
6. Replace the shock absorber if leakage is severe.
7. Disconnect the lower end of the shock absorber. Extend and compress the shock absorber as fast as possible, using as much travel as possible. Action should become smooth and uniform throughout each stroke. Higher resistance on extension than on compression is a normal condition. Faint swish noises are also normal. **Make sure that the part number of the replacement is the same as that of the original shock absorber.**

ADJUSTMENTS

Front Wheel Alignment Adjustments

Refer to the alignment charts in the Description area of this section.

After front wheel alignment has been checked, make the necessary adjustments as described below.

CAUTION: Do not bend axles or radius arms to change alignment.

Caster and Camber Adjustment

E-150-250-350, F-150-250-350 Ball Joint System

Caster and camber adjustment is possible with service adjusters available in 1/2-degree, 1-degree, and 1-1/2 degree increments. One adjuster is used to adjust both caster and camber as described below.

1. Measure vehicle caster and camber. Refer to the alignment charts this section to determine if the vehicle is within specifications.

Note any difference between the actual measurements and the specification. This information will be used to select the correct service adjuster.

2. Refer to the chart following this procedure. Using the information from Step 1, select the correct service adjuster. Note the orientation of the slot required to obtain the correct alignment. Refer to appropriate section in Group 05.
3. Remove the front wheel.
4. Loosen the pinch bolt at the upper ball joint and pry the adjuster out of the axle with the blade of a screwdriver. If required, use Pitman Arm Puller T64P-3590-F to remove the adjuster.
5. Install the new service adjuster. Orient the slot as specified in the following chart. A 1-1/2-inch socket may be used to rotate the adjuster into position.
6. Tighten the pinchbolt to 67-88 N·m (50-65 ft·lb) for F-Series, and to 87-119 N·m (65-88 ft·lb) for Econoline.
7. Install the front wheel.

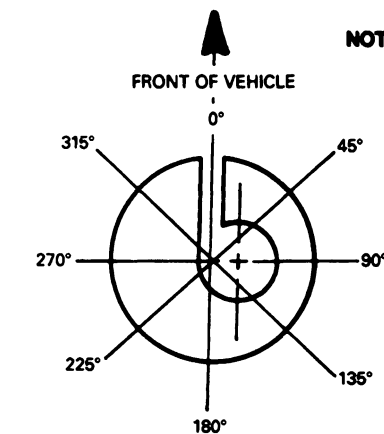
ADJUSTMENTS (Continued)

8. Check alignment and reset toe to specification.

F-SERIES 4x2 ADJUSTABLE CAMBER/CASTER

Service Adjuster Type (Degree)	Position Slot in Axle (Degree)	LH Axle		RH Axle	
		Camber Change (Degree)	Caster Change (Degree)	Camber Change (Degree)	Caster Change (Degree)
1/2	0	-0.5	0	+0.5	0
1	0	-1.0	0	+1.0	0
1-1/2	0	-1.5	0	+1.5	0
1/2	45	-0.25	+0.25	+0.25	+0.25
1	45	-0.75	+0.75	+0.75	+0.75
1-1/2	45	-1.00	+1.00	+1.00	+1.00
1/2	90	0	+0.5	0	+0.5
1	90	0	+1.0	0	+1.0
1-1/2	90	0	+1.5	0	+1.5
1/2	135	+0.25	+0.25	-0.25	+0.25
1	135	+0.75	+0.75	-0.75	+0.75
1-1/2	135	+1.00	+1.00	-1.00	+1.00
1/2	180	+0.5	0	-0.5	0
1	180	+1.0	0	-1.0	0
1-1/2	180	+1.5	0	-1.5	0
1/2	225	+0.25	-0.25	-0.25	-0.25
1	225	+0.75	-0.75	-0.75	-0.75
1-1/2	225	+1.00	-1.00	-1.00	-1.00
1/2	270	0	-0.5	0	-0.5
1	270	0	-1.0	0	-1.0
1-1/2	270	0	-1.5	0	-1.5
1/2	315	-0.25	-0.25	+0.25	-0.25
1	315	-0.75	-0.75	+0.75	-0.75
1-1/2	315	-1.00	-1.00	+1.00	-1.00

NOTE: The assembly plant sometimes builds vehicles with adjusters that are not zero-degree type to control alignment. This table shows the alignment changes that will occur if the vehicle was originally built with zero-degree adjusters. Always check to see which adjuster has been installed (and its orientation) before making changes.



TOP VIEW OF CAMBER/CASTER ADJUSTER
(POSITION SLOT IN AXLE TO OBTAIN DESIRED ALIGNMENT)

CF5729-2B

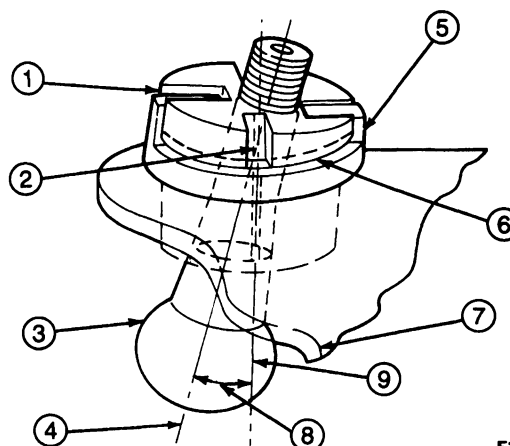
ADJUSTMENTS (Continued)

Bronco and F-150-250 4x4 Vehicles

Caster and camber adjustment is provided by means of a series of interchangeable mounting sleeves (camber adjusters) for the upper ball joint stud. There is one adjuster available for caster.

1. Measure camber with available alignment equipment. If camber is out of specification, proceed to Step 2.
2. Raise vehicle on hoist and remove the front wheels.
3. Remove the upper ball joint cotter pin and nut.
4. Loosen the lower ball joint nut to the end of the stud.
5. Strike the inside of the spindle near the upper and lower ball joints to break the spindle loose from the ball joint studs.
6. Remove the camber adjuster sleeve. If required, use Pitman Arm Puller T64P-3590-F to remove the adjuster from the spindle.
7. Install the replacement service adjuster.
 - To increase camber (more positive) point the arrow on the adjuster outboard.
 - To decrease camber (more negative) point the arrow on the adjuster inboard.
8. Remove the lower ball stud nut and apply Loctite 242 or equivalent to the lower stud.
9. Hand start the lower nut and partially tighten to 54 N·m (40 ft-lb).
10. Install the new upper nut and tighten to 115-135 N·m (85-100 ft-lb). Advance the nut to the next castellation and install a new cotter pin.
11. Finish tightening the lower nut to 128-149 N·m (95-110 ft-lb).

NOTE: Excessive spindle turning efforts, causing poor steering returnability, may result if the fastener tightening sequence described in Steps 8, 9 and 11 are not followed exactly.
12. Install the wheel and lower the vehicle.
13. Check camber and set toe according to alignment procedure.



F2852-E

Item	Description
1	Slots In Sleeve Engage Lugs To Prevent Rotation Of Sleeve Which Would Result In Change Of Caster Angle
2	Split In Sleeve Allows Sleeve To Expand When Ball Stud Nut Is Tightened, Locking Sleeve And Ball Stud In Location
3	Ball Stud (Component Of Ball Joint Assembly)
4	Ball Stud Axis
5	Support Collar With Integral Indexing Lugs Welded To Axle Arm Stamping
6	Step In Sleeve For Engagement Of 2-Jaw Puller When Necessary For Removal
7	Axle Stamping
8	Angle At Which Sleeve Holds Ball Studs Determines Camber / Caster
9	Sleeve And Support Collar Axis (Also The Ball Stud Axis When 0° Camber Sleeve Is Installed)

TF2852A

Caster Adjustment, F-250-350

The caster angle on the F-250-350 with a leaf spring type suspension can be adjusted by inserting a shim between the spring and axle. Shims are available from Service in 0-degrees, one-degree and two-degree increments. The 0-degree shim is used to adjust side-to-side height.

1. To adjust caster, raise the vehicle and support the front axles on safety stands.

CAUTION: If possible, caster adjustment should always be done on the right front axle to avoid changing front driveshaft alignment.

ADJUSTMENTS (Continued)

2. Loosen U-bolt nuts and separate spring from axle. Install caster shims between spring and axle. Position the thin edge of the shim toward the front of the vehicle to increase caster, thin edge to the rear to decrease caster.

NOTE: Caster shims installed on the left axle will change the front driveshaft angle. If a caster shim is used on the left axle, driveshaft angles must be checked and conform to specifications in Section 05-01. Always attempt to correct side-to-side caster variations by adjusting the right axle caster.

Tighten U-bolt nuts until all nuts contact cap.
Tighten nuts to 142 N·m (105 ft-lb).

F-350 Monobeam Front Drive Axle and F-Super Duty Monobeam Non-Driving Axle

Caster and camber are not adjustable on F-350 (4x4) or on the F-Super Duty.

Checking and Adjusting Toe Alignment

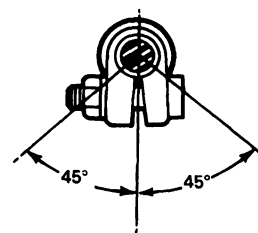
Refer to toe specifications for F-150-250-350, Bronco and E-150-250-350 in this section.

The F-Series and Econoline steering linkage has adjustments in both the tie rod and the drag link. First, remove the horn pad and make sure the steering wheel is properly installed as described in Section 11-04A. With steering wheel locked in place, set toe to correct specification.

1. Loosen the clamp bolts for the adjusting sleeve.
2. Rotate the sleeve until the correct toe alignment is obtained.
3. With the clamps 4.76mm (3 / 16 inch) from the end of the sleeve on 4x4 models and centered between the adjusting sleeve lock ring protrusions, position the bolts as described below.

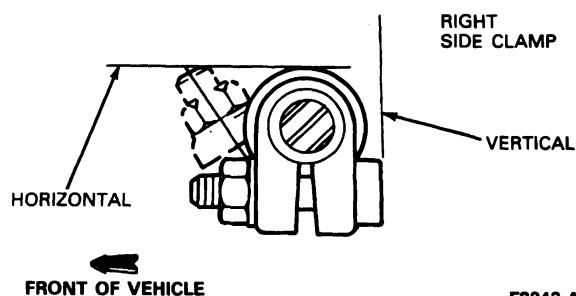
NOTE: Lubricate clamp fasteners prior to tightening.

- a. E-150-250-350: after setting toe, the two clamp bolts / nuts on the adjusting sleeve must be positioned within a limit of 45 degrees (plus / minus) as shown with the threaded end of the bolts pointing down.
- b. F-150-250-350 and Bronco: after setting toe, the two clamp bolts / nuts on each adjusting sleeve must be positioned within a limit of 45 degrees (plus / minus) as shown with the threaded end of the bolts on the left hand sleeve pointing towards the front of the vehicle and the threaded end of the bolts on the right hand sleeve facing rearward.



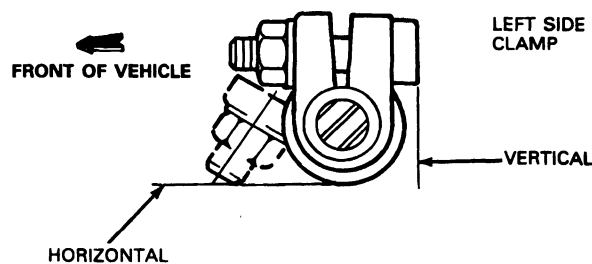
F8241-A

- c. F-Super Duty: after setting toe, the clamp bolt / nut on the right (tie rod) adjusting sleeve must be positioned within a limit of 45 degrees (plus / minus) as shown with the threaded end of the bolt pointing forward.



F8242-A

After setting toe, the clamp bolt / nut on the left (drag link) adjusting sleeve must be positioned within a limit of 45 degrees (plus / minus) as shown with the threaded end of the bolt pointing forward.



F8243-A

4. Recheck the toe alignment to make sure no changes occurred as the clamp nuts were tightened.

Steering Stop

All F-150-250-350 4x2, F-Super Duty and E-150-250-350 models have built-in steering stops (3A706) which cannot be altered.

ADJUSTMENTS (Continued)

F-150-250-350 4x4 models use a welded-in screw and locknut which is not adjustable. A spacer cap is used with wide tread tires on F-150 4x4.

F-Super Duty Stripped Chassis models use a 13 x 3.5 x 1 1/2 bolt as steering stop.

The chart below shows the degree position of the front wheels when checking the stop adjustment angles.

Vehicle Type	Spindle Arm Stop Angle — Degrees	
	Kingpin	Ball Joint
F-150 (4x2) Regular & Super Cab	36.8	36.8
F-250/350 (4x2) Regular Cab, Super Cab and Crew Cab	35.0	35.0
F-150 (4x4) Regular Cab, Super Cab and Bronco	—	36.0 ^a
F-250 (4x4) Regular Cab, Super Cab and Crew Cab	—	33.4
F-350 (4x4) Regular Cab, F-250 HD (4x4)	—	30.3
F-Super Duty Commercial and Motorhome Chassis	40.0	—

^a 34.0 with 10x15 size tires.

TF2364A

Vehicle Lean Correction**Front Lean**

Measure the left and right front wheelhouse openings to ground as depicted in the Vehicle Lean Check portion of this section. Refer to the Front Wheel Alignment Specifications chart for the specified limits on their side-to-side difference or lateral tilt. A vehicle within these limits would not have an objectionable lean appearance. However, if the lean is objectionable, perform the following to adjust:

- Vehicles with coil springs:

If the side-to-side difference is less than 19mm (3/4 inch) install a 6.35mm (1/4 inch) Service Shim (P/N 389117-S2) under the lower spring seat on the low side. No more than one shim is to be added.

If there is a side-to-side difference of 19mm (3/4 inch) or more, remove the high side spring from the vehicle and compare it with a service replacement part having the same part number.

If the free height of the original equipment spring exceeds the free height of the service part by 13mm (1/2 inch), install the service part in this location. If the free height of the original spring is smaller by at least 13mm (1/2 inch), remove the low side spring. Compare the service spring to both of the original springs and select the two springs most evenly matched. Install the higher spring at the low side.

- Vehicles with front leaf springs:

A service shim (D7TZ-5742-A) is available that installs between the spring and the axle.

For F-Super Duty Commercial and Motorhome Chassis, follow instructions provided with Vehicle Attitude Kit F1DT-5K648-AA.

Rear Lean

A side-to-side lean at the rear of the vehicle can be adjusted by approximately 10mm (3/8 inch) by installing a shim between the rear spring and axle on the low side of the vehicle. A "low at the rear" vehicle can be raised approximately 10mm (3/8 inch) by installation of one shim on each side. Use the following procedure to install the shim (D7TZ-5742-A).

1. Raise the vehicle frame until the weight is off the rear springs but with the tires still touching the floor.
2. Loosen the spring U-bolts to allow the axle to separate from the spring approximately 13mm (1/2 inch).
3. Position the shim (D7TZ-5742-A) between the spring and the spring seat and with the tie bolt head through the hole in the shim. On 4x4 vehicles, position the shim between the rear spring and axle spacer. Tape may be used to hold the shim in position.
4. Make sure the spring leaves are properly aligned and the spring U-bolts contact the edges of the spring assembly or axle seat.
5. Tighten the spring U-bolt sufficiently. The spring bolt end should extend through shim into axle seat hole.
6. Tighten U-bolt nuts to
 - 102-135 N·m (75-100 ft-lb) on F-150 (4x2 and 4x4) Bronco.
 - 204-282 N·m (150-210 ft-lb) on F-250-350 (4x2 and 4x4).
 - 300-400 N·m (220-300 ft-lb) on F-Super Duty vehicles.
 - 97-134 N·m (72-98 ft-lb) on E-150.
 - 148-202 N·m (109-149 ft-lb) on E-250-350.

For F-Super Duty Commercial and Motorhome Chassis, follow instructions provided in Rear Spring (Raise) Kit F1DT-5A581-AA.

SPECIFICATIONS**TORQUE SPECIFICATIONS**


Description	N·m	Lb·Ft
Pinch Bolt at Upper Ball Joint, F-Series	67-88	50-65
Pinch Bolt at Upper Ball Joint, E-Series	87-119	65-88
U-Bolts	—	—
F-150 4x2 and 4x4, Bronco	102-135	75-100
F-250-350 4x2 and 4x4	204-282	150-210
F-Super Duty Vehicles	300-400	220-300

(Continued)

SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS (Cont'd)		
Description	N-m	Lb-Ft
E-150	97-134	72-98
E-250-350 For F-Super Duty Commercial and Motorhome follow instructions provided in Kit F1DT-5A581-AA	148-202	109-149

SPECIAL SERVICE TOOLS

Tool Number/ Description	Illustration
T64P-3590-F Pitman Arm Puller	 T64P-3590-F

SECTION 04-01A Suspension, Front, 4x2

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Wheel Bearing Adjustment, F-150-250-350, F-Super Duty, E-150-250-350	04-01A-40	F-Super Duty Chassis Cab	04-01A-33
DESCRIPTION AND OPERATION		F-Super Duty Commercial and Motorhome Chassis.....	04-01A-34
Front Suspension	04-01A-1	Front Stabilizer Bar Bushing	04-01A-34
REMOVAL AND INSTALLATION		Front Twin I-Beam Axle	04-01A-35
Axle Pivot Bracket (Right Side).....	04-01A-28	Front Wheel Grease Seal and Bearing	04-01A-5
Axle Pivot Bushing.....	04-01A-22	Front Wheel Spindle	04-01A-17
Removal.....	04-01A-22	F-150-250-350 4x2, E-150-250-350 with Ball Joints	04-01A-19
Camber Adjuster, F-150-250-350 4x2, E-150-250-350 with Ball Joints	04-01A-21	F-Super Duty	04-01A-17
Front Axle, F-Super Duty Series Vehicles	04-01A-38	Jounce Bumper	04-01A-27
Front Shock Absorber	04-01A-15	F-150-250-350 and E-150-250-350.....	04-01A-27
E-150-250-350.....	04-01A-15	F-Super Duty Chassis Cab	04-01A-27
F-150-250-350.....	04-01A-15	F-Super Duty Commercial and Motorhome Chassis.....	04-01A-27
F-Super Duty Chassis Cab, Commercial Chassis and Motorhome Chassis Vehicles.....	04-01A-16	Radius Arm	04-01A-23
Front Spring, F-150-250-350 4x2 and E-150-250-350.....	04-01A-6	Radius Arm Rear Bracket, E-150-250-350	04-01A-27
Front Spring, F-Super Duty Chassis Cab, Commercial Chassis and Motorhome Chassis Vehicles	04-01A-9	Spindle Bushing, Bronze	04-01A-38
Front Stabilizer Bar.....	04-01A-29	Track Bar, F-Super Duty Chassis Cab	04-01A-35
E-150-250-350.....	04-01A-29	Upper and Lower Ball Joints, F-150-250-350 4x2, E-150-250-350	04-01A-21
F-150-250-350 4x2	04-01A-30	SPECIAL SERVICE TOOLS/EQUIPMENT	04-01A-42
		SPECIFICATIONS	04-01A-41
		VEHICLE APPLICATION	04-01A-1

VEHICLE APPLICATION

F-150-250-350 4x2, E-150-250-350, F-Super Duty
Chassis Cab, Commercial Chassis and Motorhome
Chassis Vehicles

DESCRIPTION AND OPERATION

Front Suspension

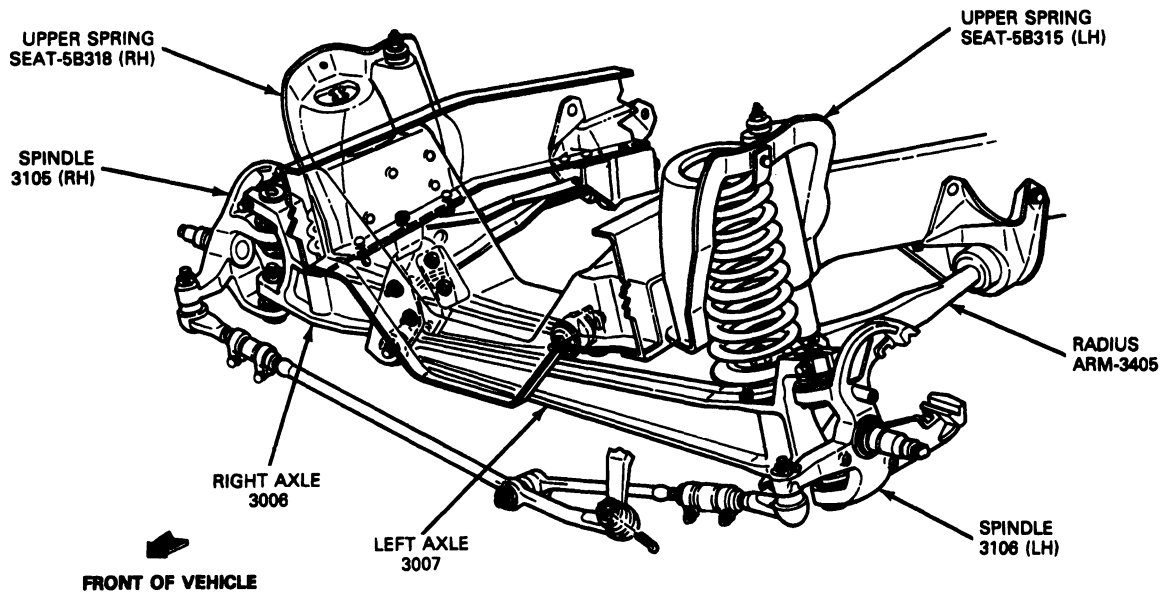
The F-150-250-350 4x2 and E-150-250-350 vehicles use coil springs with the two I-beam type front axles. The springs are mounted between the frame spring pocket and the axle.

One end of each axle is attached to the spindle and a radius arm, and the other end is attached to a frame pivot bracket on the opposite side of the vehicle.

Each spindle is held in place on the axle by ball joints (F-150-250-350 4x2) on I-beam axles or a spindle pin (kingpin) (E-150-250-350 and F-Super Duty Series) which pivots on bronze bushings pressed in the upper and lower ends of the spindle on forged I-beam axles. A thrust bearing is installed between the lower end of the axle and the spindle to support the load on the axle. All vehicles (except F-Super Duty Chassis and Motorhome Chassis vehicles) have a steering arm which is an integral part of the spindle.

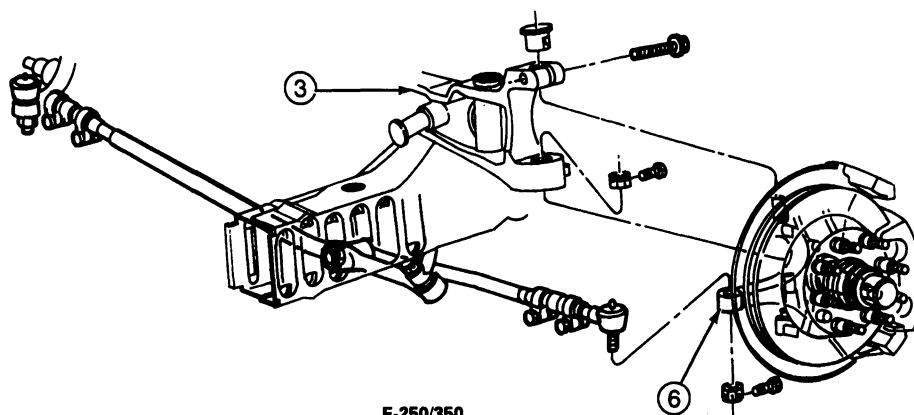
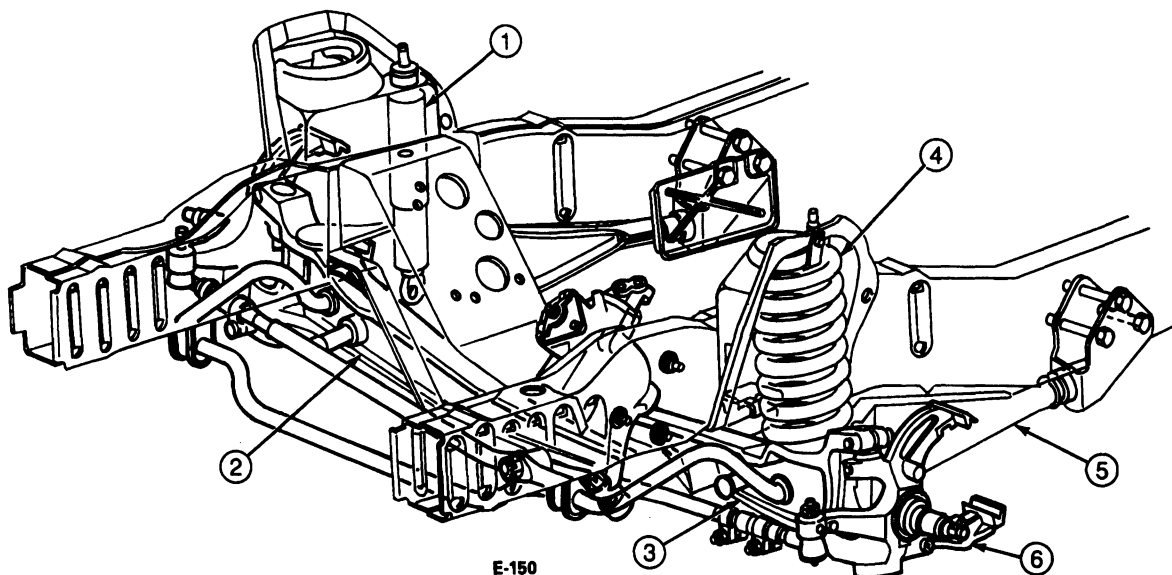
DESCRIPTION AND OPERATION (Continued)

Front Suspension, F-150-250-350 (4x2)



DESCRIPTION AND OPERATION (Continued)

Front Suspension, E-150-250-350



F7563-A

Item	Part Number	Description
1	18045	Shock Absorber
2	3006	Axle Assembly, Right Hand
3	3007	Axle Assembly, Left Hand

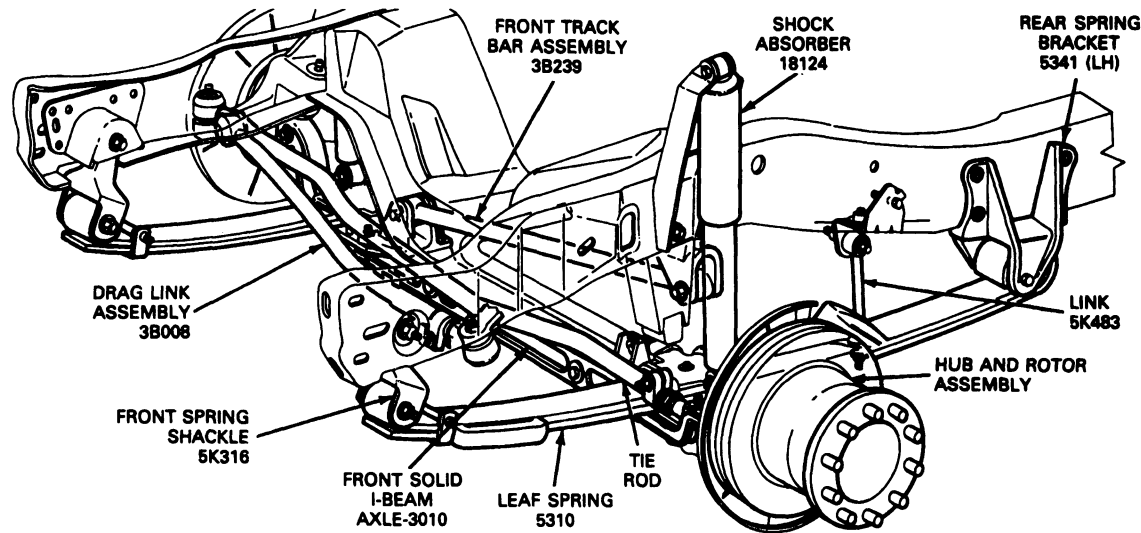
(Continued)

Item	Part Number	Description
4	5310	Spring
5	3405	Arm, Radius
6	3106	Spindle Assembly, Left Hand

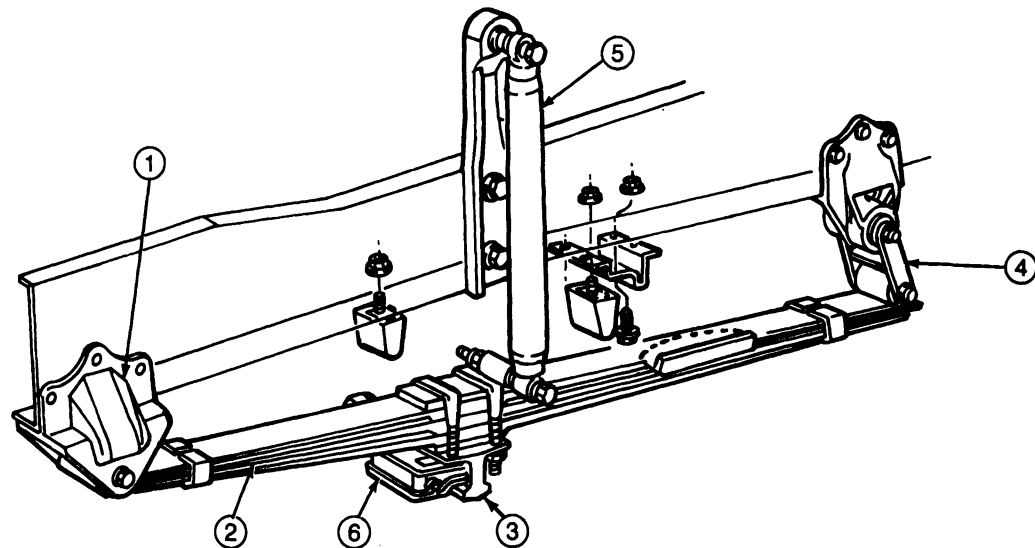
TF7563A

DESCRIPTION AND OPERATION (Continued)

Front Suspension, F-Super Duty Chassis Cab



Front Suspension, F-Super Duty Commercial and Motorhome Chassis



Item	Part Number	Description
1	5340	Bracket, Front Spring
2	5310	Spring Assembly, Front
3	3010	Axle Assembly, Front

(Continued)

Item	Part Number	Description
4	5335	Bracket Assembly, Front Spring Shackle
5	18045	Shock Absorber
6	5486/5A490	Bracket, Stabilizer Bar Mounting

TF7565A

REMOVAL AND INSTALLATION

Front Wheel Grease Seal and Bearing

Removal

Wheel bearing lubricant is a lithium base grease, Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent.

NOTE: Sodium-base grease is not compatible with lithium-base grease and should not be intermixed. Therefore, do not lubricate front and / or rear wheel bearings without first identifying the type of original wheel bearing lubricant. Usage of incompatible bearing lubricants could result in premature lubricant breakdown.

If bearing adjustment will not eliminate looseness or rough and noisy operation, the hub and bearings should be cleaned, inspected, and repacked with specified wheel grease. If the bearing cups or the cone and roller assemblies are worn or damaged, they should be replaced.

1. Raise the vehicle until the tire clears the floor and remove the wheel and tire assembly from the hub and rotor as described in Section 04-04.
2. Remove the brake caliper (refer to Section 06-03), and wire to the underbody to prevent brake hose damage. It is not necessary to disconnect the hose from the caliper.

CAUTION: Do not let the caliper hang with its weight on the brake hose or the hose may become stretched, twisted or ruptured.

3. Remove the grease cap, cotter pin, retainer adjusting nut and washer.
4. Remove the outer bearing cone and roller.
5. Pull the hub and rotor off the spindle. Remove and discard the grease seal.
6. Remove the inner bearing cone and roller from the hub.
7. Remove all traces of old lubricant from bearings, hub and axle spindle.
8. Inspect the cups for scratches, pits or cracks. If the cups are worn or damaged, remove with a drift.
9. Clean the inner and outer bearing cones and rollers with solvent and dry thoroughly.
NOTE: Do not spin the bearings dry with compressed air.
10. Inspect the cones and rollers for cracks, nicks, brinelling, or seized rollers. Inspect the grease retainer and replace if cracked, nicked, dented, or worn.
11. Cover the spindle with a clean cloth and brush all loose dust and dirt from the brake assembly using Rotunda Brake and Clutch Service Vacuum 091-00001 or equivalent.

NOTE: Remove the cloth from the spindle carefully to prevent dirt from falling on the spindle.

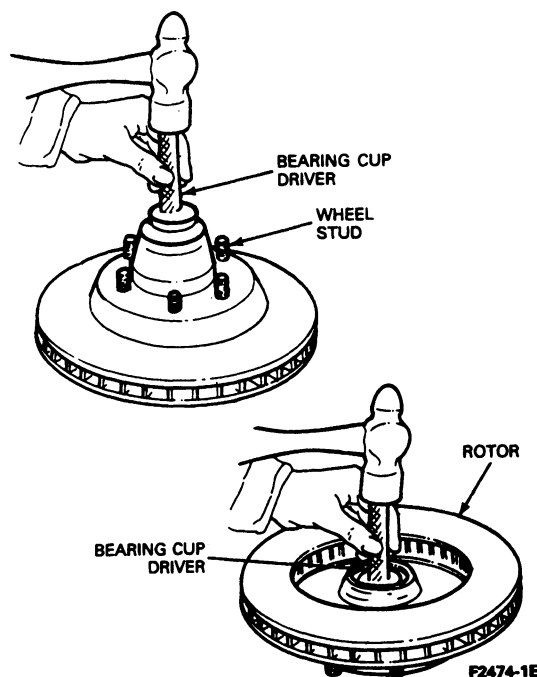
Installation

1. If inner or outer bearing cups were removed, install replacement inner and outer bearing cups in the hub with the appropriate bearing cup replacer tool (refer to the Special Service tool chart in the Specifications portion of this section) and Driver Handle T80T-4000-W.
2. Properly seat cups in hub. The cups are properly seated when fully bottomed.
3. Replace grease retainers. Polish grease retainer journal on spindle with 400 grit sandpaper. Clean with clean cloth.

CAUTION: Make sure spindle and hub are clean prior to application of lubricant.

4. Pack the inside of the hub with lithium-base grease, Premium Long-Life Grease XG-1-C or -K C1AZ-19590-BA (ESA-M1C75-B) or equivalent. Fill the hub until the grease is flush with the inside diameters of both bearing cups.
5. Pack the bearing cones and rollers with wheel bearing grease. Use a bearing packer, Rotunda model 108-00074, 108-00076, 108-00078 or equivalent.

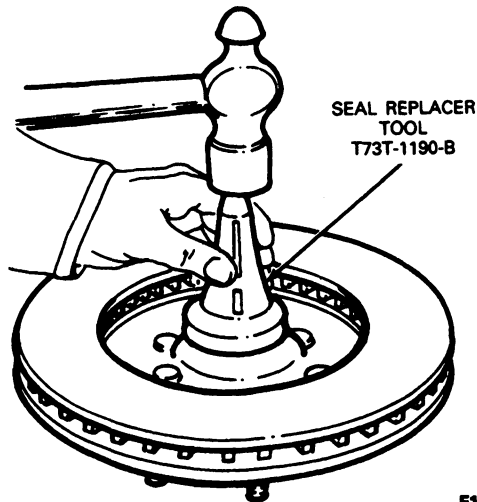
NOTE: If a packer is not available, work as much lubricant as possible between the rollers and cages. Lubricate the cone surfaces with grease.



REMOVAL AND INSTALLATION (Continued)

6. Place the inner bearing cone and roller in the inner cup and install the new grease seal with an appropriate tool such as Seal Replacer T73T-1190-B. Be sure that the seal is fully bottomed.

NOTE: Different vehicles having different size bearings and seals will require a different seal replacer.



F1465-1D

7. Install the hub and rotor on the wheel spindle.
CAUTION: Keep the hub centered on the spindle to prevent damage to grease retainer or spindle threads.
8. Install the outer bearing cone, roller and flatwasher on the spindle.
9. Install the adjusting nut, and adjust the wheel bearing as described under Adjustments in this section.
10. Install the retainer and new cotter pin bending both ends of cotter pin around retainer. Install grease cap.
11. Install the caliper. Refer to Section 06-03.
12. Install the wheel and tire assembly on the hub as described in Section 04-04.
13. Lower vehicle and tighten lugnuts to specification. Install the wheel cover or hub cap.
14. Before driving the vehicle, pump the brake pedal several times to restore normal brake pedal travel.

15. Retighten the lugnuts. Refer to the caution below. Failure to retighten the lugnuts could result in the wheel coming off while the vehicle is in motion.

CAUTION: On vehicles equipped with single rear wheels, retighten wheel lugnuts to the specified torque at 500 miles (800 km) of new vehicle operation and at the intervals specified in the separate Maintenance Schedule and Record Log.

On vehicles equipped with dual rear wheels retighten the wheel lugnuts to the specified torque at 100 miles (160 km), and again at 500 miles (800 km) of new vehicle operation and at the intervals specified in the separate Maintenance Schedule and Record Log.

Also retighten at 500 miles (800 km) after any wheel change or any time the lugnuts are loosened.

Failure to retighten wheel lugnuts at mileage specified could allow wheels to come off while the vehicle is in motion, possibly causing loss of vehicle control and collision.

Front Spring, F-150-250-350 4x2 and E-150-250-350

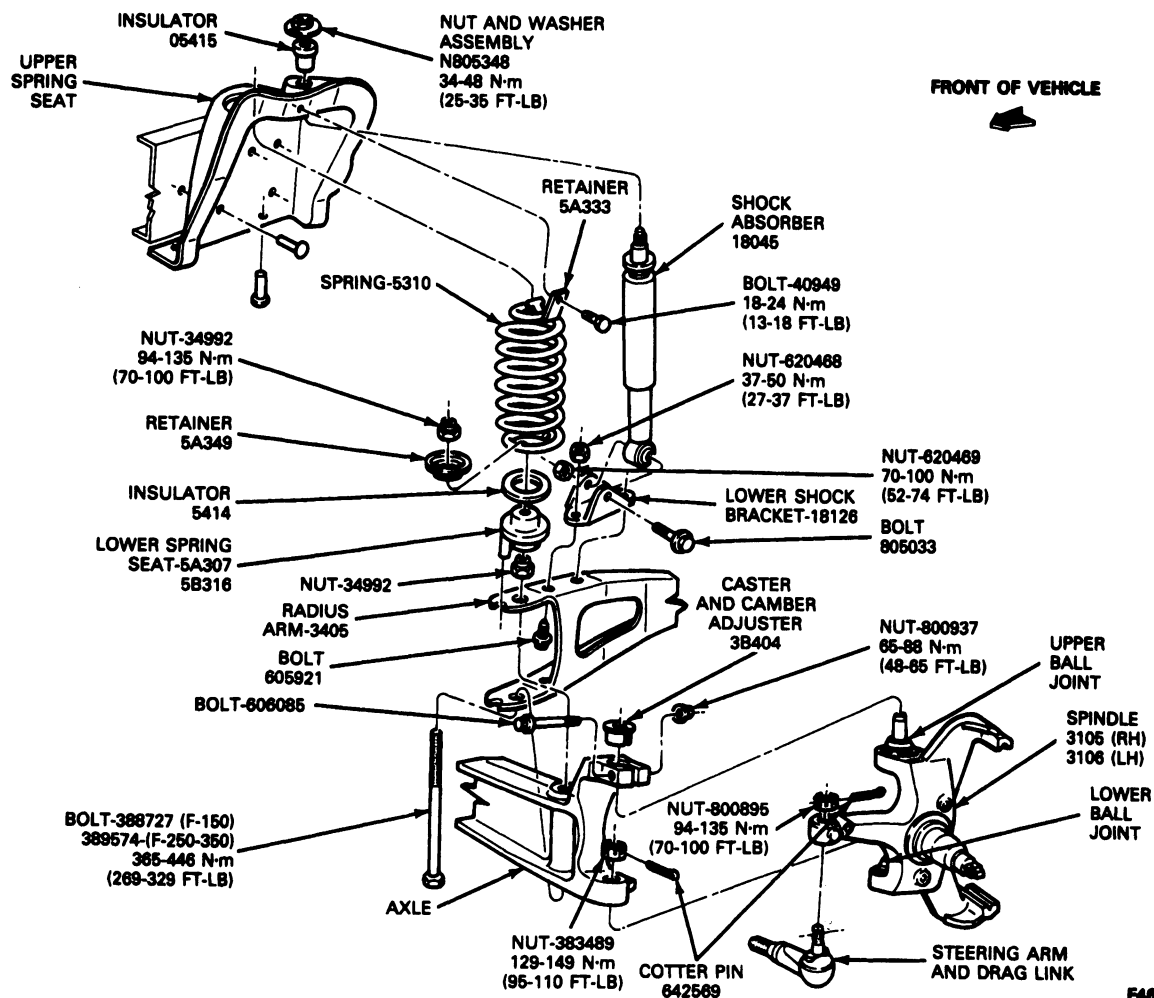
Removal

1. Raise the front of the vehicle and place safety stands under the frame and a jack under the axle. Refer to Section 00-01 for hoisting instructions.
2. Remove the wheel and tire assembly. Refer to Section 04-04.

CAUTION: The axle must be supported on the jack throughout spring removal and installation, and must not be permitted to hang by the brake hose. If the length of the brake hose is not sufficient to provide adequate clearance for removal and installation of the spring, the disc brake caliper must be removed from the spindle according to the procedures specified in Section 06-03. After removal, the caliper must be placed on the frame or otherwise supported to prevent suspending the caliper from the brake hose. These precautions are absolutely necessary to prevent serious damage to the tube portion of the caliper hose assembly.

REMOVAL AND INSTALLATION (Continued)

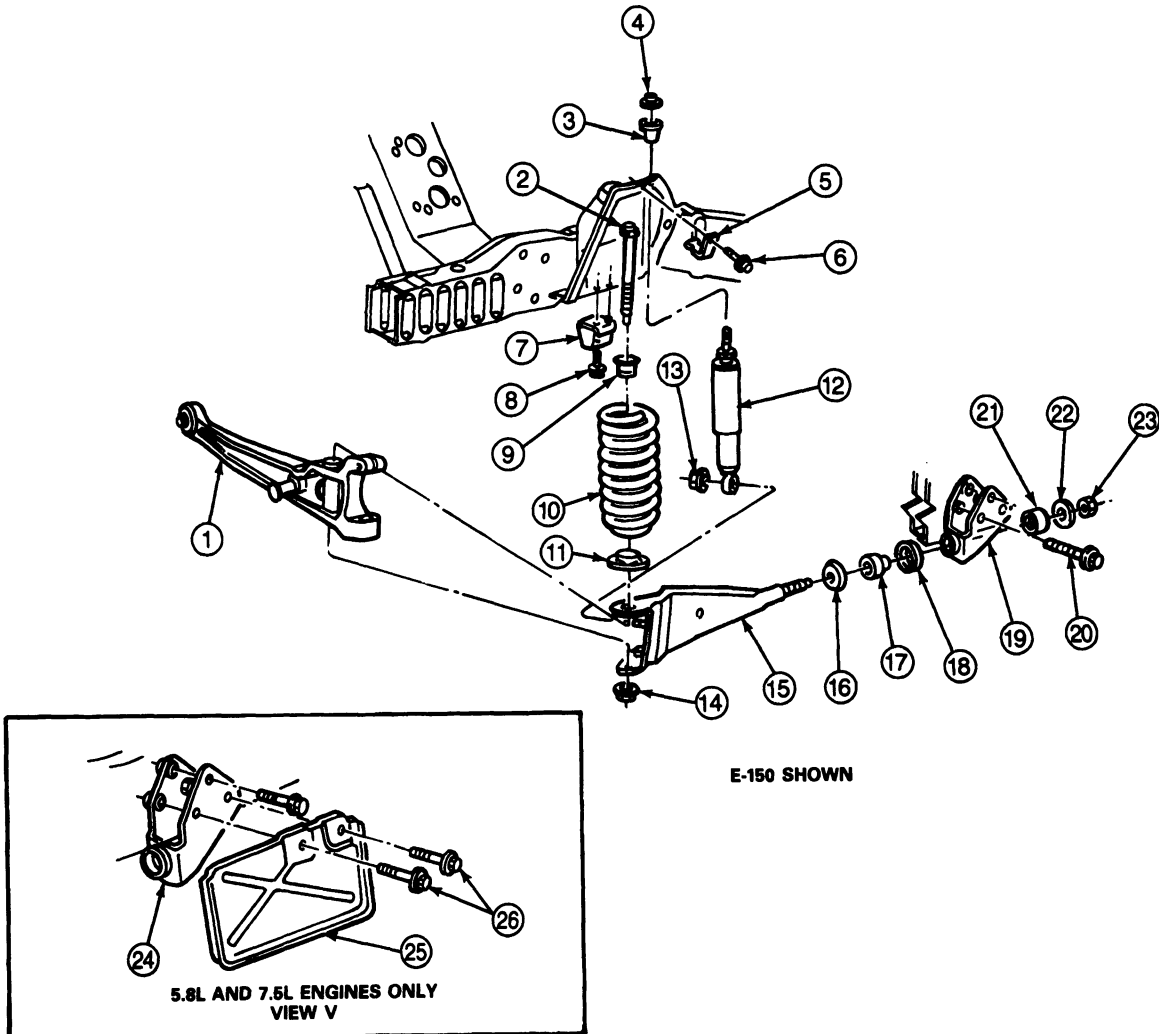
Front Spring and Shock Absorber, F-150-250-350 (4x2)



F4689-E

REMOVAL AND INSTALLATION (Continued)

Front Spring and Shock Absorber Installation, E-150-250-350



F7567-A

REMOVAL AND INSTALLATION (Continued)

FRONT SPRING AND SHOCK ABSORBER E-150-250-350 (LEGEND)

Item No.	Part Number	Description
1	3007	Axle Assembly, Left Hand
2	N806592-S150	Bolt M20-2.5 x 206.6 Hex Flange E-250, E-350
	N806591-S150	Bolt M20-2.5 x 194.7 Hex Flange
3	18198	Insulator, Shock Absorber
4	N806246-S56	Nut and Washer Assembly 34-47 N·m (25-35 Ft-Lb)
5	5A333	Retainer, Front Spring, Upper
6	N802455-S2	Screw M8-1.25 x 28 Hex Flange 25-35 N·m (19-26 Ft-Lb)
7	3020	Bumper
8	N802455-S2	Screw M8-1.25 x 28 Hex Flange 25-35 N·m (19-26 Ft-Lb)
9	5A349	Retainer, Front Spring, Mounting, Lower
10	5310	Spring, Front Coil
11	5414	Insulator, Front Spring, Lower
12	18045	Shock Absorber
13	N806085-S8	Nut and Washer Assembly M12 x 1.75 68-92 N·m (50-68 Ft-Lb)

Item No.	Part Number	Description
14	N805028-S100	Nut M20-2.5 Hex Flange 255-345 N·m (191-245 Ft-Lb)
15	3405	Arm Assembly, Front Radius
16	3B186	Retainer, Front Radius Arm Bushing
17	3B203	Insulator, Front Radius Arm Bushing
18	3B244	Spacer, Front Radius Arm Bracket
19	3B243	Bracket, Radius Arm, Left Hand
20	N800898-S60	Bolt M12-1.75 x 110 Hex Flange 87-119 N·m (64-87 Ft-Lb)
21	3B203	Insulator, Front Radius Arm, Inner
22	37852	Washer 3/4 Inch
23	34992-S2	Nut 3/4-10 Hex 108-162 N·m (80-119 Ft-Lb)
24	3B094	Bracket, Radius Arm, Right Hand
25	3B463	Shield, Radius Arm, Insulator Heat
26	N800898-S60	Bolt M12-1.75 x 110 Hex Flange 87-119 N·m (64-87 Ft-Lb)

CF7568-A

3. Disconnect the shock absorber from the lower bracket.
4. Remove the spring upper retainer attaching bolts or screws from the top of the spring upper seat and remove the retainer.
5. On F-150-250-350 vehicles, remove spring lower retainer nut to lower seat and lower insulator and axle. Remove the retainer.

On E-150-250-350 vehicles, loosen at least four turns nut (N805028) holding the lower spring retainer, radius arm and axle. Push the joint bolt up so lower spring retainer is free to tip. While tipping the lower spring retainer, lift the coil spring over the retainer.

Installation

1. For F-150-250-350 vehicles, install the spring and slowly raise the axle.

On E-150-250-350 vehicles, tip the spring over the loosely attached lower spring retainer and orient the insulator's "D shape" into the springs' bottom coil. Slowly raise the axle and orient the springs' upper coil into the front spring towers' helix.

2. On F-150-250-350 vehicles, position the spring lower retainer over the stud, lower insulator and seat, and install attaching nut.
3. Position the upper retainer over the spring coil and against the spring upper seat, and install attaching screw.

4. Tighten the upper retainer attaching and lower retainer attaching nut to specifications as follows:

F-150-250-350

Upper Retainer, 18-24 N·m (13-18 ft-lb)

Lower Retainer, 95-135 N·m (70-100 ft-lb)

E-150-250-350

Upper Retainer, 25-35 N·m (19-26 ft-lb)

Lower Retainer, 255-345 N·m (191-245 ft-lb)

5. On F-150-250-350 vehicles, connect the shock absorber to the lower bracket. Install the lower bolt with the head towards the tire and tighten the nut to 70-100 N·m (52-74 ft-lb).

On E-150-250-350 vehicles, connect the shock absorber to the radius arm stud and tighten to 68-92 N·m (50-68 ft-lb).

6. Install the wheel and tire assembly. Refer to Section 04-04. Remove the jack and safety stands and lower the vehicle.

Front Spring, F-Super Duty Chassis Cab, Commercial Chassis and Motorhome Chassis Vehicles

Refer to the following illustrations and procedure for front spring removal and installation.

Removal

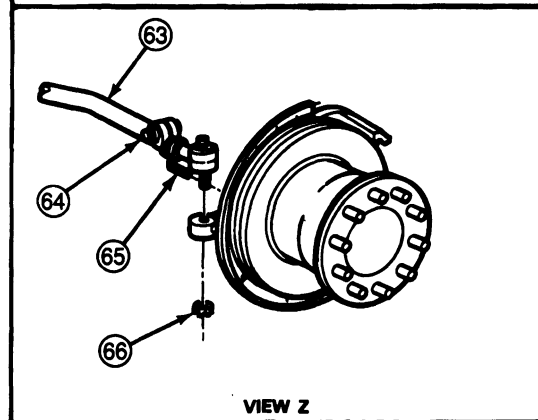
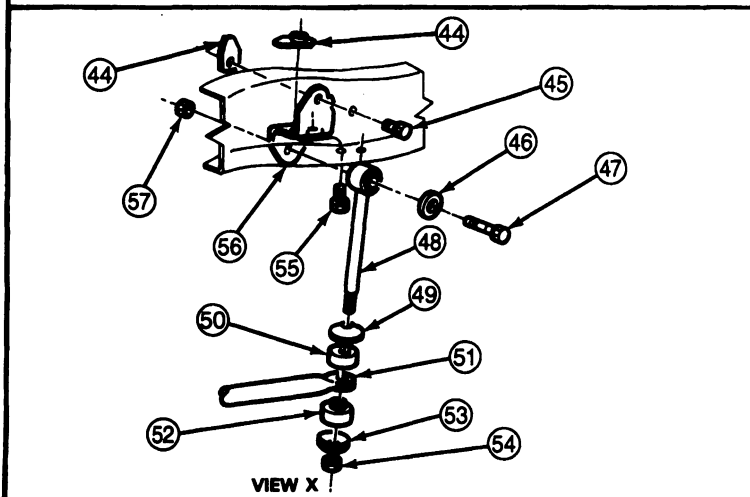
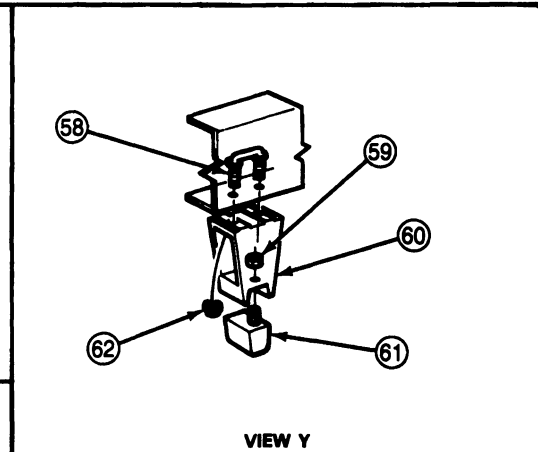
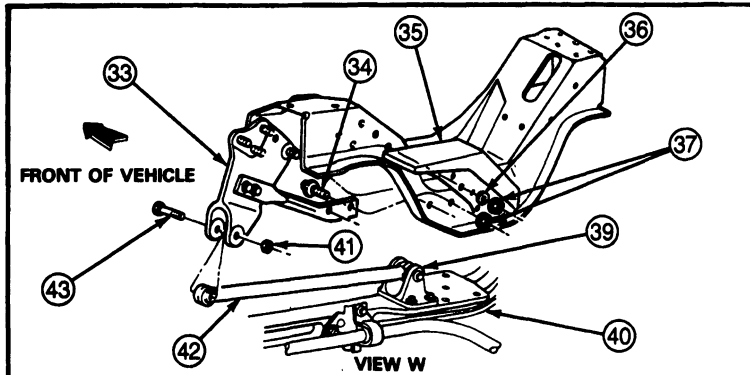
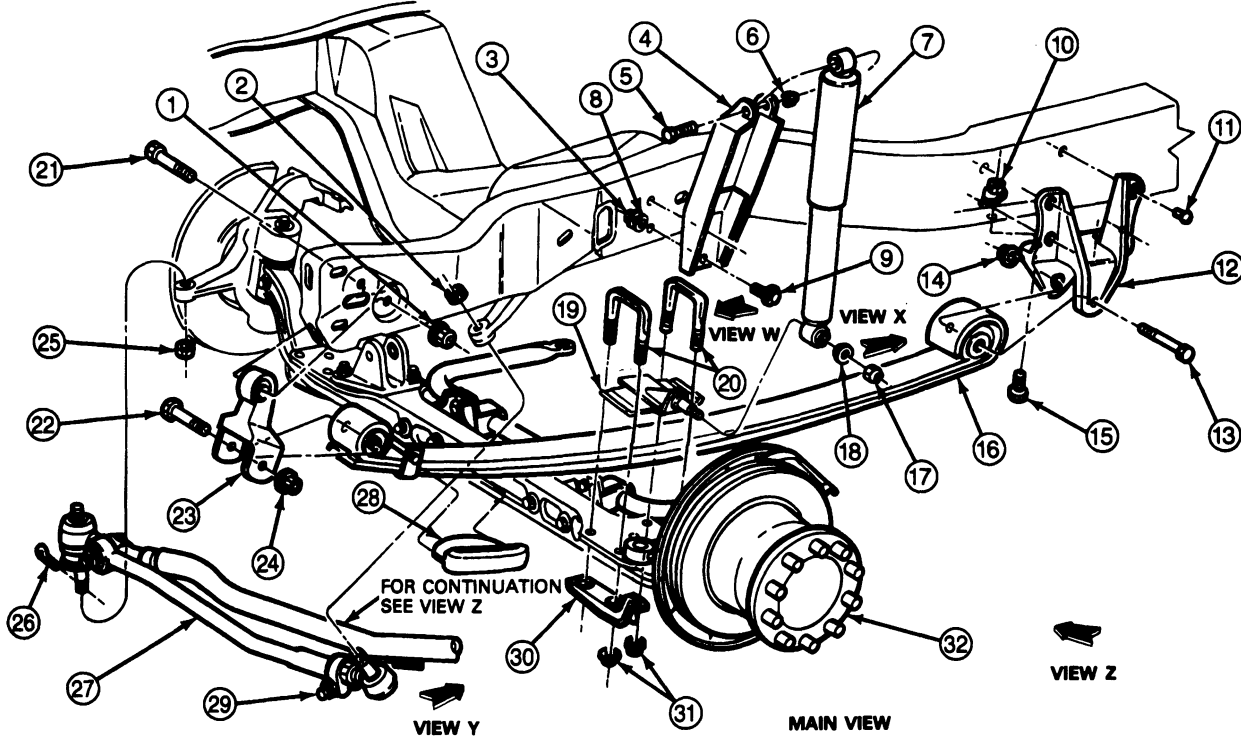
1. Raise vehicle frame until the weight is off the front springs with wheels still touching floor.
2. Support front axle with jacks to remove weight from the spring U-bolts.

REMOVAL AND INSTALLATION (Continued)

- | | |
|---|---|
| <ol style="list-style-type: none">3. Remove shock absorber-to-the spring spacer nut and washer. Disconnect the shock absorber from the spring spacer.4. Remove spring-to-the front spring shackle nut and bolt.5. Remove spring-to-the front spring bracket nut and bolt. | <ol style="list-style-type: none">6. Remove the four U-bolt nuts. Remove the jack bracket or stabilizer bar bracket. Remove the U-bolts.7. Remove the spring from the vehicle. |
|---|---|

REMOVAL AND INSTALLATION (Continued)

Front Spring, Shock Absorber and Tracking Bar, F-Super Duty Chassis Cab



F6253-F

REMOVAL AND INSTALLATION (Continued)

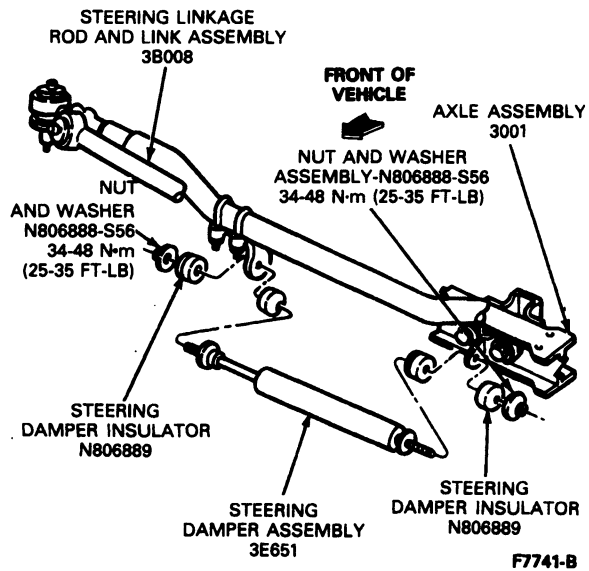
Item	Part Number	Description
1	N620485	Nut 203-285 N-m (150-210 Ft-Lb)
2	N800895	Nut 70-100 N-m (52-74 Ft-Lb)
3	N620483	Nut 70-100 N-m (52-74 Ft-Lb)
4	18035	Upper Shock Bracket
5	N800021	Bolt
6	N620469	Nut 70-100 N-m (52-74 Ft-Lb)
7	18045	Shock Absorber
8	N801527	Washer
9	N802115	Bolt
10	N805007	Retainer and Nut
11	N647101	Rivet
12	5341 (LH) 5340 (RH)	Spring Bracket
13	N601528	Bolt
14	N620485	Nut 203-285 N-m (150-210 Ft-Lb)
15	N802115	Bolt 104-149 N-m (77-110 Ft-Lb)
16	5310	Spring
17	—	Nut 70-100 N-m (52-74 Ft-Lb)
18	18040	Washer
19	5458	Spring Spacer
20	805445	U-Bolt
21	N601522	Bolt
22	N800911	Bolt
23	5K316	Spring Shackle
24	N620484	Nut 163-203 N-m (120-150 Ft-Lb)
25	N800895	Nut 70-100 N-m (52-74 Ft-Lb)
26	N642569	Cotter Pin
27	38008	Rod and Link Assembly
28	5L302	Insulator
29	—	Nut 81-122 N-m (60-90 Ft-Lb)
30	17A028 (RH) 17A029 (LH)	Jack Bracket
31	N620485	Nut 115-163 N-m (85-120 Ft-Lb)

Item	Part Number	Description
32	3001	Axle Assembly
33	3B241	Track Bar Bracket
34	N806158-S100	Bolt
35	6061	LH Engine Mount 7.5L Engine Only
36	630090-S2	Washer
37	N801670-S151	Nut 149-201 N-m (107-148 Ft-Lb)
39	—	Nut 149-201 N-m (107-148 Ft-Lb)
40	3001	Front Axle
41	N620604-S100	Nut 149-201 N-m (107-148 Ft-Lb)
42	3B239	Track Bar
43	N803960-S2	Bolt
44	N802158	Nut 48-68 N-m (35-50 Ft-Lb)
45	N605546	Bolt
46	N801527	Washer
47	N605704	Bolt
48	5K483	Link
49	18171	Upper Washer
50	4A037	Insulator
51	—	Stabilizer Bar
52	4A037	Insulator
53	18041	Lower Washer
54	384485	Nut 21-32 N-m (15-25 Ft-Lb)
55	N605546	Bolt
56	5C495	Front Stabilizer Link Mounting
57	N620469	Nut 70-100 N-m (52-74 Ft-Lb)
58	N805008	U-Bolt
59	N620468	Nut 25-40 N-m (18-30 Ft-Lb)
60	3B251	Bumper Mounting Bracket
61	4002	Bumper Assembly
62	N620483	Nut 70-100 N-m (52-74 Ft-Lb)
63	38008	Steering Linkage Assembly
64	—	Nut 81-122 N-m (60-90 Ft-Lb)
65	N642569	Cotter Pin
66	N800895	Nut 70-100 N-m (52-74 Ft-Lb)

(Continued)

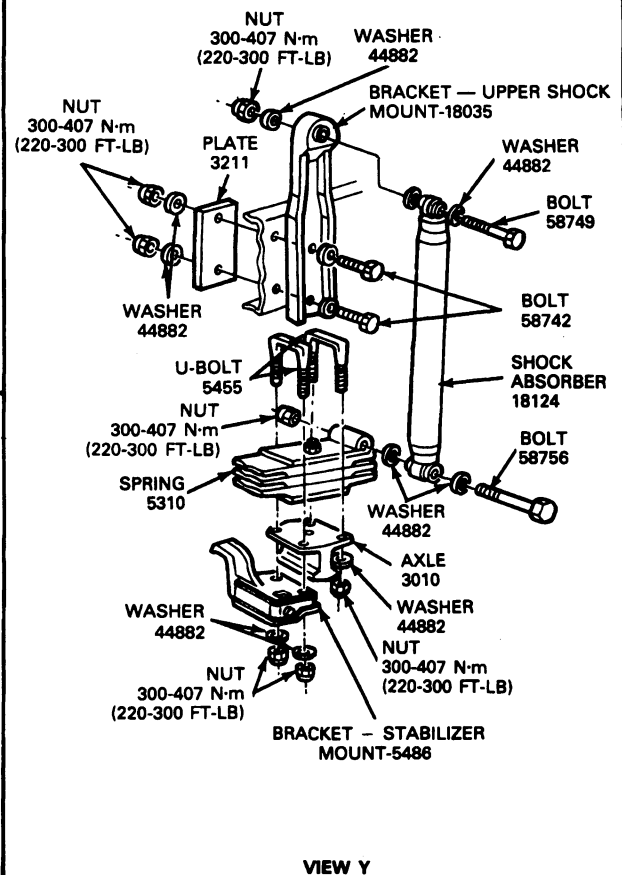
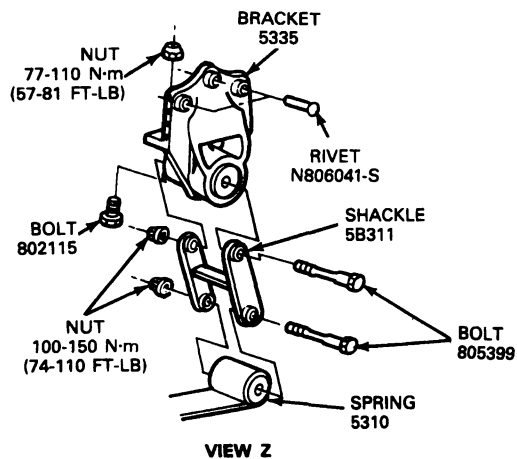
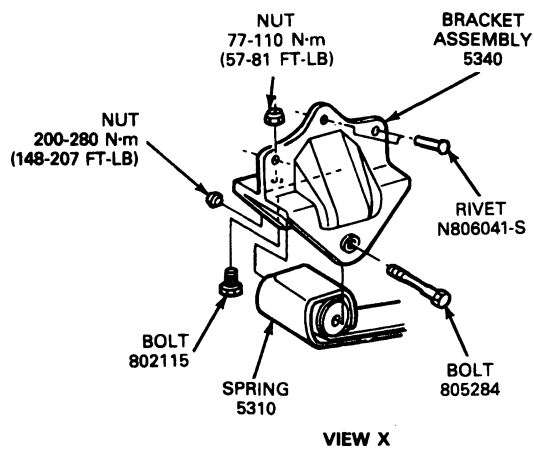
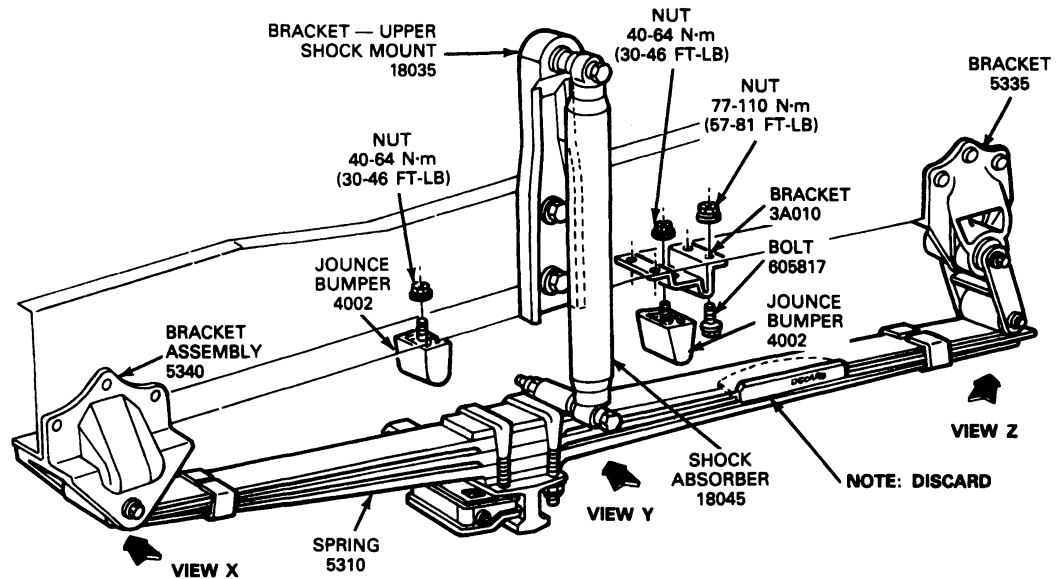
REMOVAL AND INSTALLATION (Continued)

Steering Damper, F-Super Duty Chassis Cab



REMOVAL AND INSTALLATION (Continued)

Front Spring and Shock Absorber, F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles



F6452-D

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Position the spring at the spring seat on the front axle and align the spring eye with mating hole in front spring shackle.
2. Prior to installation, coat the bushing with Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent.
3. Gently guide the bolt through the shackle and spring eye.
4. Install the retaining nut. On F-Super Duty Chassis Cab Vehicles, tighten to 163-203 N·m (120-150 ft-lbs). On F-Super Duty Commercial and Motorhome vehicles, tighten the nut to 100-150 N·m (74-100 ft-lb).
5. Align the spring eye with mating hole in spring bracket.
6. Coat the bushing with Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent.
7. Gently guide the bolt through the bracket and spring eye. Install the retaining nut. Tighten nut to 203-285 N·m (150-210 ft-lb).
8. Position the spring spacer on the locating boss in the spring (Chassis Cab only).
9. Install the U-bolts.
10. Install the jack bracket or stabilizer bar bracket on the forward U-bolt.
11. Install the four U-bolt nuts to 115-163 N·m (85-120 ft-lb) for F-Super Duty Chassis Cab vehicles, and to 300-407 N·m (220-300 ft-lb) for F-Super Duty Commercial and Motorhome Chassis vehicles.
12. Install shock to spring spacer nut and washer. Install shock absorber to the spring spacer. Tighten to 70-100 N·m (52-74 ft-lb) on F-Super Duty Chassis Cab and to 300-407 N·m (200-300 ft-lb) on F-Super Duty Commercial and Motorhome Chassis vehicles.
13. Remove the jacks from under the front axle.
14. Lower the vehicle.

Front Shock Absorber**E-150-250-350**

CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kPa (135 psi). Do not attempt to open, puncture or apply heat to the shock absorbers.

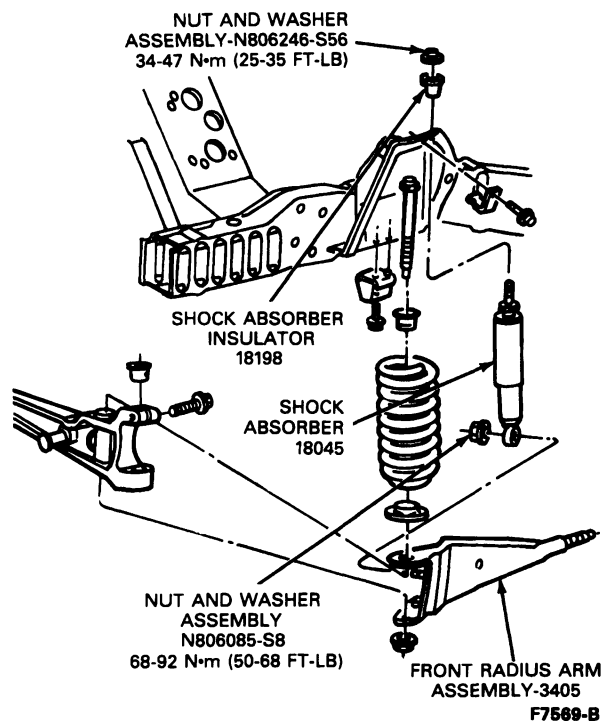
Removal

1. Insert a medium-depth socket from the front side of the spring upper seat, or insert a wrench from the rear side of the spring upper seat to hold the shock absorber upper retaining nut.
2. Loosen the stud by turning the hex provided on the exposed (lower) part of the stud and remove the nut.

3. Disconnect the lower end of the shock absorber from the lower bracket bolt and nut.
4. Remove the shock absorber, washers and rubber insulators.

Installation

1. When installing a new shock absorber, use a new rubber insulator. Push the insulator down through the hole in the spring tower.
2. Place the shock absorber's bayonet into the upper insulator and slide the shock's lower bushing over the radius arm stud. Tighten the shock absorber lower nut and washer assembly to 68-92 N·m (50-68 ft-lb).
3. While holding the nut as described in Step 1 of Removal, tighten to 34-47 N·m (25-35 ft-lb) by turning the hex provided on the stud.

**F-150-250-350**

CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kPa (135 psi). Do not attempt to open, puncture or apply heat to the shock absorbers.

Removal

1. Insert a wrench from the rear side of the upper spring seat to hold the shock absorber retaining nut in place.
2. Loosen the stud by turning the hex provided on the exposed (lower) part of the stud and remove the nut and washer.
3. Disconnect the lower end of the shock absorber from the lower bracket by removing the nut and bolt.

REMOVAL AND INSTALLATION (Continued)

4. Compress the shock absorber and remove from vehicle.
5. Cut out the insulator from the upper spring seat.

Installation

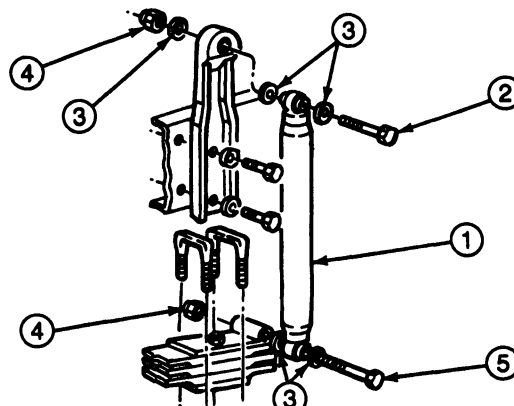
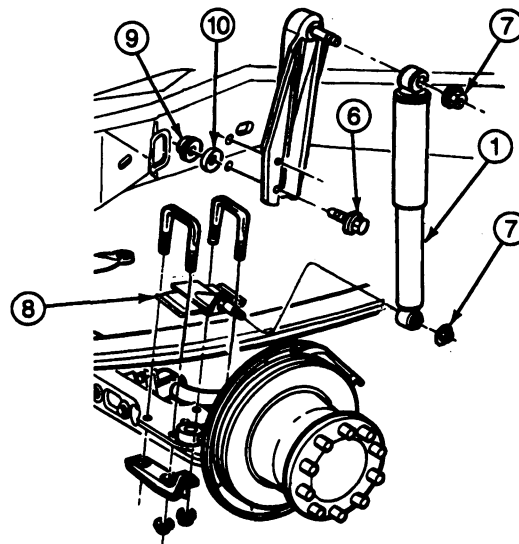
1. Coat the upper spring seat with a soap solution and install a new one-piece insulator in the seat.
2. Insert the upper shock absorber stud through the insulator.
3. Install the steel washer and hand start the nut.
4. Insert a wrench from the rear of the upper spring seat to hold the upper nut stationary.
5. Tighten the hex on the shock absorber to 34-48 N-m (25-35 ft-lb).
6. Position the shock absorber in the lower bracket. Install the bolt so the bolt head faces the tire. Install the nut and tighten to 70-100 N-m (52-74 ft-lb).

F-Super Duty Chassis Cab, Commercial Chassis and Motorhome Chassis Vehicles**Removal**

1. Remove shock absorber nut and bolt to the upper shock bracket.
2. Remove shock absorber nut and bolt to the eyes on the spring spacer.
3. Remove the shock absorber from the vehicle.

Installation

1. Position the shock absorber in the upper shock bracket. Install the nut and bolt and tighten to specification as follows.
2. Position the lower end of the shock absorber in the spring spacer eyes. Install the nut and bolt and tighten to specification as follows.
 - F-Super Duty Chassis Cab Upper and Lower, 53-72 N-m (39-53 ft-lb).
 - F-Super Duty Commercial and Motorhome Upper and Lower, 300-407 N-m (220-300 ft-lb).

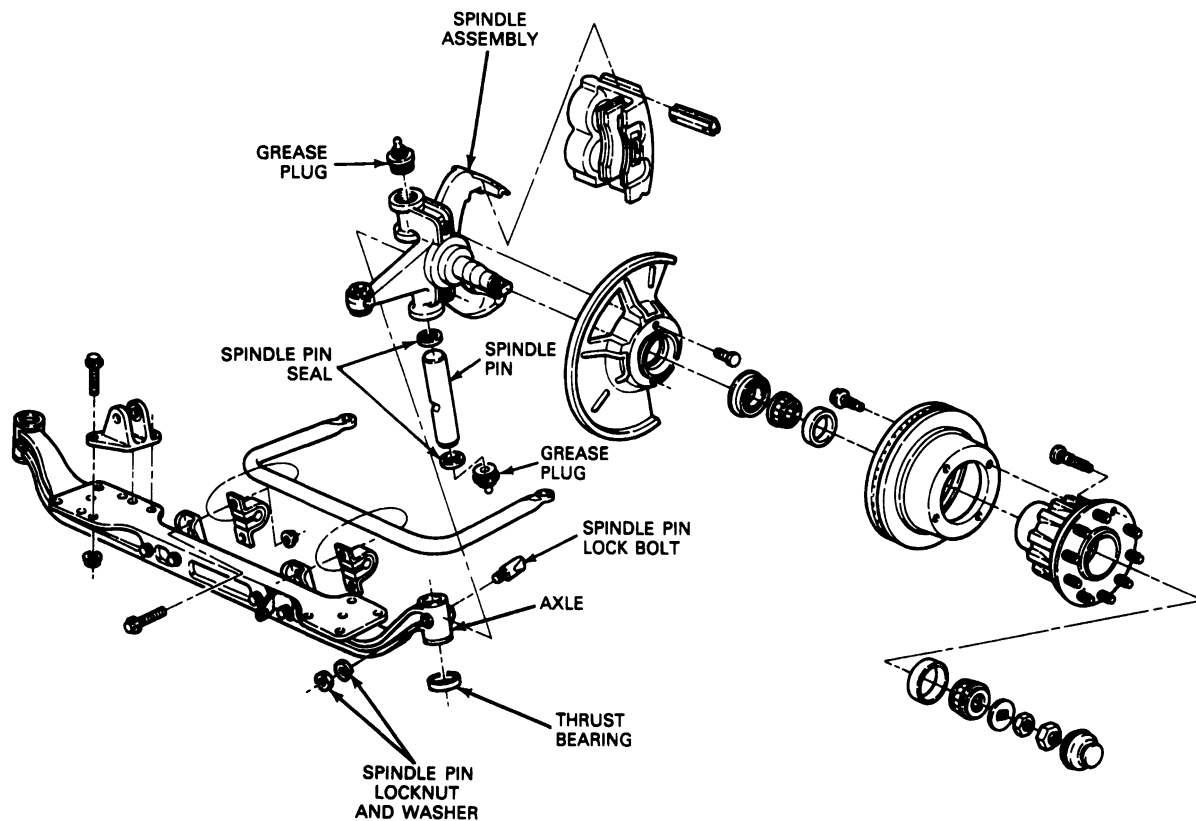
F-Super Duty Chassis Cab, Commercial Chassis and Motorhome Chassis Vehicles**F-SUPER DUTY COMMERCIAL AND MOTORHOME CHASSIS VEHICLES****F-SUPER DUTY CHASSIS CAB VEHICLES****F7571-B**

Item	Part Number	Description
1	18045	Shock Absorber
2	58749-S2	Bolt 3/4-10 x 4.0 Hex Head
3	383053-S2	Washer
4	34992-S2	Nut 3/4-10 Hex Flange 300-407 N-m (220-300 Ft-Lb)
5	58756-S2	Bolt 3/4-10 x 7.0 Hex Head
6	N802115-S2	Bolt
7	N806496-S100	Nut and Washer M12-1.75 Hex 53-72 N-m (39-53 Ft-Lb)
8	5458	Spacer, Front Spring Plate
9	N620483-S2	Nut 87-103 N-m (64-76 Ft-Lb)
10	N801527-S2	Washer

TF7571A

REMOVAL AND INSTALLATION (Continued)**Front Wheel Spindle****F-Super Duty****Removal**

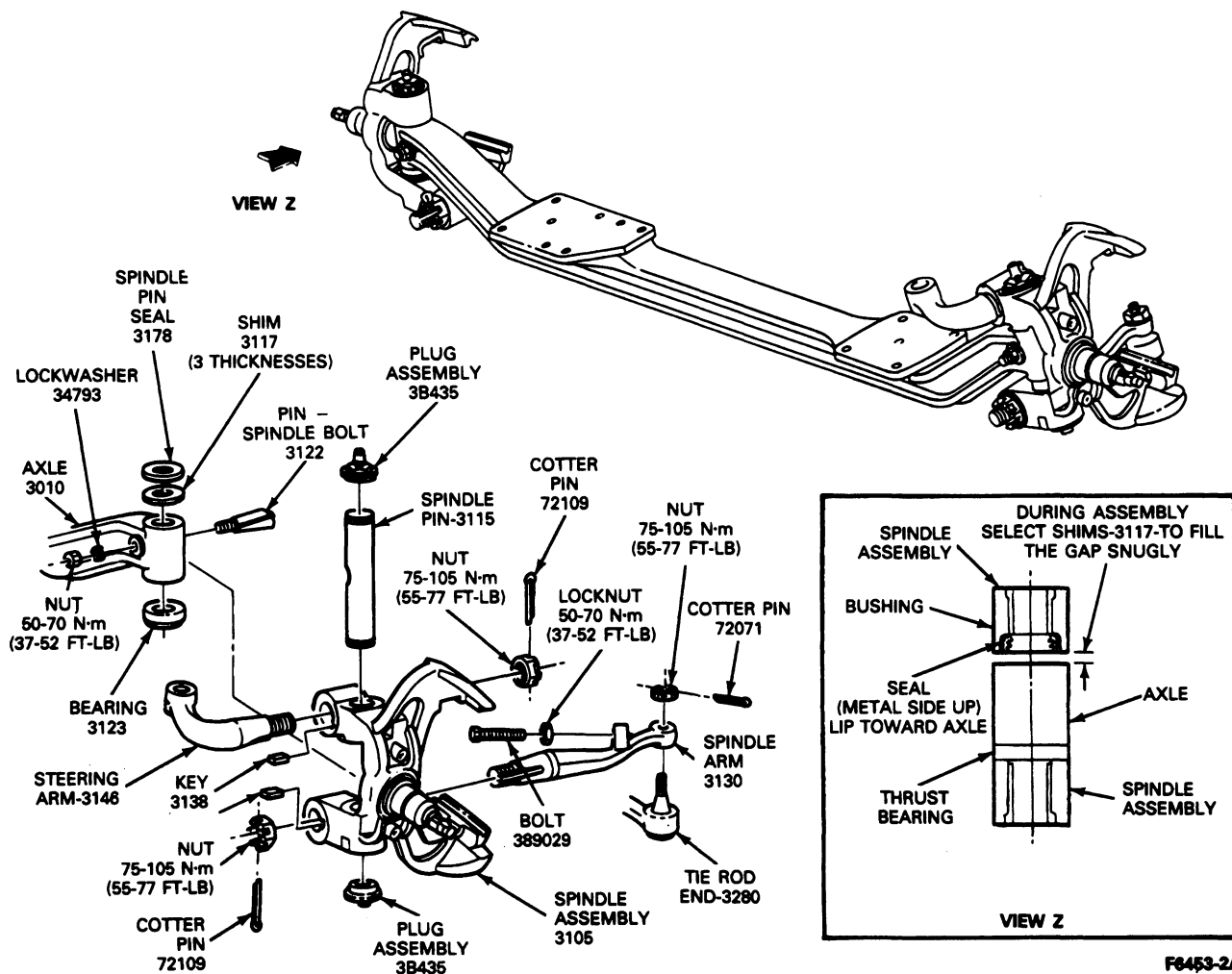
1. Raise the front of the vehicle and install safety stands.
2. Remove the wheel and tire assembly. Refer to Section 04-04.
3. Remove the caliper assembly from the rotor and wire it out of the way. Refer to Section 06-03.
4. Remove the dust cap, cotter pin, nut retainer, nut, washer, and outer bearing.
5. Remove the rotor from the spindle.
6. Remove inner bearing cone and seal. Discard the seal.
7. Remove brake dust shield. Refer to Section 06-03.
8. Disconnect the steering linkage from the spindle arm by removing the cotter pin and nut, and remove tie rod end from the spindle arm with Tie Rod End Remover, TOOL-3290-D.
9. On Commercial Chassis and Motorhome Chassis vehicles, disconnect the drag link from the steering arm (left side) with Tie Rod End Remover TOOL-3290-D.
10. Remove lock pin nut and lockwasher. Remove the lock pin.
11. Remove the upper and lower spindle pin plugs.
12. Using an appropriate punch, drive the spindle pin out from the top of the axle.
13. Remove the spindle and thrust bearing.
14. Remove the spindle pin seal and thrust bearing.

Front Wheel Spindle Installation, F-Super Duty with Spindle Pins

F6254-B

REMOVAL AND INSTALLATION (Continued)

Front Wheel Spindle Installation, Typical F-Super Duty Commercial Chassis and Motorhome Chassis

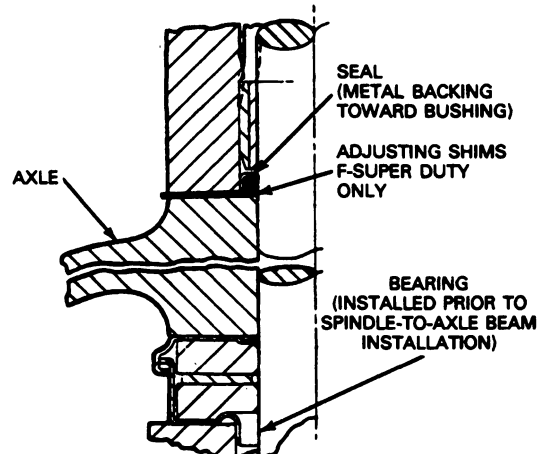


F6453-2A

Installation

1. Make sure the spindle pin hole in the axle is free of nicks, burrs, corrosion or foreign material. Clean bore as necessary and lightly coat the surface with a lithium-base grease, Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent.
2. Install a new spindle pin seal with the metal backing facing up towards the bushing into the spindle as shown.
3. Gently press seal into position; do not distort the casing.
4. Install a new thrust bearing with the lip flange facing down towards the lower bushing as shown.
5. Press until the bearing is firmly seated against the surface of the spindle.

Bearing Seal Installation, E-150-250-350 and F-Super Duty, Typical



F1489-1C

REMOVAL AND INSTALLATION (Continued)

6. Lightly coat the bushing surfaces with grease and place the spindle in position on the axle.
7. Hold the spindle with thrust bearing in place tight against the axle and measure the space between the axle and the spindle at the top of the axle. If the vehicle uses shims, select the proper shims (3117) and install.
8. Install the spindle pin with the "T" stamped on one end towards the top. Align pin notch with lock pin hole in axle.
9. Insert the spindle pin through the bushings and axle from the top until the spindle pin notch and axle lock pin hole are aligned.
10. Install the lock pin with the threads pointing forward and the wedge groove facing the spindle pin notch. Firmly drive the lock pin into position and mount the lockwasher and nut. Tighten the nut to specifications.
11. Install the spindle pin plugs into the threads at the top and bottom of the spindle. Tighten the plugs to 48-67 N·m (35-50 ft-lbs).
12. Lubricate the spindle pin and bushings with Long-Life Premium Grease XG-1-C or -K (ESA-M1C75-B) or equivalent, through both fittings until grease is visible seeping past the upper seal at the top and from the thrust bearing slip joint at the bottom.

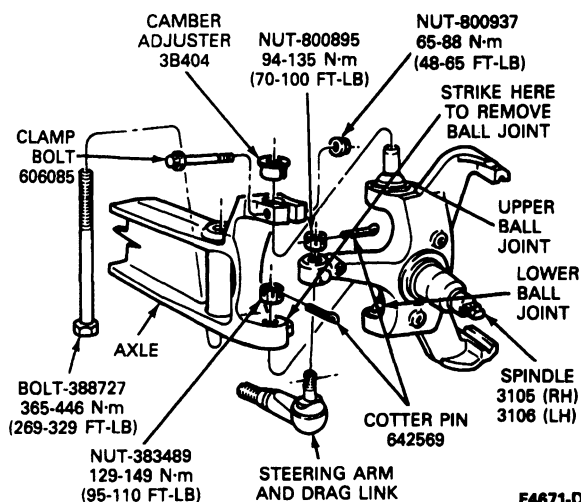
NOTE: If grease does not appear, recheck the installation procedure to correct the problem. Lack of adequate lubrication will result in rapid failure of the spindle components.

13. Install the dust shield. Refer to Section 06-03.
14. Pack the inner and outer bearing cone with bearing grease. Use a bearing packer. If a bearing packer is unavailable, pack the bearing cone by hand working the grease through the cage behind the rollers.
15. Install the inner bearing cone and seal as described in this section. Install the hub and rotor on the spindle.
16. Install the outer bearing cone, washer, and nut. Adjust bearing end play.
17. Install the nut retainer, cotter pin and dust cap as described in this section.
18. Install the caliper as described in Section 06-03.

19. Connect the steering tie rod and drag link to spindle, if equipped. Tighten the nut to specifications and advance the nut as required for installation of the cotter pin.
20. Install the wheel and tire assembly.
21. Lower the vehicle.
22. Check and, if necessary adjust the toe setting. Refer to Section 04-00. Check the brakes for proper operation.

F-150-250-350 4x2, E-150-250-350 with Ball Joints**Removal**

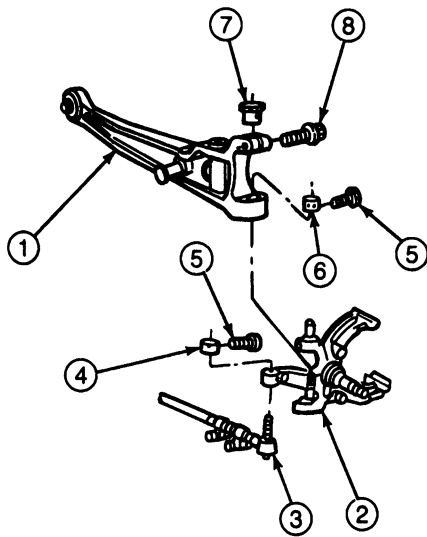
1. Raise the front of the vehicle and install safety stands.
2. Remove the wheel and tire assembly. Refer to Section 04-04.
3. Remove the caliper assembly from the rotor and wire it out of the way. Refer to Caliper Removal instructions in Section 06-03.
4. Remove the dust cap, cotter pin, nut retainer, nut, washer, and outer bearing.
5. Remove the rotor from the spindle.

Front Wheel Spindle Installation, F-150-250-350 4x2

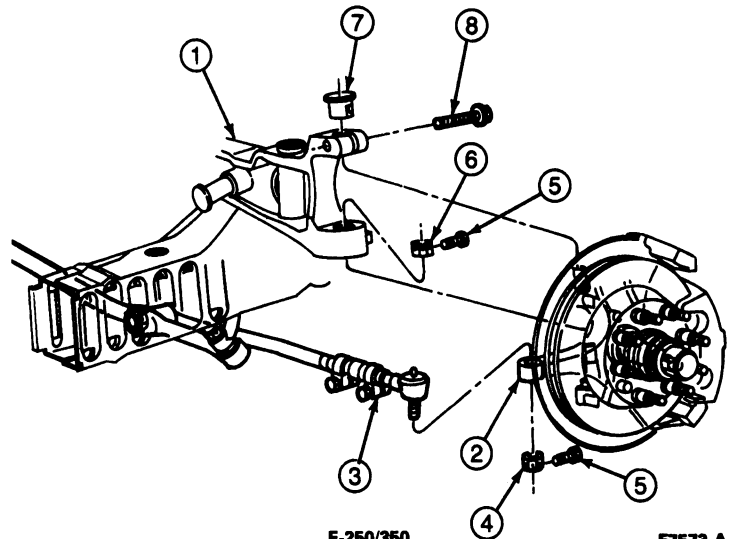
F4671-D

REMOVAL AND INSTALLATION (Continued)

Front Wheel Spindle Installation, E-150-250-350



E-150



E-250/350

F7573-A

Item	Part Number	Description
1	3007 / 6	Axle Assembly
2	3105 / 6	Spindle Assembly
3	3B008	Rod and Link Assembly, Steering
4	N800895-S56	Nut M14 x 2.0 Hex Slot
5	N642569-S36	Pin, Cotter

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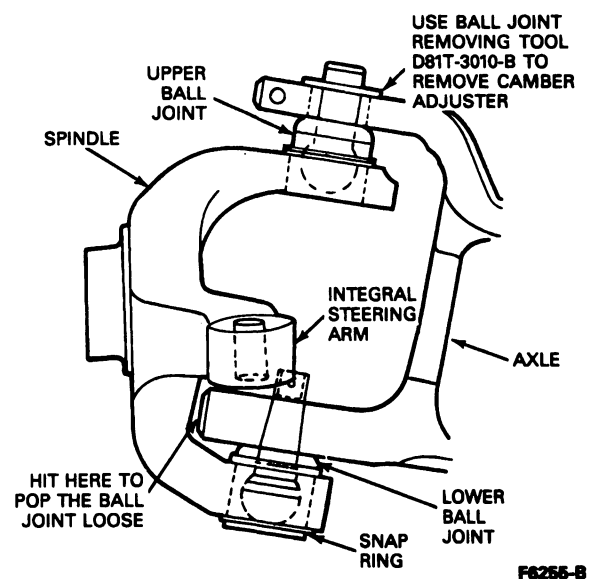
Item	Part Number	Description
6	383489-S100	Nut 3/4-16 Hex Slot 148-202 N-m (109-148 Ft-Lb)
7	3B404	Adjuster, Front Suspension, Upper
8	N806590-S2	Bolt M12-1.75 x 60 Hex Flange 87-119 N-m (64-88 Ft-Lb)

TF7573A

6. Remove inner bearing cone and seal. Discard the seal.
7. Remove brake dust shield. Refer to Section 06-03.
8. Disconnect the steering linkage from the integral spindle and spindle arm by removing the cotter pin and nut and then removing the tie rod end from the spindle arm with Tie Rod End Remover TOOL-3290-D.
9. Remove the cotter pin and castellated nut from the lower ball joint stud.
10. Remove the nut from the axle clamp bolt and remove the bolt from the axle.
11. Remove the camber adjuster from the upper ball joint stud and axle beam. If required, use Ball Joint Removing Tool D81T-3010-B or equivalent to remove adjuster.
12. Strike the inside area of the axle as shown to pop lower ball joints loose from the axle beam.

CAUTION: Do not use a pickle fork to separate the ball joint from the axle as this will damage the seal and the ball joint socket.

13. Remove the spindle and ball joint assembly from the axle.



F6255-B

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Place the spindle and the ball joints into the axle.
2. Install lower ball joint stud nut and tighten to 129-149 N·m (95-110 ft-lb) for F-150-250-350 vehicles, and to 148-202 N·m (109-148 ft-lb) for E-150-250-350 vehicles, and continue tightening the castellated nut until it lines up with the hole in the stud. Install the cotter pin.
3. Install the camber adjuster in the upper spindle over the upper ball joint stud. Align adjuster properly.
NOTE: If camber adjustment is necessary, special adjusters must be installed. Refer to Section 04-00.
4. Install the clamp bolt and nut into the axle boss. Tighten the nut to 65-88 N·m (48-65 ft-lb) for F-150-250-350 vehicles and to 87-119 N·m (64-88 ft-lb) for E-150-250-350 vehicles.
5. Install the dust shield. Refer to Section 06-03.
6. Pack the inner and outer bearing cone with a lithium-base grease, Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent. Use a bearing packer. If a bearing packer is unavailable, pack the bearing cone by hand working the grease through the cage behind the rollers.
7. Install the inner bearing cone and seal as described in this section.
8. Install the hub and rotor on the spindle.
9. Install the outer bearing cone, washer, and nut. Adjust bearing end play.
10. Install the nut retainer, cotter pin and dust cap as described in this section.
11. Install the caliper as described in Section 06-03.
12. Connect the steering linkage to the spindle. Tighten the nut to 94-135 N·m (70-100 ft-lbs) for F-150-250-350 vehicles, and to 70-100 N·m (52-74 ft-lb) for E-150-250-350 vehicles, and advance the nut as required for installation of the cotter pin.
13. Install the wheel and tire assembly.
14. Lower the vehicle.
15. Check, and if necessary, adjust the toe setting. Refer to Section 04-00.
16. Check the brakes for proper operation.

Camber Adjuster, F-150-250-350 4x2, E-150-250-350 with Ball Joints**Removal**

1. Raise the vehicle and remove the wheel and tire. Refer to Section 04-04.

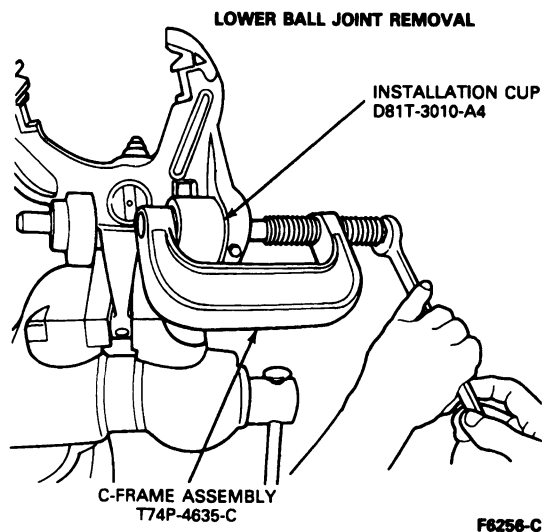
2. Remove the upper ball joint camber adjuster clamp bolt and nut. Remove the clamp from axle.
3. Remove the camber adjuster from the axle. Using Ball Joint Removing Tool D81T-3010-B or equivalent, wedge the adjuster out of the axle.

Installation

1. Install the correct camber adjuster (3B404) into the axle, aligning the slot in the adjuster.
2. Install the adjuster on the upper ball joint stud and tap the adjuster into the axle.
3. Install the clamp bolt and nut in the axle. Tighten the nut to 65-88 N·m (48-65 ft-lb) for F-150-250-350 vehicles, and to 87-119 N·m (64-88 ft-lb) for E-150-250-350 vehicles.

Upper and Lower Ball Joints, F-150-250-350 4x2, E-150-250-350**Removal**

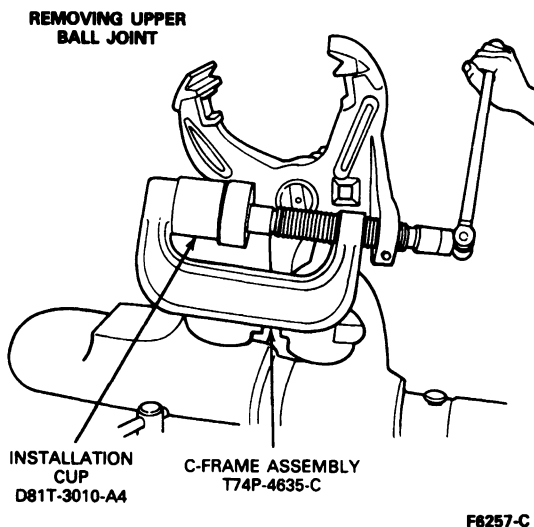
1. Remove the spindle and ball joint assembly from the axle as described in this section under Front Wheel Spindle, F-150-250-350 4x2, E-150-250-350 with Ball Joints.
2. Install the spindle assembly in a vise and remove the snap ring from the lower ball joint.
NOTE: Lower ball joint **must** be removed first.
3. Remove the lower ball joint from the spindle using C-Frame Assembly T74P-4635-C and Receiver Cup D81T-3010-A or equivalent.
4. Turn the forcing screw clockwise until the ball joint is removed from the spindle.



REMOVAL AND INSTALLATION (Continued)

5. Assemble C-frame assembly and receiver cup on the upper ball joint, and turn forcing screw clockwise until ball joint is removed from the spindle.

CAUTION: Do not heat the ball joint or the spindle to aid in removal.

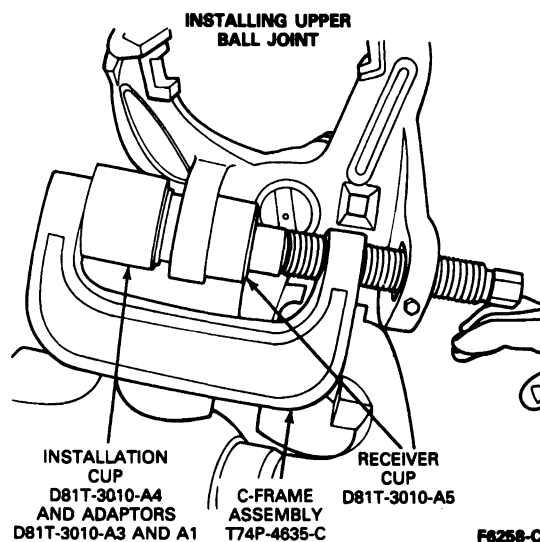
**Installation**

NOTE: Upper ball joint must be installed into the spindle first.

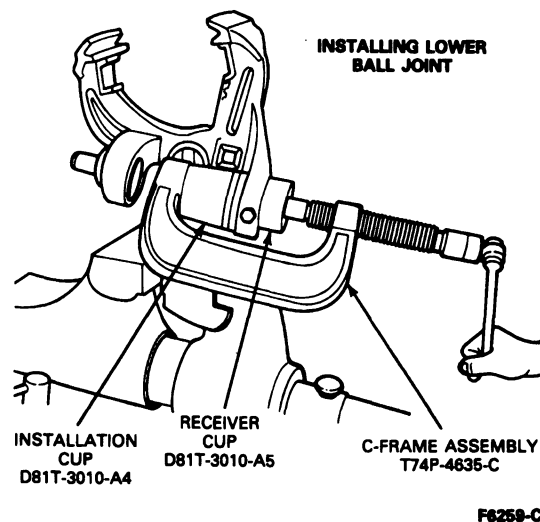
NOTE: Individual ball joint tools are included in Ball Joint Adapter Set D81T-3010-A.

1. To install the upper ball joint, assemble C-Frame Assembly, Ball Joint Receiver Cup D81T-3010-A5 and Installation Cup D81T-3010-A4 or equivalents inside cup D81T-3010-A4 or equivalent in position on the spindle.
2. Turn forcing screw clockwise until ball joint is seated.

CAUTION: Do not heat the ball joint or axle to aid in installation.



3. To install the lower ball joint, assemble the C-frame in position on the spindle and repeat Step 1.
4. Install the snap ring onto the ball joint.



5. Install the spindle and ball joint assembly as described in this section.

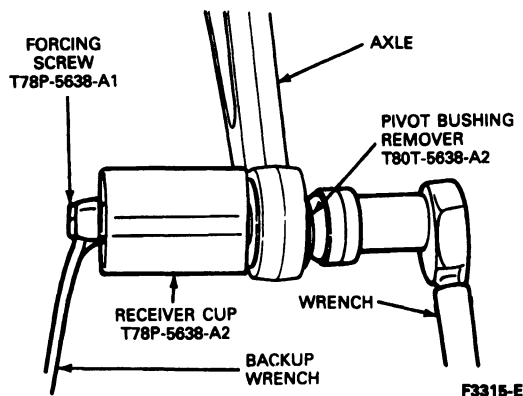
Axle Pivot Bushing**Removal**

NOTE: Individual bushing tools are included in Suspension Bushing Service Set T78P-5638-A.

1. Remove front coil spring as described in this section.
2. Remove the axle pivot nut and bolt.

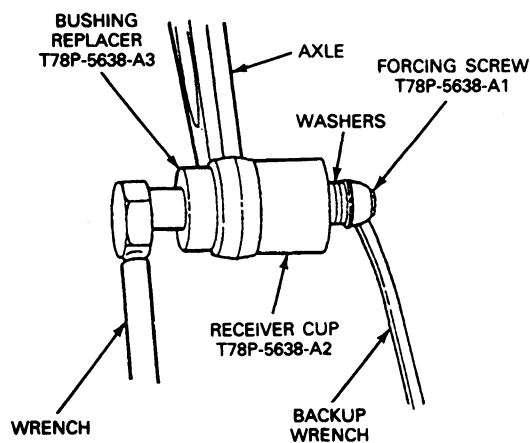
REMOVAL AND INSTALLATION (Continued)

3. Pull the pivot end of axle down until bushing is exposed.
4. Install Forcing Screw T78P-5638-A1, Bushing Remover T80T-5638-A2 and Receiver Cup T78P-5638-A4 onto pivot bushing.
5. Turn the forcing screw clockwise to remove the pivot bushing.

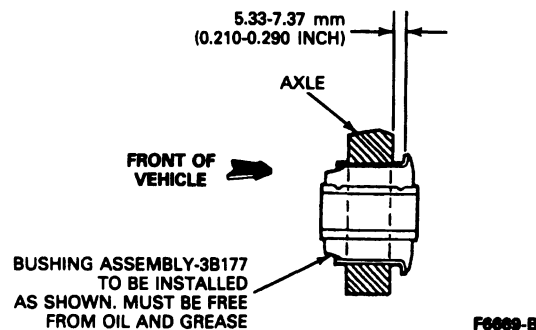
**Installation**

1. Place pivot bushing in axle. Assemble Receiver Cup T78P-5638-A2, Forcing Screw T78P-5638-A1 and Bushing Replacer T78P-5638-A3 as shown.
2. Add four to six washers between head of forcing screw and Bushing Replacer T78P-5638-A3.
3. Install bushing into axle, leaving 5.33-7.37mm (0.210-0.290 inch) gap between the shoulder of the bushing outer metal and the face of the I-beam as shown in the illustration.

NOTE: Bushing must be free of any grease or oil.



4. Position axle in pivot bracket and install axle pivot bolt through the bracket and axle. Install nut but do not tighten at this time.
5. Install spring, following the procedure in this section. Make sure spring is seated.
6. Lower vehicle and with the weight on the suspension, tighten pivot bushing bolt and nut to 163-203 N·m (120-150 ft-lbs) for F-150-250-350 vehicles, and to 148-202 N·m (109-148 ft-lb) for E-150-250-350 vehicles.

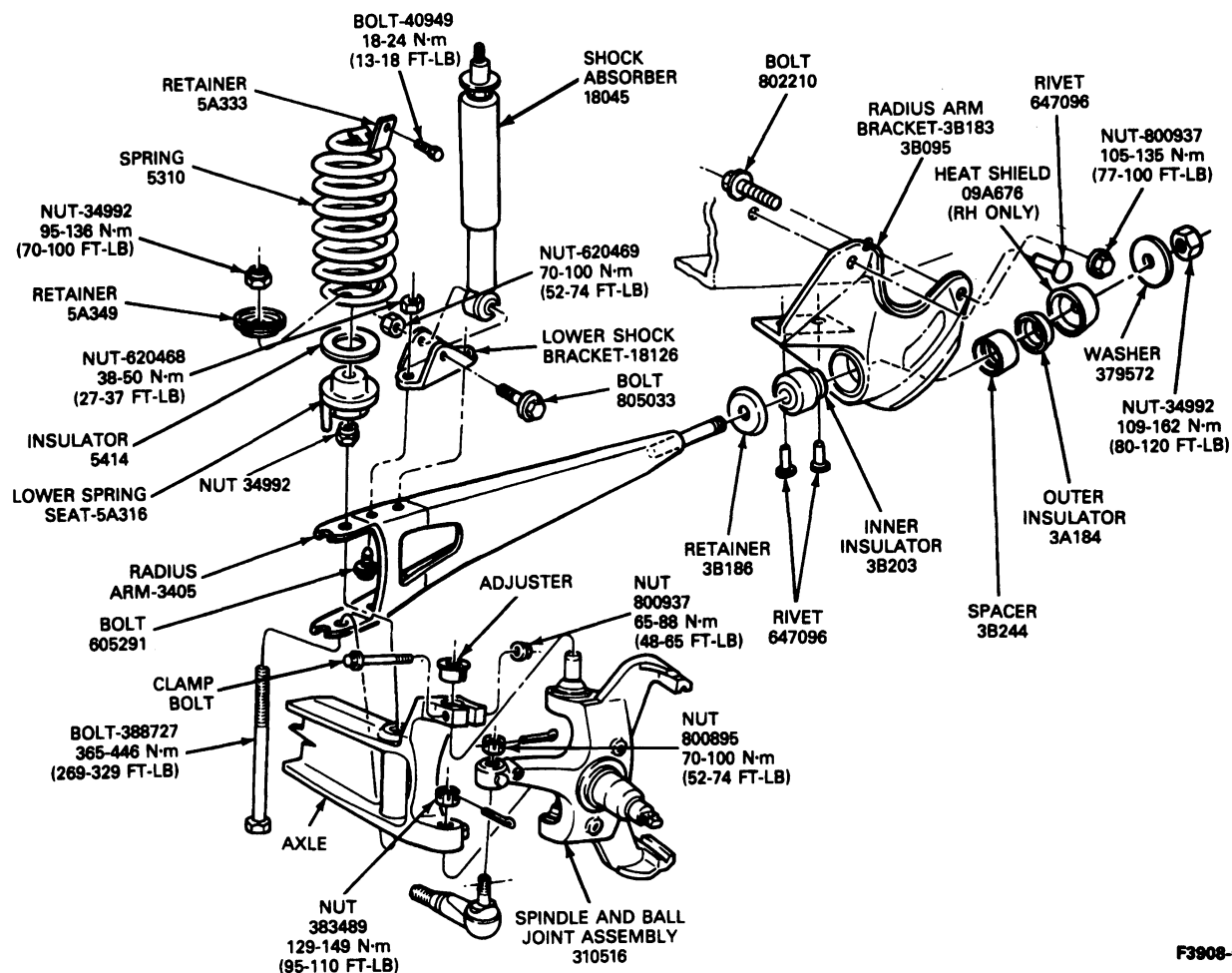
Axle Pivot Bushing Installed**Radius Arm****Removal**

1. Raise the front of the vehicle, and place safety stands under the frame. Place a jack under the axle.
2. Remove front tires.
3. Disconnect front stabilizer bar at the link, if so equipped.

NOTE: The axle must be supported on the jack throughout spring removal and installation, and must not hang by the brake hose. If the length of the brake hose is not sufficient to provide adequate clearance for removal and installation of the spring, the disc brake caliper must be removed from the spindle according to the procedures in Section 06-03. After removal, the caliper must be placed on the frame or otherwise supported to prevent suspending the caliper from the brake hose. These precautions are absolutely necessary to prevent serious damage to the tube portion of the caliper hose assembly.

REMOVAL AND INSTALLATION (Continued)

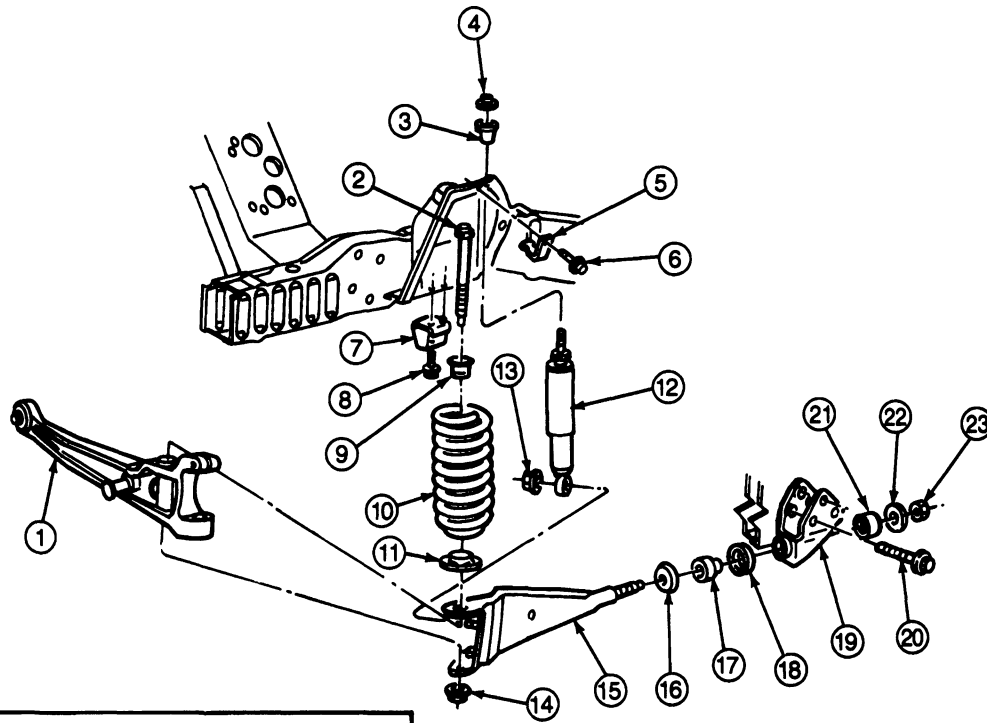
Radius Arm Installation, F-150-250-350 4x2



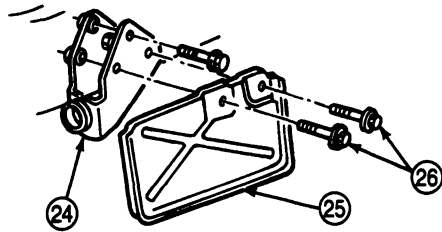
F3908-G

REMOVAL AND INSTALLATION (Continued)

Radius Arm Assembly, E-150-250-350



E-150 SHOWN

5.8L AND 7.5L ENGINES ONLY
VIEW V

F7567-A

REMOVAL AND INSTALLATION (Continued)**RADIUS ARM ASSEMBLY, E150-350 (LEGEND)**

Item No.	Part Number	Description
1	3007	Axle Assembly, Left Hand
2	N806592-S150	Bolt M20-2.5 x 206.6 Hex Flange E-250, E-350
	N806591-S150	Bolt M20-2.5 x 194.7 Hex Flange
3	18198	Insulator, Shock Absorber
4	N806246-S56	Nut and Washer Assembly 34-47 N·m (25-35 Ft-Lb)
5	5A333	Retainer, Front Spring, Upper
6	N802455-S2	Screw M8-1.25 x 28 Hex Flange 25-35 N·m (19-26 Ft-Lb)
7	3020	Bumper
8	N802455-S2	Screw M8-1.25 x 28 Hex Flange 25-35 N·m (19-26 Ft-Lb)
9	5A349	Retainer, Front Spring, Mounting, Lower
10	5310	Spring, Front Coil
11	5414	Insulator, Front Spring, Lower
12	18045	Shock Absorber
13	N806085-S8	Nut and Washer Assembly M12 x 1.75 68-92 N·m (50-68 Ft-Lb)

Item No.	Part Number	Description
14	N805028-S100	Nut M20-2.5 Hex Flange 255-345 N·m (191-245 Ft-Lb)
15	3405	Arm Assembly, Front Radius
16	3B186	Retainer, Front Radius Arm Bushing
17	3B203	Insulator, Front Radius Arm Bushing
18	3B244	Spacer, Front Radius Arm Bracket
19	3B243	Bracket, Radius Arm, Left Hand
20	N800898-S60	Bolt M12-1.75 x 110 Hex Flange 87-119 N·m (64-87 Ft-Lb)
21	3B203	Insulator, Front Radius Arm, Inner
22	37852	Washer 3/4 Inch
23	34992-S2	Nut 3/4-10 Hex 108-162 N·m (80-119 Ft-Lb)
24	3B094	Bracket, Radius Arm, Right Hand
25	3B463	Shield, Radius Arm, Insulator Heat
26	N800898-S60	Bolt M12-1.75 x 110 Hex Flange 87-119 N·m (64-87 Ft-Lb)

CF7575-A

4. Disconnect the lower end of the shock absorber from the shock lower bracket bolt and nut or stud.
5. Remove the front spring as outlined in this section.
6. Remove the spring lower insulator and seat from the radius arm.
7. Remove radius arm-to-axle bolt and nut.
8. Remove the nut, rear washer, insulator and spacer (F-150-250-350) from the rear side of the radius arm rear bracket.
9. Remove the radius arm from the vehicle, and remove the spacer (E-150-250-350) inner insulator and retainer from the radius arm stud.

NOTE: Inspect inner insulator for heat deterioration. Replace with new insulator, if necessary.

Installation

1. Position the front end of the radius arm to the axle. On F-150-250-350 vehicles, install the attaching bolt from underneath through the radius arm and axle, and then install the nut finger-tight. On E-150-250-350 vehicles, slide lower spring retainer and insulator onto attaching bolt. Install attaching bolt from top through radius arm and axle, and then install the nut finger-tight.
2. Install the retainer and inner insulator on the radius arm stud. Insert the stud through the rear bracket.
3. Install the spacer (F-150-250-350 vehicles), insulator, rear washer and nut on the arm stud at the rear side of the arm bracket. Tighten the nut to 109-162 N·m (80-120 ft-lb).

4. Install the retainer, inner insulator and spacer (E-150-250-350 vehicles), on the radius arm stud. Insert the stud through the radius arm rear bracket. Install the other insulator, washer and nut on the radius arm stud.
5. Tighten the nut on the radius arm to the axle bolt using the following torque: F-150-250-350, 365-446 N·m (269-329 ft-lbs) E-150-250-350, 255-345 N·m (191-245 ft-lbs).
6. Install the spring lower seat and spring insulator on the radius arm so hole in the seat goes over the arm-to-axle bolt (F-Series only).
7. Install the front spring described in this section.
8. Connect the lower end of the shock absorber to the lower bracket on the radius arm with the attaching bolt and nut (F-Series) or attaching nut (Econoline). On the F-150-250-350, the bolt head must be installed toward tire. Tighten the nut to 70-100 N·m (52-74 ft-lbs). On the E-150-250-350, tighten the nut to 68-92 N·m (50-68 ft-lb).
9. Reinstall front stabilizer bar to link (F-Series only). Tighten nut to 70-100 N·m (52-74 ft-lbs).
10. Install front brake calipers if removed. Refer to Section 06-03.
11. Install front tires. Refer to Section 04-04.
12. Lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

Radius Arm Rear Bracket, E-150-250-350

With the radius arm removed from the bracket, remove the three rear bracket-to-frame bolts and remove the bracket. Position the replacement bracket to the frame and install the three attaching bolts and nuts. **Do not completely tighten one at a time. Partially tighten all three and repeat in sequence until specified torque of 87-119 N·m (64-87 ft-lbs) is obtained for all.**

Jounce Bumper

F-150-250-350 and E-150-250-350

Removal

1. Remove hex head bolt (F-Series) or screw (Econoline) that holds jounce bumper to frame. Remove jounce bumper.

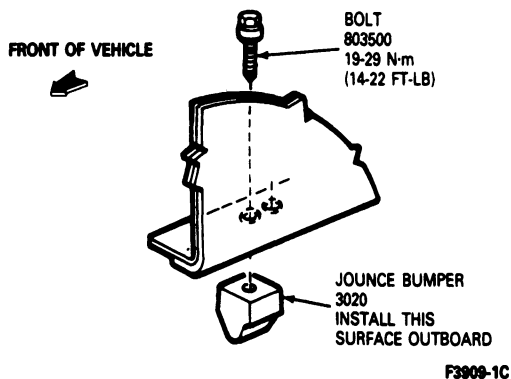
Installation

1. Place the jounce bumper in position under the frame and spring upper seat. For F-150-250-350 4x2 vehicles, position jounce bumper in rearward set of holes on right side of the frame.

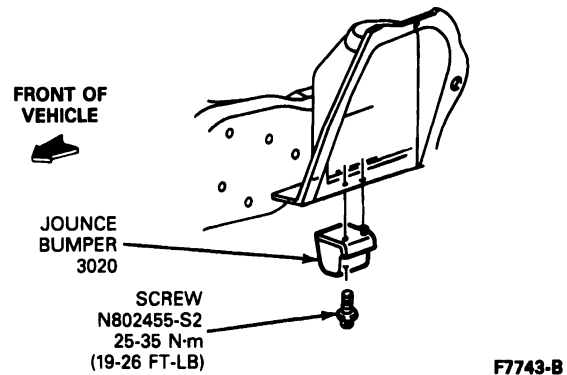
NOTE: The rearward set of holes are for F-150-250-350 4x2 vehicles only. The forward set of holes are for F-150 4x4 and Bronco only.

2. Install bolt or screw and tighten to 19-29 N·m (14-22 ft-lbs) for F-150-250-350, 25-35 N·m (19-26 ft-lbs) for E-150-250-350.

Jounce Bumper Installation, F-150-250-350



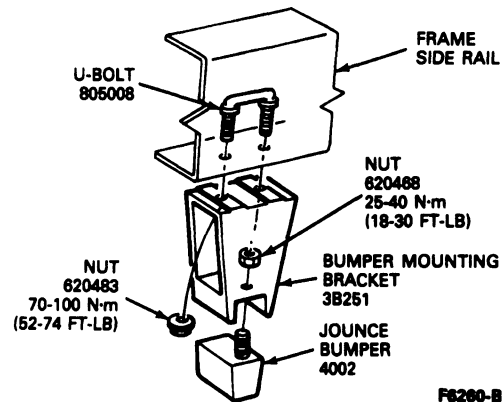
Jounce Bumper Installation, E-150-250-350



F-Super Duty Chassis Cab

Removal and Installation

1. Raise vehicle on a hoist and position suitable safety stands under vehicle.
2. Remove the attaching nut and remove the jounce bumper from the bracket.
3. Position the jounce bumper and install the attaching nut. Tighten nut to 25-40 N·m (18-30 ft-lb).
4. Remove safety stands and lower vehicle.



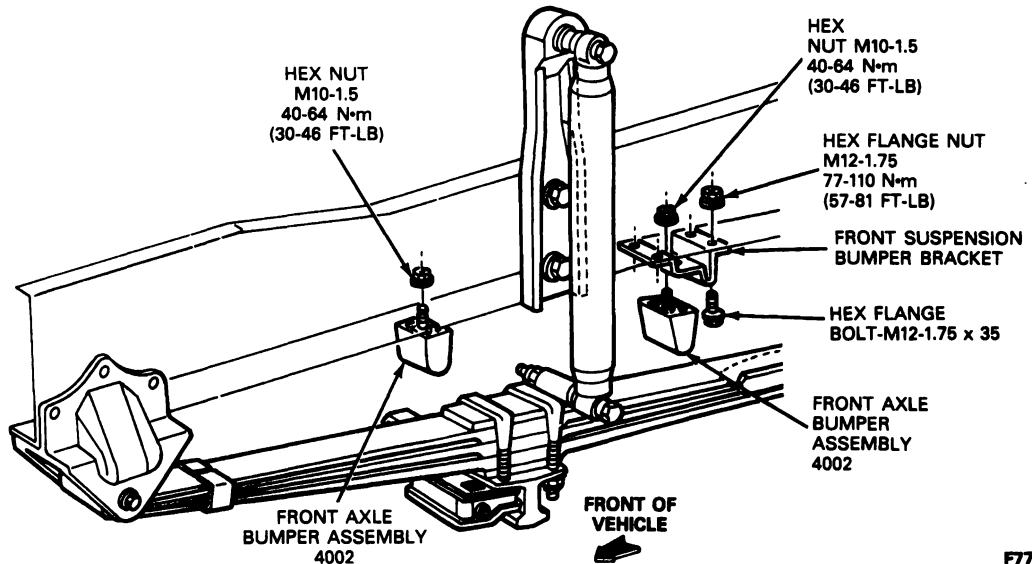
F-Super Duty Commercial and Motorhome Chassis

Removal and Installation

Remove attaching nut and remove jounce bumper from the frame or bracket. Install the replacement bumper and attaching nut. Tighten nut to 40-64 N·m (30-46 ft-lb).

REMOVAL AND INSTALLATION (Continued)

Jounce Bumper Installation, F-Super Duty Commercial and Motorhome Chassis



F7701-B

Axle Pivot Bracket (Right Side)

Removal

1. Remove the front coil spring as described in this section.
2. Remove the axle pivot nut and bolt. Pull the pivot end of the axle down and out of the bracket.
3. Remove the four attaching nuts and bolts and remove the axle pivot bracket.

Installation

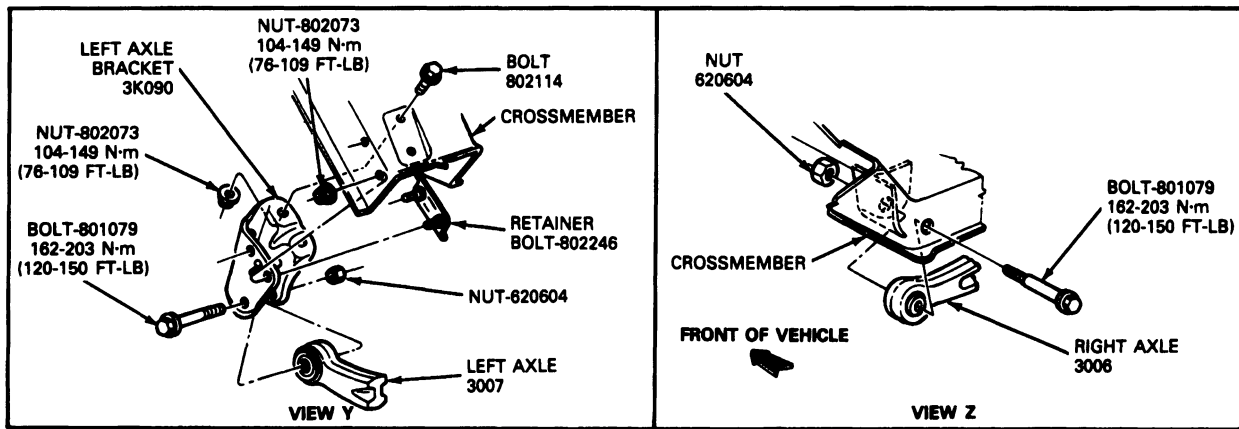
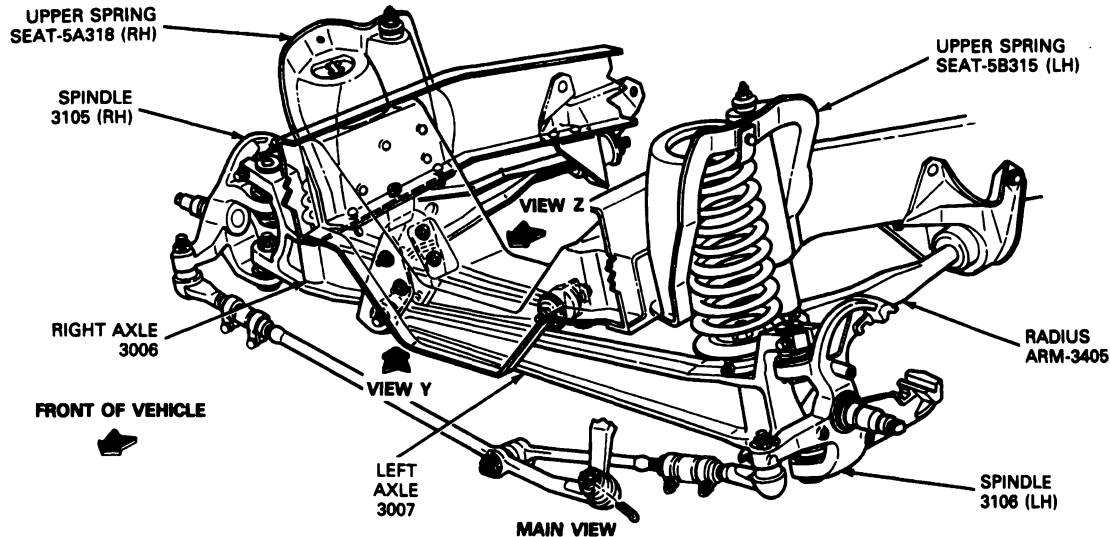
1. Position the axle pivot bracket to the crossmember. Loosely install the bolts, bolt and retainer nuts. Do not tighten at this time.

NOTE: The two rearward vertical bolts must be installed with the bolt heads next to the engine oil pan to maintain the required clearance. The bolt and retainer assembly must be installed with the bolt heads on the inside surface of the pivot bracket.

2. To obtain correct positioning of the axle pivot brackets, tighten the two forward (horizontal) fasteners to 149 N·m (110 ft-lbs) first. Then, tighten the two rearward (vertical) bolts and nuts (at top of crossmember) to 149 N·m (110 ft-lbs).
3. Install the front coil spring as described in this section.

REMOVAL AND INSTALLATION (Continued)

Axle Pivot Bracket, F-150-250-350 4x2



F3910-C

Front Stabilizer Bar

E-150-250-350

Removal

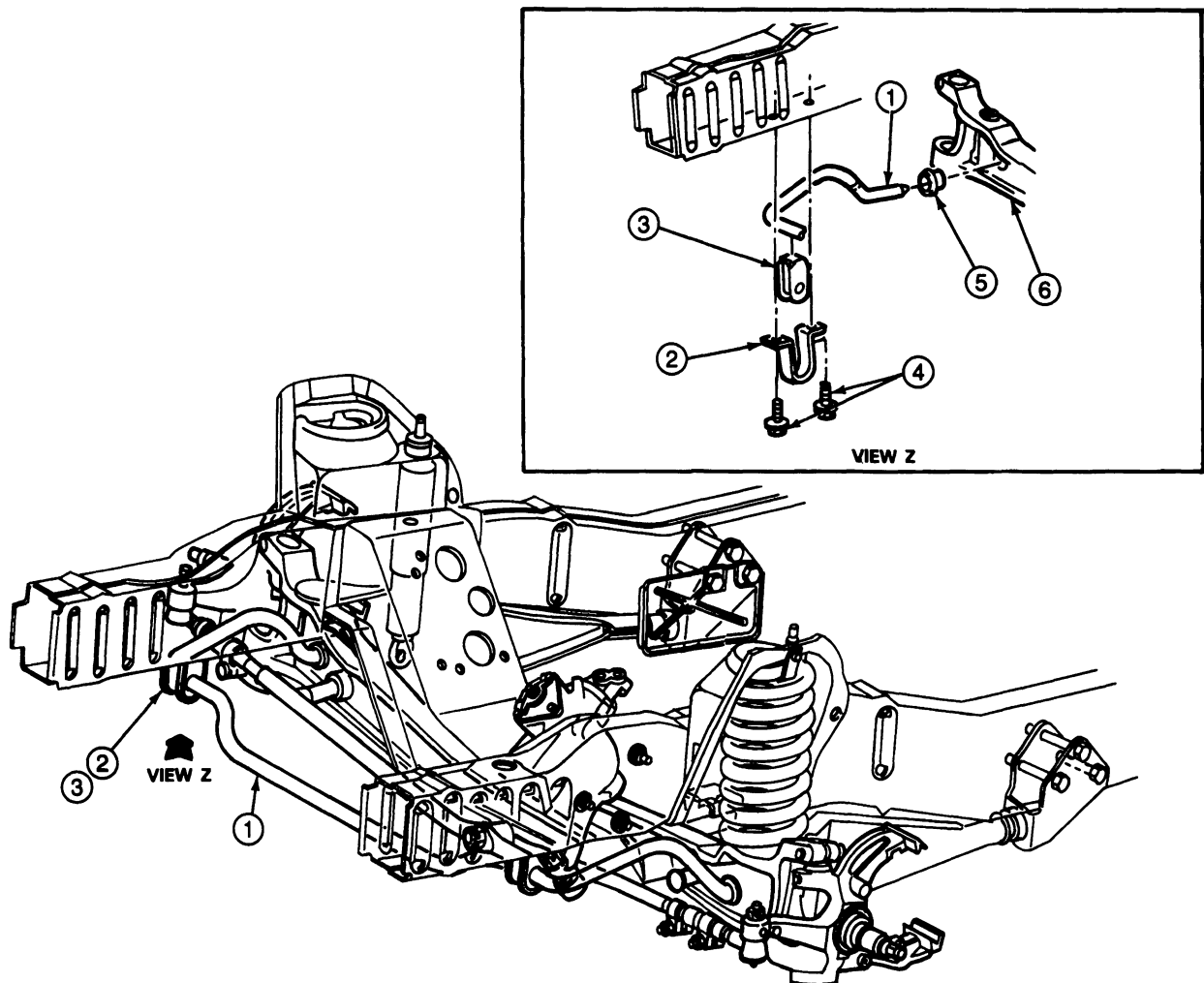
1. Raise vehicle on a hoist and position suitable safety stands under vehicle.
2. Remove attaching screws at retainer brackets.
3. Remove the stabilizer bar by pulling it out of both axles, leaving the bushings in place.

Installation

1. Install insulators onto the stabilizer bar.
2. Position the stabilizer bar in place inserting the ends into the bushings in the axles.
3. Install the retainer brackets and screws. Tighten the screws to 21-29 N·m (15-21 ft-lb).
4. Remove the safety stands and lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

Front Stabilizer Bar, E-150-250-350



F7703-A

Item	Part Number	Description
1	5494	Bar, Front Stabilizer
2	3B353	Retainer, Front Stabilizer Bar
3	5484	Insulator, Front Stabilizer Bar

(Continued)

Item	Part Number	Description
4	N801954-S60	Screw M10-1.5 Hex Washer To Tap
5	5K486	Bushing, Front Stabilizer Bar
6	3006/7	Axle Assembly

TF7703A

F-150-250-350 4x2

Removal

1. Disconnect the left and right ends of the front stabilizer bar from the link assembly attached to the spring seat.
2. Disconnect the retainer bolts. Remove the stabilizer bar.
3. Disconnect the stabilizer link assemblies by loosening the right and left locknuts from their respective I-beam brackets.

Installation

1. Loosely assemble the entire stabilizer bar system with both link assemblies outboard of the stabilizer bar.
2. Force the stabilizer bar rearward to connect the bar ends to the link assemblies.
3. Tighten the nuts and bolts retaining the link assemblies to the stabilizer bar and spring seat to 71-100 N·m (52-74 ft·lbs).

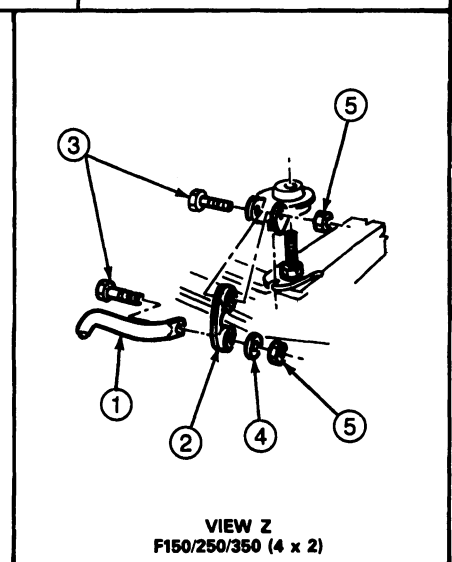
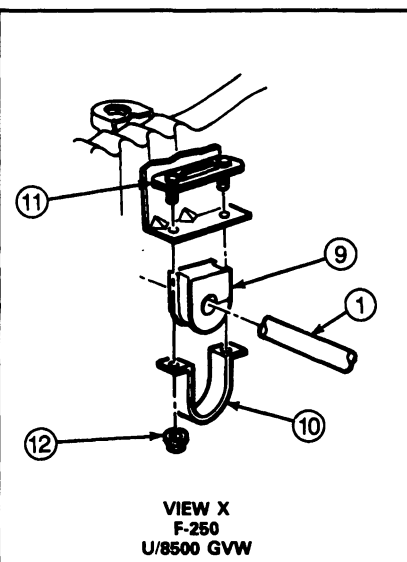
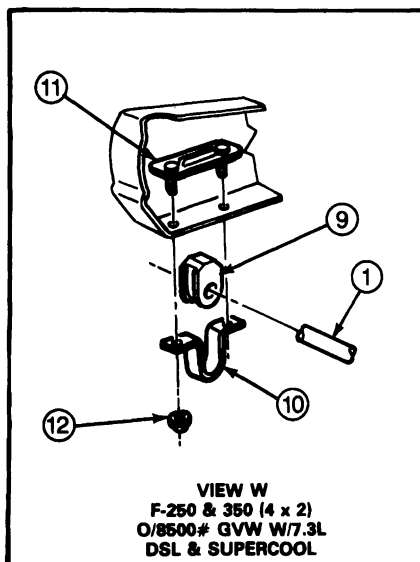
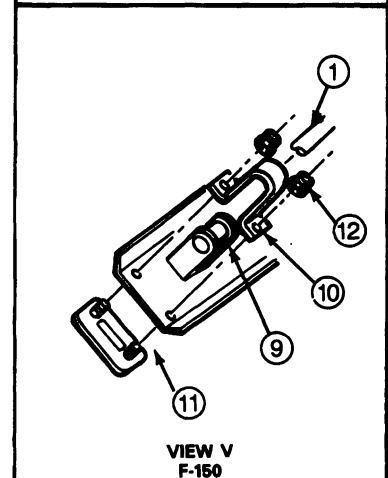
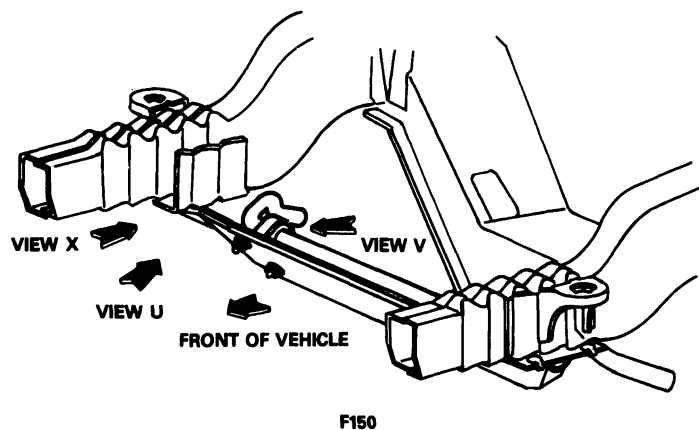
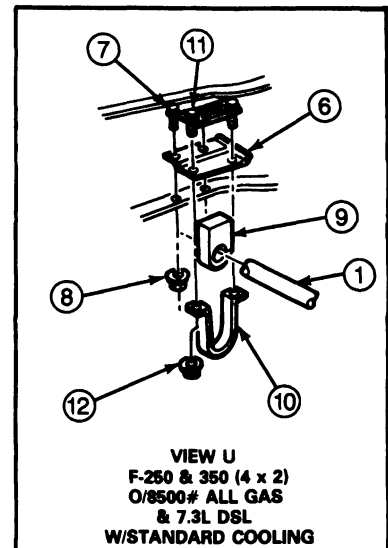
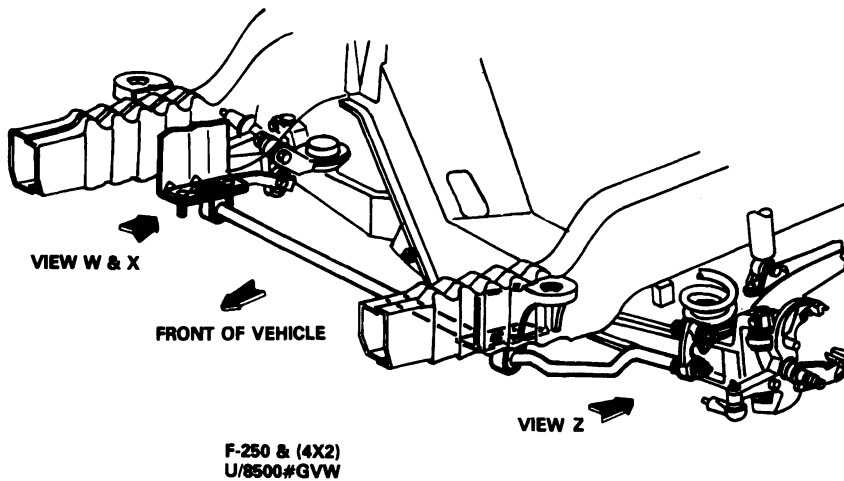
REMOVAL AND INSTALLATION (Continued)

4. Check insulators are seated in retainers and the stabilizer bar is centered in the assembly.

5. Tighten the stabilizer bar-to-frame retainer nuts and bolts to 37-50 N·m (27-37 ft-lbs).

REMOVAL AND INSTALLATION (Continued)

Front Stabilizer Bar, F 150-250-350 4x2



F7707-A

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	5494	Bar, Stabilizer, Front
2	3C140 / 1	Link Assembly
3	N605704-S2	Bolt M12-1.75 x 65 Hex Head
4	N801527-S2	Washer 13 x 34 x 2.5 Flat Hard
5	N620469-S2	Nut M12 x 1.75 72-108 N-m (53-80 Ft-Lb)
6	5C495	Bracket, Stabilizer Bar, Front
7	N605933-S2	Bolt M12 x 1.75 Hex Flange

(Continued)

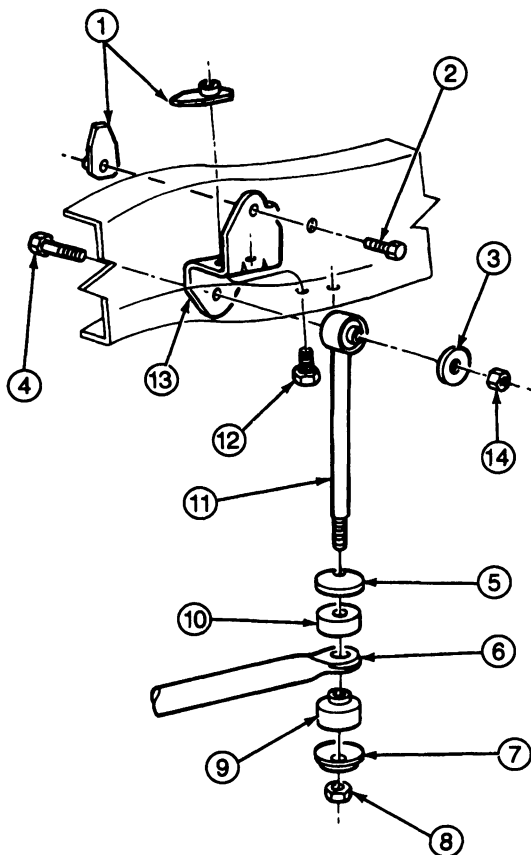
Item	Part Number	Description
8	N620483-S2	Nut M12 x 1.75 Hex Flange 53-72 N-m (39-53 Ft-Lb)
9	5484	Insulator, Stabilizer Bar, Front
10	3B353	Retainer, Stabilizer Bar, Front
11	N806789-S2	Bolt and Retainer, M10-1.5 x 33.5 Hex Flange
12	N620482-S36	Nut M12 x 1.75 Hex Flange 34-46 N-m (25-34 Ft-Lb)

TF7707A

F-Super Duty Chassis Cab

Removal

1. Disconnect the left and right ends of the front stabilizer bar from the link assembly attached to the frame side rail mounting brackets.
2. Disconnect the retainer bolt and remove the stabilizer bar from front axle.
3. Disconnect the stabilizer link assemblies by removing from the frame side rail mounting brackets.



F6261-D

Item	Part Number	Description
1	802158	Stamped Nut 48-68 N-m (35-50 Ft-Lb)
2	605546	Bolt
3	801527	Washer
4	605704	Bolt
5	18171	Washer
6	5494	Stabilizer Bar
7	18041	Washer (lower)
8	384485	Nut 21-32 N-m (15-24 Ft-Lb)
9	4A037	Insulator
10	4A037	Insulator
11	5K483	Link
12	N620483-S2	Bolt
13	5C495	Mounting Bracket
14	620469	Nut 70-100 N-m (52-74 Ft-Lb)

TF6261A

Installation

1. Loosely assemble the entire stabilizer bar system:
 - Both link assemblies loosely attached to the frame mounting brackets and,
 - Stabilizer bar in position on the axle.
2. Make sure stabilizer bar insulators are seated in the retainers and the stabilizer bar is centered between the front leaf springs.
3. Attach the stabilizer bar to the axle by assembling the retainers to the axle mounting brackets. Tighten the retainer screws to 48-68 N-m (35-50 ft-lb).
4. Install the link assemblies to the frame mounting brackets using the bolts, washers and locknuts. Tighten the locknut to 70-100 N-m (52-74 ft-lb).
5. Install the link assembly to stabilizer bar with two cup washers, two rubber insulators and one locknut. Tighten the locknut to 21-32 N-m (15-25 ft-lb).

REMOVAL AND INSTALLATION (Continued)

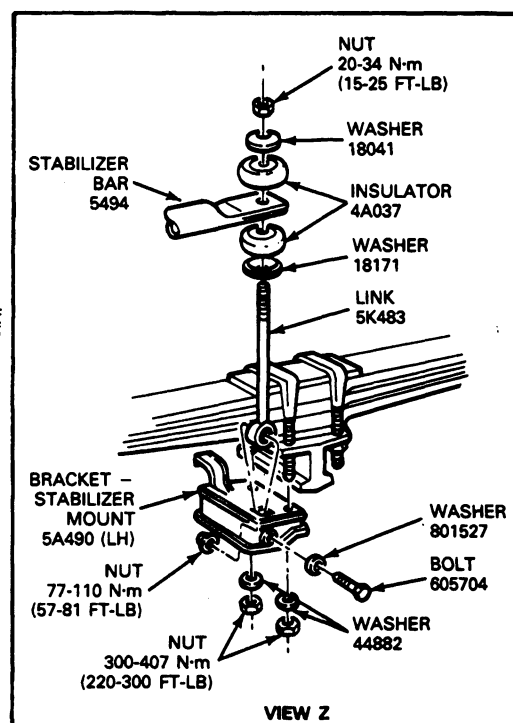
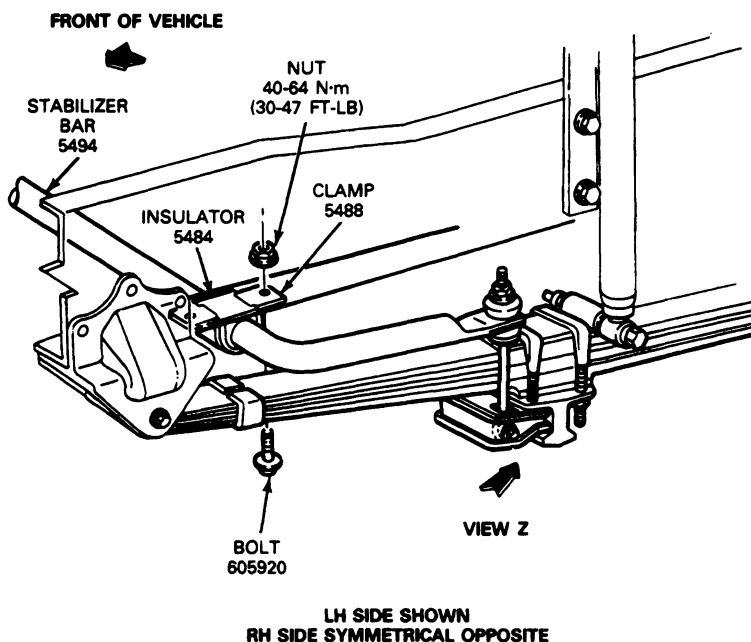
F-Super Duty Commercial and Motorhome Chassis**Removal**

1. Disconnect the left and right ends of the front stabilizer bar from the link assembly attached to the front axle.
2. Remove stabilizer bar-to-frame nuts and bolts. Remove the stabilizer bar.
3. Disconnect the stabilizer bar link assemblies by removing them from the axle mounting brackets.

Installation

1. Loosely assemble the entire stabilizer bar system with both link assemblies loosely attached to the axle mounting brackets, and the stabilizer bar in position on the frame.

2. Make sure that stabilizer bar insulators are seated in the retainers and the stabilizer bar is centered on the frame.
3. Attach the stabilizer bar to the frame by assembling the retainers to the frame mounts. Tighten the bolts to 40-64 N·m (30-47 ft-lb).
4. Install the link assemblies to the axle mounting brackets using the bolts, washers and locknuts. Tighten to 77-110 N·m (57-81 ft-lb).
5. Install the link assemblies to the stabilizer bar with two cup washers, two rubber insulators and one locknut per side. Tighten the locknut to 20-34 N·m (15-25 ft-lb).

Front Stabilizer Bar, F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles

F6451-2A

Front Stabilizer Bar Bushing**Removal**

1. Raise vehicle on hoist and position suitable safety stands under vehicle.
2. Remove front stabilizer bar described in this section.
3. Install Forcing Screw T78P-5638-A, Receiver Cup T78P-5638-A4 and Remover T80T-5638-A2 onto the front axle surrounding the stabilizer bar bushing.

4. Turn the forcing screw clockwise to remove the bushing from the axle.

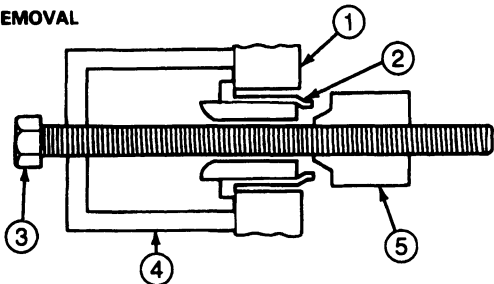
Installation

1. Assemble Forcing Screw T78P-5638-A and Receiver Cup T79P-5638-A3 through the bushing hole in the axle.
2. Slide the bushing over the forcing screw.
3. Install Replacer T78P-5638-A2 or equivalent on the end of the forcing screw.
4. Turn the forcing screw clockwise to engage the bushing into the axle.

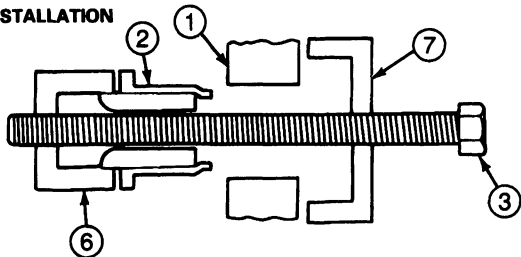
REMOVAL AND INSTALLATION (Continued)

- 5. Install the stabilizer bar as described in this section.
- 6. Remove safety stands and lower the vehicle.

REMOVAL



INSTALLATION



F7705-A

Item	Part Number	Description
1	3006 / 7	Axle Assembly
2	5K486	Bushing, Front Stabilizer Bar
3	T78P-5638-A	Forcing Screw
4	T78P-5638-A4	Receiver Cup
5	T80T-5638-A2	Remover
6	T78P-5638-A2	Replacer
7	T79P-5638-A3	Receiver Cup

TF7705A

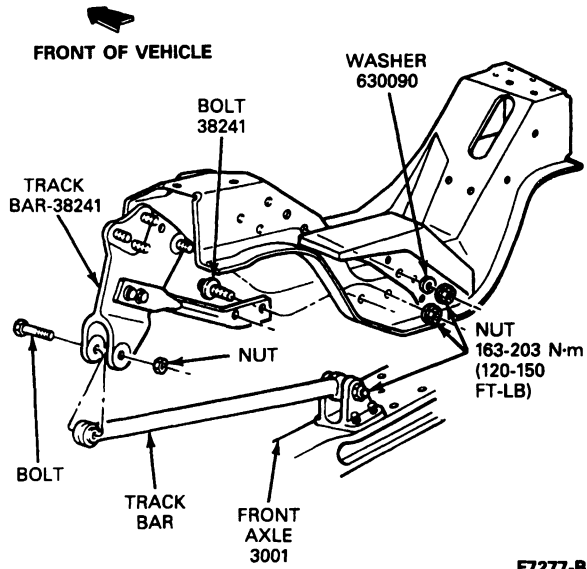
Track Bar, F-Super Duty Chassis Cab

Removal

- 1. Remove the bolt and nut attaching the track bar assembly to the No. 1 crossmember.
- 2. Remove the bolt and nut attaching the track bar to the mounting bracket at the axle.
- 3. Remove the track bar.

Installation

- 1. Attach the track bar to the No. 1 crossmember mounting bracket with a bolt and locknut. Tighten the nut to 163-203 N·m (120-150 ft-lb).
- 2. Attach the track bar to the axle mounting bracket with the bolt and nut. Tighten the nut to 163-203 N·m (120-150 ft-lb).



F7277-B

Front Twin I-Beam Axle

Removal

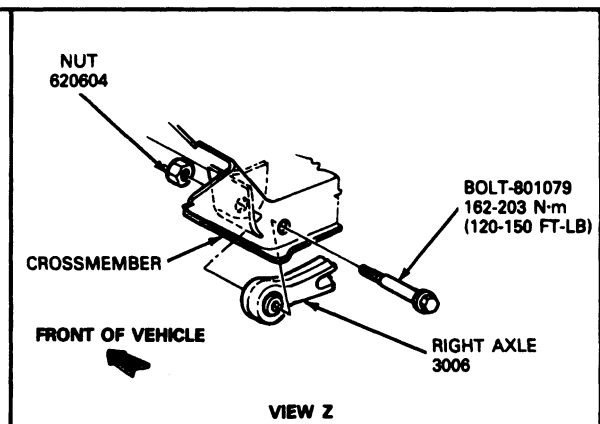
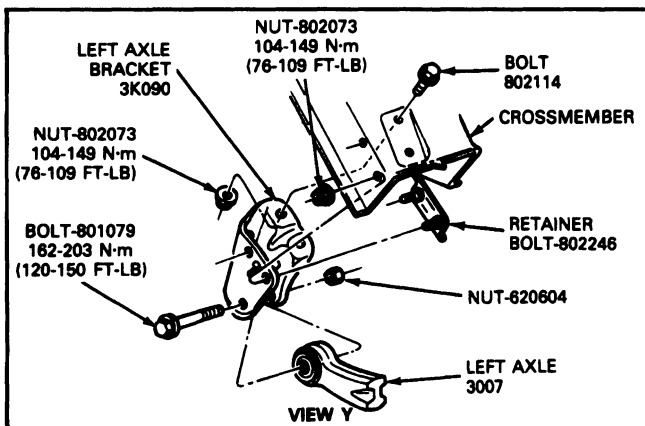
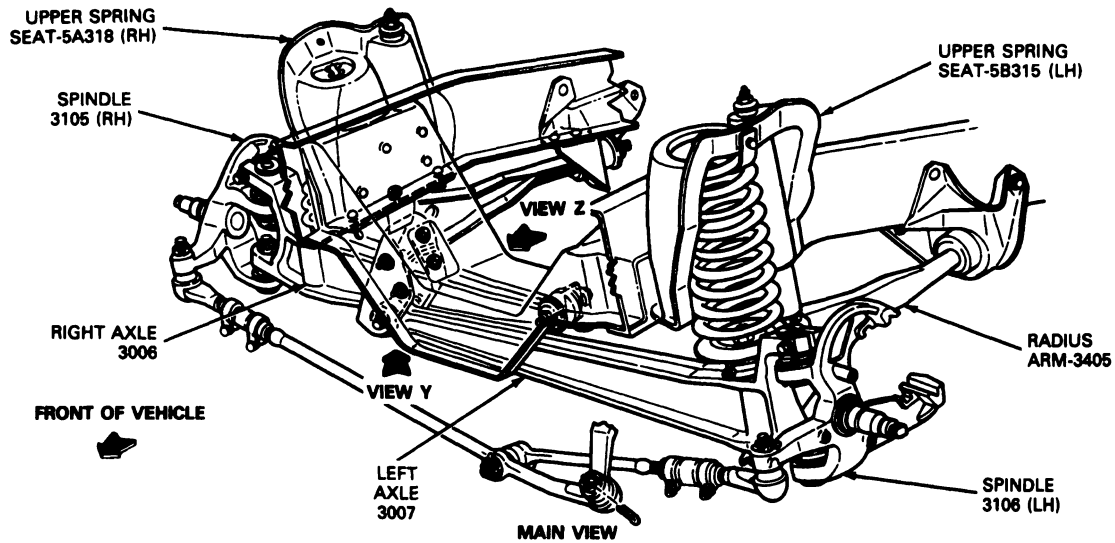
- 1. Remove the front wheel spindle, the front spring, and the stabilizer bar (if so equipped) described in this section.
- 2. Remove the spring lower seat from the radius arm, and then remove the bolt and nut that attach the radius arm to the front I-beam axle.
- 3. Remove the axle-to-frame pivot bracket bolt and nut.

Installation

- 1. Position the axle to the frame pivot bracket. Install the bolt and nut finger-tight.
- 2. Position the opposite end of the axle to the radius arm. Install the attaching bolt from underneath through the bracket, radius arm, and axle.
- 3. Install the spring lower seat and spring insulator on the radius arm so hole in the seat indexes over the arm-to-axle bolt and the pin on the spring seat engages the slot in the radius arm.
- 4. Install the front spring as outlined in this section.
- 5. Install the front wheel spindle.
- 6. If so equipped, install stabilizer bar as described in this section.
- 7. Lower the vehicle. With the weight on the suspension, tighten the axle-to-frame pivot bolt to 163-203 N·m (120-150 ft-lbs).

REMOVAL AND INSTALLATION (Continued)

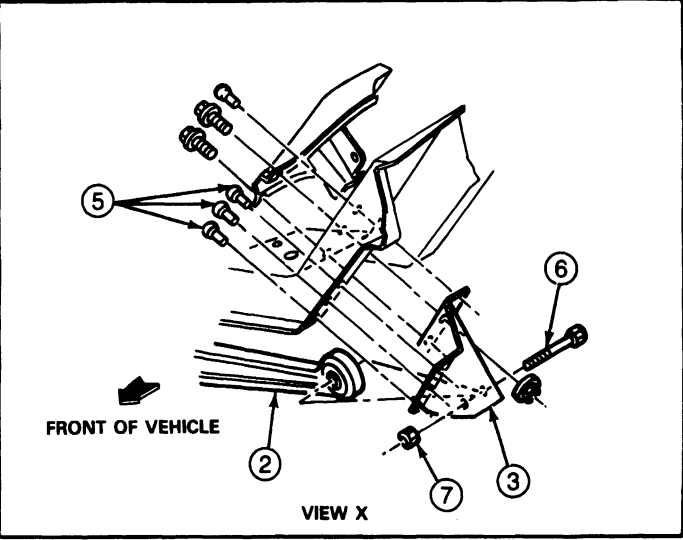
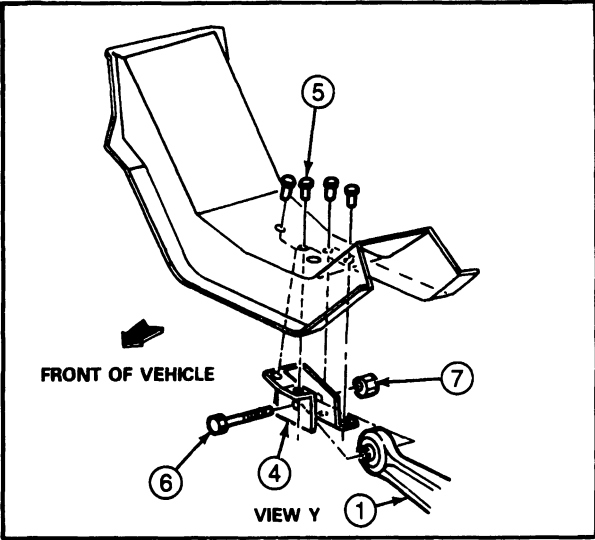
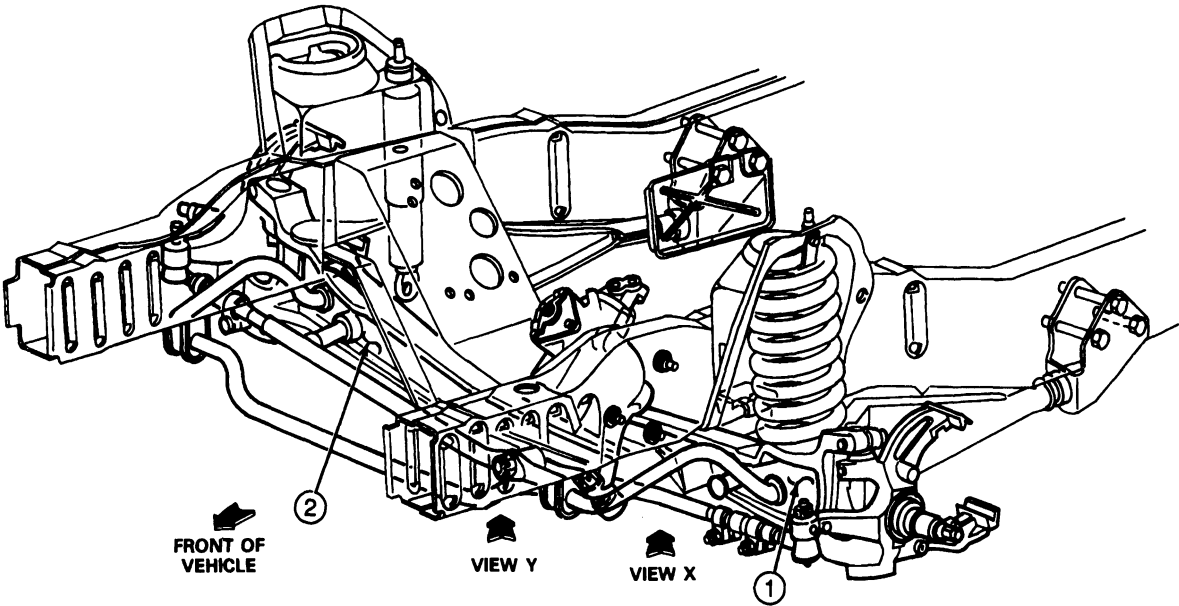
Axle Arm, F-150-250-350



F3910-C

REMOVAL AND INSTALLATION (Continued)

Axle Arm, E150-250-350



F7709-A

Item	Part Number	Description
1	3007	Axle Assembly, Left Hand
2	3006	Axle Assembly, Right Hand
3	3K090	Bracket, Front Axle Pivot, Left Hand
4	3B178	Bracket, Front Axle Pivot, Right Hand

Item	Part Number	Description
5	65092-S	Rivet
6	N806859-S2	Bolt M14-2.0 x 75.0 Flange Head
7	N620604-S100	Nut M14-20 Hex

TF7709A

(Continued)

REMOVAL AND INSTALLATION (Continued)**Front Axle, F-Super Duty Series Vehicles****Removal**

1. Using a hoist, raise the vehicle by the frame until the weight is off the front springs. Where a frame hoist is unavailable, use a suitable floor jack to jack up the vehicle by the frame. Raise the vehicle high enough to get the weight off the springs.
2. Remove the wheel and tire assemblies. Refer to Section 04-04.
3. Remove the caliper assemblies from the rotators and wire out of the way. Refer to caliper removal instructions in Section 06-03.
4. On F-Super Duty Commercial and Motorhome Chassis Vehicles, remove the shock absorber lower mounting bolt.
5. Install the wheel and tire assemblies with three or four lugnuts finger-tight.
6. Remove the nuts that hold the stabilizer links to the stabilizer bar.
7. Remove the washers and insulators and disconnect the links from the bar.
8. On F-Super Duty Commercial Chassis vehicles, disconnect the steering drag link from the steering arm on the spindle using Tie Rod End Remover TOOL-3290-D. Wire the steering drag link to the frame. On F-Super Duty Chassis Cab vehicles, remove the drag link from the tie rod.
9. On Chassis Cab vehicles, remove the tracking bar-to-axle nut and bolt. Disconnect the bar from the axle mounting bracket.
10. Remove the nuts from the U-bolts that hold the springs to the axle.
11. Remove the U-bolts and stabilizer bar brackets, or jack brackets.
12. Raise the vehicle and roll the axle out from under the vehicle.

Installation

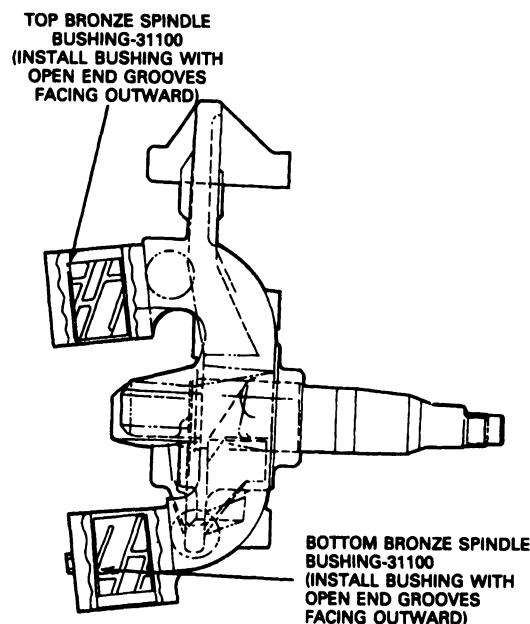
1. Position the axle so the spring seats on the I-beam link with the locating boss on the spring.
2. Install the U-bolts and the jack brackets or stabilizer bar brackets. Tighten the U-bolt nuts to 115-163 N·m (85-120 ft-lb).
3. Connect the steering drag link to the steering arm on the spindle. Install the castellated nuts and tighten to 75-105 N·m (55-77 ft-lb).
4. On Chassis Cab vehicles, position the tracking bar to the axle, install the nut and bolt. Tighten to 163-203 N·m (120-150 ft-lb).
5. Position the ends of the stabilizer links onto the stabilizer bar. Install the insulators, washers and nuts and tighten to 20-34 N·m (15-25 ft-lb).

6. Install the calipers as described in Section 06-03.
7. Install the lower shock absorber mounting bolt, washers and nut. Tighten to 300-407 N·m (220-300 ft-lbs).
8. Install the wheel and tire assemblies and tighten to specification. Refer to Section 04-04.
9. Remove the safety stands and lower the vehicle.

Spindle Bushing, Bronze**Removal and Installation**

1. Remove the spindle as described in this Section. Install the spindle in a vise.
2. On the F-Super Duty, the bronze spindle bushings have an inside diameter of 1.301 / 1.302 inch and use the following tools: King Pin Reamer T88T-3110-BH, Bushing Remover / Installer Driver T88T-3110-AH and Driver Handle T80T-4000-W.

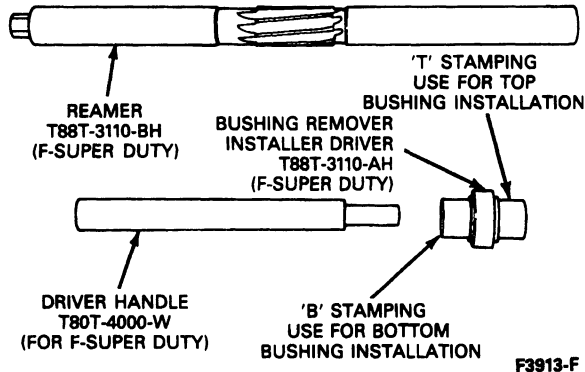
NOTE: Each side of the Bushing Remover / Installer Driver tool is marked with a "T" or a "B". Use the side with the "T" stamping to install the top spindle bushing. Use the side with the "B" stamping to install the bottom spindle bushing.

Spindle Bushing, Cutaway View

F3912-B

REMOVAL AND INSTALLATION (Continued)

Spindle Bushing Removal/Installation Tools

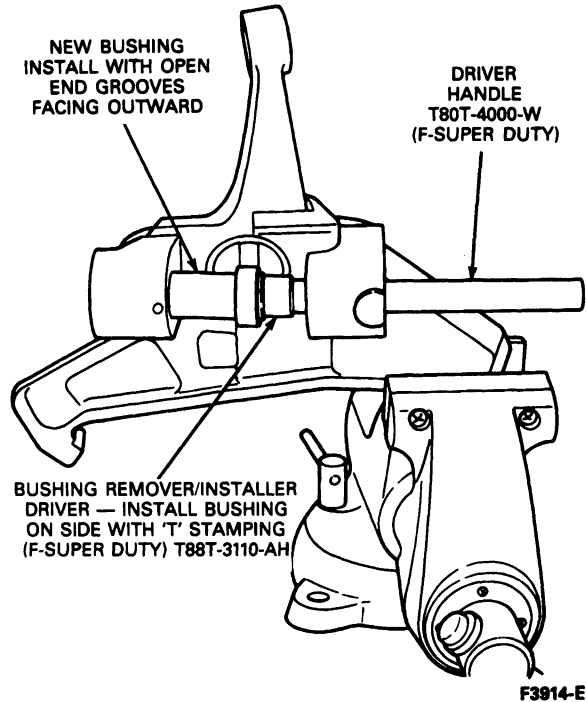


3. Remove and discard the seal from the bottom of the upper bushing bore of the upper spindle yoke.
4. Remove and install the top spindle bushing.
5. Install the driver handle through the bottom bore. Position a new bushing on the "T" side stamping of the bushing Remover / Installer Driver.

NOTE: The bushing must be installed on the tool so the open end grooves will face outward when installed.

6. Position the new bushing and driver over the old bushing, insert the handle into the driver and drive the old bushing out while the new bushing is driven in. Drive until the tool is seated.

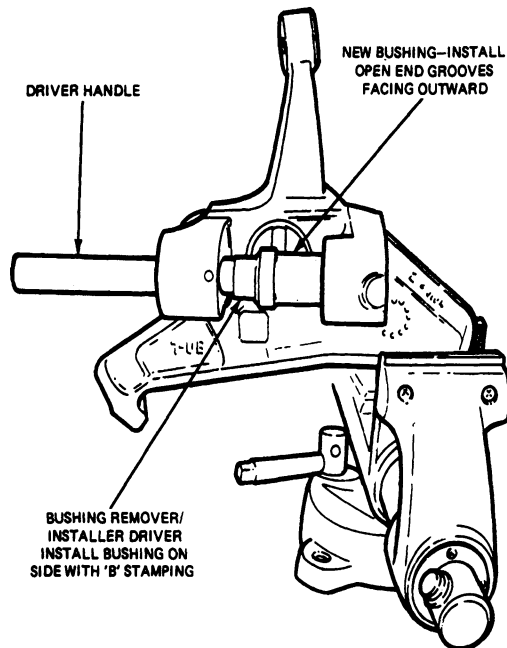
7. Bushing will then be seated at the proper depth (2.03mm [0.080 inch] minimum from bottom of upper spindle boss).



REMOVAL AND INSTALLATION (Continued)

8. Remove and install the bottom spindle bushing. Install the Driver Handle through the top bushing bore. Position a new bushing on the "B" side stamping of the Bushing Remover / Installer Driver.

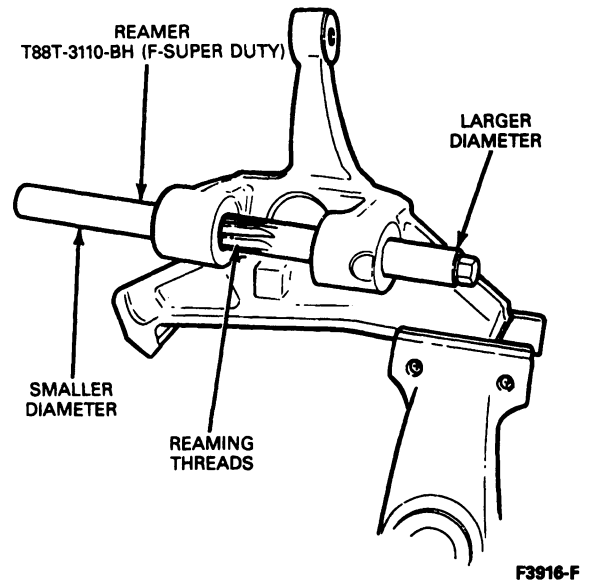
NOTE: The bushing must be installed on the tool so the open-end grooves will face outward when installed.



F3915-1A

9. Position the new bushing and driver over the old bushing in the bottom spindle bore. Insert the handle into the driver and drive the old bushing out while the new bushing is driven in. Drive until the tool is seated.
10. The bottom bushing will then be seated at the proper depth (3.30mm [0.130 inch] minimum from the top of the lower spindle boss).
11. Ream the new bushings to 0.025-0.076mm (0.001-0.003 inch) larger than the diameter of a new spindle pin. Ream the top bushing first with the reamer tool.
12. Install the smaller diameter of the tool through the top bore and into the bottom bore until the reaming threads are in position in the top bushing.
13. Turn the tool until the threads exit the top bushing. Ream the bottom bushing.

NOTE: The larger diameter portion of the tool will act as a pilot in the top bushing to properly ream the bottom bushing.



F3916-F

14. Clean all the metal shavings from the bronze bushings after reaming. Coat the bushings and spindle pin with Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent.
15. Install a new seal on Bushing Remover / Installer Driver tool on the side with the "T" stamping. Install the handle into the driver and push the seal into position in the bottom of the top bushing bore.
16. Remove the spindle from the vise and install as described in this section.

ADJUSTMENTS**Wheel Bearing Adjustment, F-150-250-350, F-Super Duty, E-150-250-350**

1. Raise the vehicle until the tire clears the floor and install safety stands.
2. To check the wheel bearing adjustment, grasp the tire at the sides. Alternately push inward and pull outward on the tire.
3. If any looseness is felt, adjust the wheel bearings as follows.
4. Remove the wheel cover or hub cap, if so equipped. Using a suitable tool such as a lady foot pry bar, remove the grease cap from the hub.
5. Wipe the excess grease from the end of the spindle. Remove the cotter pin and locknut.
6. Loosen the adjusting nut three turns. Attempt to obtain running clearance between the rotor brake surface and the linings by rocking the wheel, hub and rotor assembly in and out several times to push the linings away from the rotor, or by light tapping on the caliper housing or some other means that does not damage the rotor lining surfaces.

NOTE: Do not pry on the caliper phenolic piston.

ADJUSTMENTS (Continued)

7.

If running clearance cannot be maintained throughout bearing adjustment in Steps 7 and 8, the caliper must be removed. Refer to Section 06-03.

8.

Tighten the wheel bearing adjusting nut to 23-34 N·m (17-25 ft·lb) while rotating the disc brake rotor in the opposite direction.

9.

Back the nut off approximately one half turn.

10.

Tighten the nut to 2.03-2.26 N·m (18-20 in·lb) while rotating the disc brake rotor.

● End play should be .006-.127mm (.00025-.005 inch).

● Torque required to rotate the hub should be 1.13-2.82 N·m (10-25 in·lb).

11.

Install the retainer and new cotter pin bending both ends of cotter pin around retainer. Install grease cap.

12.

Install the caliper if removed.

13.

Install the wheel and tire assembly. Refer to Section 04-04.

14.

Lower the vehicle and tighten the lugnuts to 135 N·m (100 ft·lb) for E-150, F-150 and Bronco vehicles. All other vehicles, tighten lugnuts to 190 N·m (140 ft·lb).

15.

Install the wheel cover or hub cap, if equipped.

16.

Before driving the vehicle, pump the brake pedal several times to restore normal braking action.

WARNING: AFTER 800 KILOMETERS (500 MILES) OF OPERATION, RETIGHTEN THE LUGNUTS TO SPECIFICATIONS.

ON VEHICLES EQUIPPED WITH DUAL REAR WHEELS RETIGHTEN THE WHEEL LUGNUTS TO THE SPECIFIED TORQUE AT 100 MILES (160 KM), AND AGAIN AT 500 MILES (800 KM) OF NEW VEHICLE OPERATION AND AT THE INTERVALS SPECIFIED IN THE SEPARATE MAINTENANCE SCHEDULE AND RECORD LOG.

ALSO RETIGHTEN AT 500 MILES (800 KM) AFTER ANY WHEEL CHANGE OR ANY TIME THE LUGNUTS ARE LOOSENED.

FAILURE TO RETIGHTEN WHEEL LUGNUTS AT MILEAGE SPECIFIED COULD ALLOW WHEELS TO COME OFF WHILE THE VEHICLE IS IN MOTION, POSSIBLY CAUSING LOSS OF VEHICLE CONTROL AND COLLISION.

SPECIFICATIONS

F-SUPER DUTY CHASSIS CAB FRONT SUSPENSION		
Description	N·m	Lb·Ft
Drag Link to Pitman Arm Nut	70-100	52-74
Steering Linkage to Spindle Nut	70-100	52-74

(Continued)

F-SUPER DUTY CHASSIS CAB FRONT SUSPENSION (Cont'd)		
Description	N·m	Lb·Ft
Spring Shackle to Frame Nut	203-285	150-210
Spring to Spring Shackle Nut	163-203	120-150
Axle to Spring U-Bolt Nut	115-163	85-120
Tracking Bar Retaining Nuts and Bolts	163-203	120-150
Tracking Bar Mounting Bracket Nuts and Bolts and Brace to Crossmember	163-203	120-150
Jounce Bumper Bracket U-Bolt Nuts	70-100	52-74
Jounce Bumper Mounting Nuts	25-40	18-30
Spring to Rear Hanger Bracket	203-285	150-210
Stabilizer Link Mounting Bracket Nut	48-68	35-50
Stabilizer Link to Stabilizer Bar Nut	21-32	15-25
Upper Shock Bracket Nuts	70-100	52-74
Upper and Lower Shock to Bracket Nuts	53-72	39-55
Linkage Adjusting Clamp Nut	81-122	60-90
Drag Link to Tie Rod	70-100	52-74

F-SUPER DUTY COMMERCIAL CHASSIS AND MOTORHOME CHASSIS VEHICLES		
Description	N·m	Lb·Ft
Shock Absorber to Upper Shock Mount	300-407	220-300
Shock Absorber Upper Mount to Frame	300-407	220-300
Shock Absorber to Lower Mount	300-407	220-300
Leaf Spring U-Bolt Nuts	300-407	220-300
Jounce Bumpers to Frame or Bracket	40-64	30-46
Leaf Spring Front Shackle Through Bolt	200-280	148-207
Leaf Spring Rear Shackle Through Bolt	100-150	74-110
Steering Arm to Tie Rod, Castellated Nut	75-105	55-77
Steering Stop Bolt Lock Nut	50-70	37-52
Steering Drag Link to Steering Arm Castellated Nut	75-105	55-77
Steering Arm, Castellated Nut	75-105	55-77
Spindle Pin Lock Bolt, Nut	50-70	37-52
Stabilizer Bar Clamp to Frame	40-64	30-47
Stabilizer Link through Bolt	77-110	57-81
Stabilizer Link to Stabilizer Bar, Nut	20-34	15-25

1993 Econoline / F-150, F-250, F-350 / Bronco / F-Super Duty Body / Chassis Aug 1992

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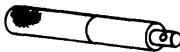

SPECIFICATIONS (Continued)

WHEEL TORQUE SPECIFICATIONS


Description	N-m	Lb-Ft
E-150, F-150, Bronco 5-Lug Wheel 1/2-20	135	100
E-250, E-350, F-250, F-350 8-Lug Wheel 9/16-18	190	140
F-Super Duty and F-Super Duty Stripped Chassis Vehicles 10-Lug Wheel 9/16-18	190	140

Description	F-150 (4x2)		F-250, 350 (4x2)		E-150, 250, 350	
	N-m	Ft-Lbs	N-m	Ft-Lbs	N-m	Ft-Lbs
Axle to Pivot Bracket Nut and Bolt	162-203	120-150	162-203	120-150	148-202	109-149
Axle to Radius Arm Nut and Bolt	365-446	269-329	255-345	188-254		
Axle to Upper Ball Joint Pinch Bolt Nut	65-88	48-65	65-88	48-65	87-119	64-88
Axle Pivot Bracket (Left) to Upper Frame Nut	104-149	77-109	77-109	76-104	56-77	
Axle Pivot Bracket (Left) Side Retainer to Frame Nut	104-149	77-109	104-149	77-109	—	—
Ball Joint (Lower) to Axle Nut	129-149	95-110	129-149	95-110	148-202	109-149
Coil Spring to Lower Retainer Nut	95-135	70-100	95-135	70-100	755-345	188-254
Coil Spring Upper Retainer to Spring Seat Nut and Bolt	18-24	13-18	18-24	13-18	21-29	15-21
Jounce Bumper to Frame Bolt	19-30	14-22	19-30	14-22	21-29	15-21
Radius Arm to Rear Bracket Nut	109-163	80-120	109-163	80-120	109-162	80-120
Radius Arm Rear Bracket to Frame Bolt	104-149	77-110	104-149	77-110	87-119	64-88
Shock Absorber to Lower Bracket Nut and Bolt	39-56	29-41	39-56	29-41	68-92	50-68
Shock Absorber to Upper Spring Seat Nut	34-48	25-35	34-48	25-35	34-47	25-48
Shock Absorber Bracket to Radius Arm Nut and Bolt	37-50	27-37	37-50	27-37	—	—
Stabilizer Bar Link to Bracket	71-100	52-74	71-100	52-74	—	—
Stabilizer Bar Link to Stabilizer Bar	72-108	53-80	72-108	53-80	—	—
Stabilizer Bar Retainer to Frame Crossmember Mounting Bracket	34-46	24-35	34-46	25-34	21-29	15-21
Steering Linkage to Spindle Nut	70-100	52-74	70-100	52-74	70-100	52-74

SPECIAL SERVICE TOOLS/EQUIPMENT

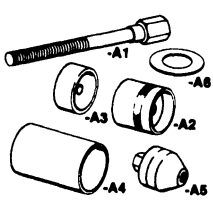



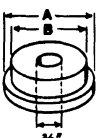
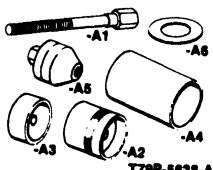
Tool Number/ Description	Illustration
T80T-4000-W Driver Handle	 T80T-4000-W
TOOL-3290-D Tie Rod End Remover	 TOOL-3290-D

(Continued)

Tool Number/ Description	Illustration
T74P-4635-C C-Frame Assembly	 T74P-4635-C

(Continued)

SPECIAL SERVICE TOOLS/EQUIPMENT
(Continued)

Tool Number/ Description	Illustration
T78P-5638-A Suspension Bushing Service Set	 <p>T78P-5638-A</p>
T80T-5638-A Front Suspension Bushing Tool	 <p>T80T-5638-A</p>
T88T-3110-BH Reamer	 <p>T88T-3110-BH</p>
T88T-3110-AH Bushing Remover/Installer Driver	 <p>T88T-3110-AH</p>
T73T-1190-B Seal Replacer	 <p>T73T-1190-B</p>
T79P-5638-A Suspension Bushing Service Set	 <p>T79P-5638-A</p>

ROTUNDA EQUIPMENT

Tool Number	Description
108-00076	Wheel Bearing Packer
108-00078	Wheel Bearing Packer
091-00001	Brake and Clutch Service Vacuum
108-00074	Wheel Bearing Packer

Tool Number	Description
D81T-3010-B	Ball Joint Removing Tool
D81T-3010-A	Ball Joint Adapter Set

SECTION 04-01B Suspension, Front, 4-Wheel Drive

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Front Suspension	04-01B-1	Bronco and F-150 4x4	04-01B-7
REMOVAL AND INSTALLATION		Front Stabilizer Bar	04-01B-16
Axle Housing Pivot Bushing	04-01B-14	Bronco and F-150 4x4	04-01B-16
Axle Pivot Bracket	04-01B-14	Front Wheel Spindle	04-01B-12
Bronco and F-150 4x4	04-01B-14	Jounce Bumper	04-01B-16
Front Driving Axle	04-01B-13	Radius Arm	04-01B-13
Front Shock Absorber	04-01B-12	Bronco and F-150 4x4	04-01B-13
F-150 4x4 and Bronco Equipped with Quad		SPECIAL SERVICE TOOLS/EQUIPMENT	04-01B-21
Front Shock Absorbers	04-01B-12	SPECIFICATIONS	04-01B-20
F-250-350 4x4	04-01B-12	VEHICLE APPLICATION	04-01B-1
Front Spring	04-01B-7		

VEHICLE APPLICATION

F-150-250-350 4x4 and Bronco Vehicles

DESCRIPTION AND OPERATION

Front Suspension

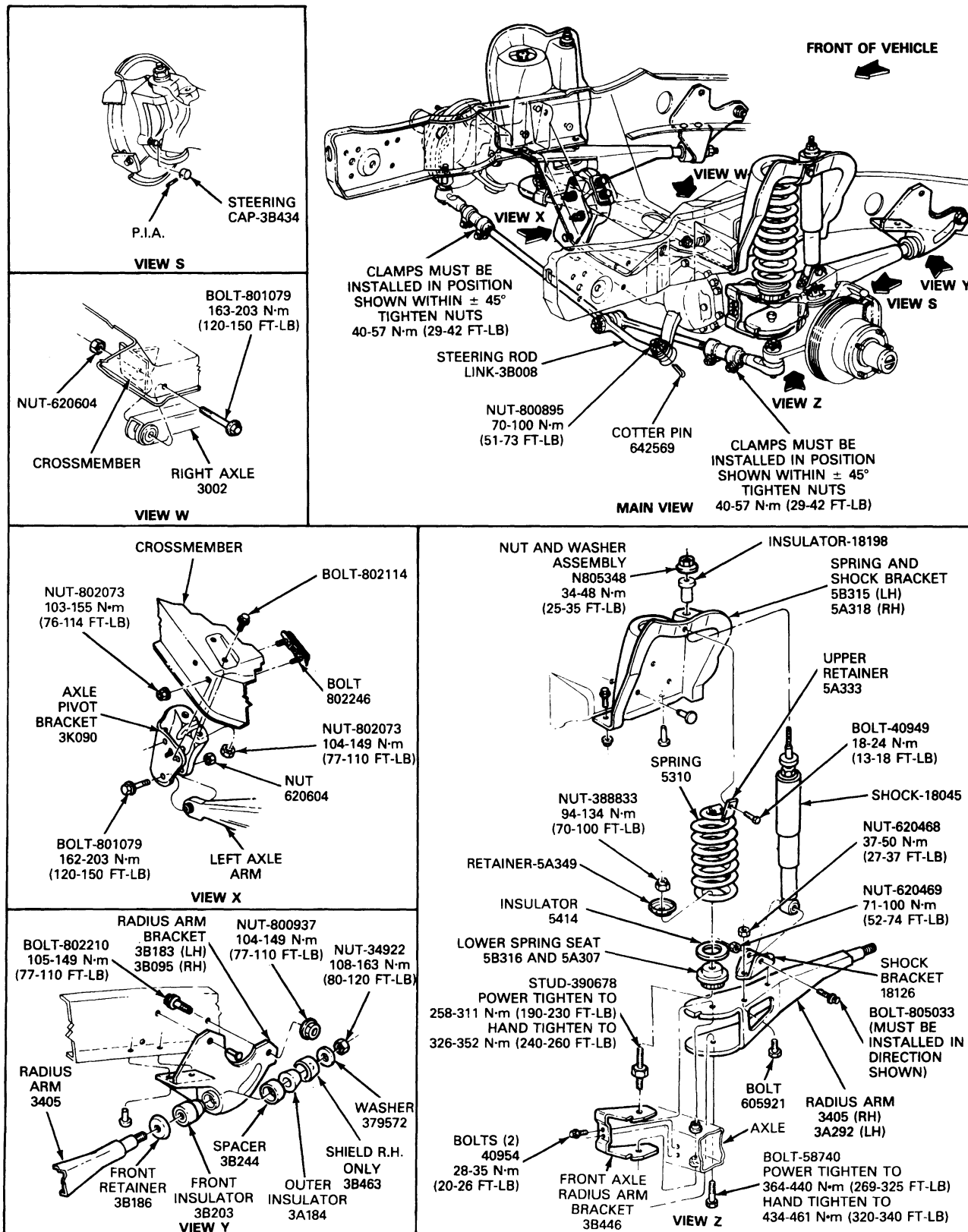
Bronco and F-150 4x4 with Dana Model 44 Front Drive Axle

The Bronco and F-150 4x4 Independent Front Suspension (IFS) system is composed of a Dana 44 two-piece front driving axle assembly, two helical coil springs and two radius arms.

The front driving axle consists of two independent axle arm assemblies. One end of each axle arm assembly is anchored to the frame. The other end of each axle arm assembly is supported by the coil spring and radius arm.

DESCRIPTION AND OPERATION (Continued)

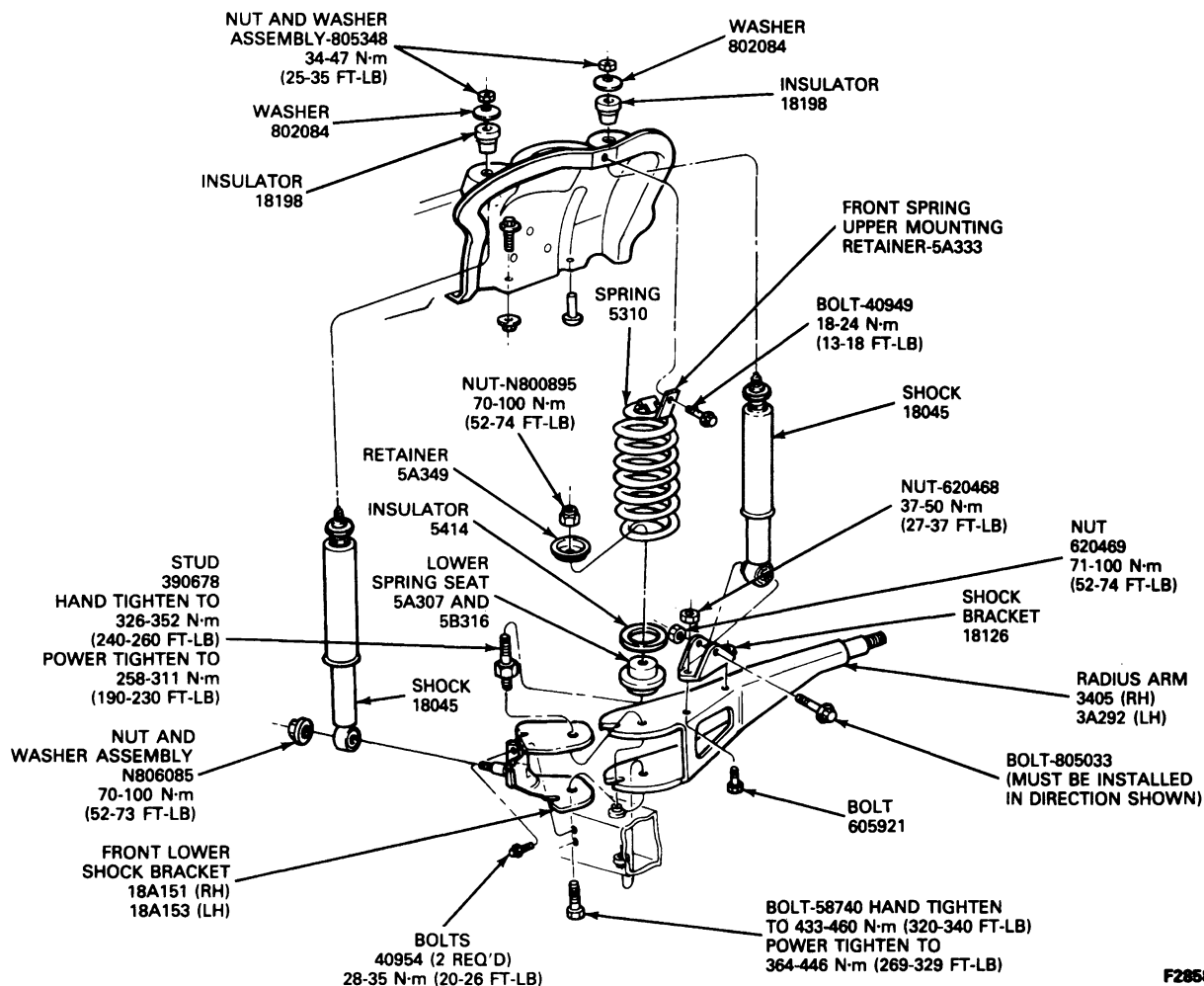
Front Suspension, Bronco and F-150 4x4 with Dana Model 44 IFS Front Drive Axle



F2856-L

DESCRIPTION AND OPERATION (Continued)

Front Suspension, Bronco and F-150 4x4 with Handling Package (Quad Shocks)



F2858-M

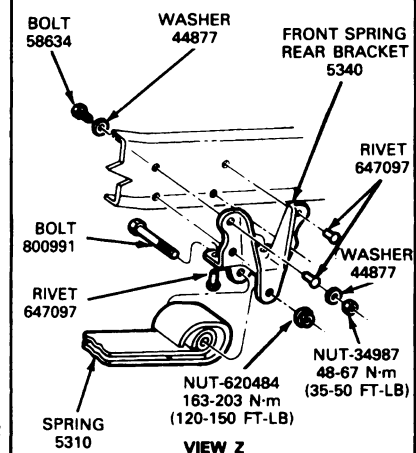
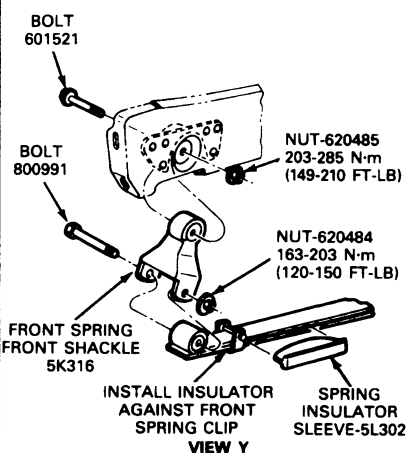
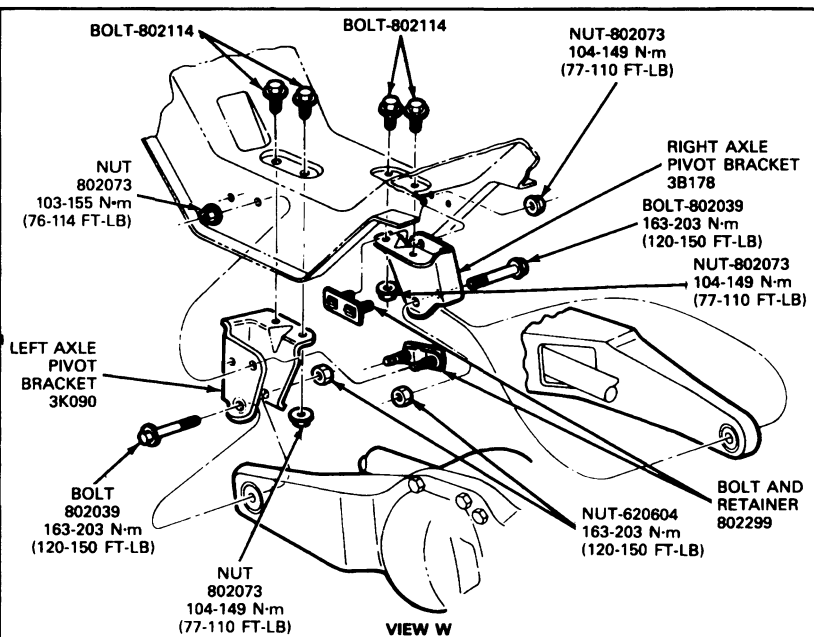
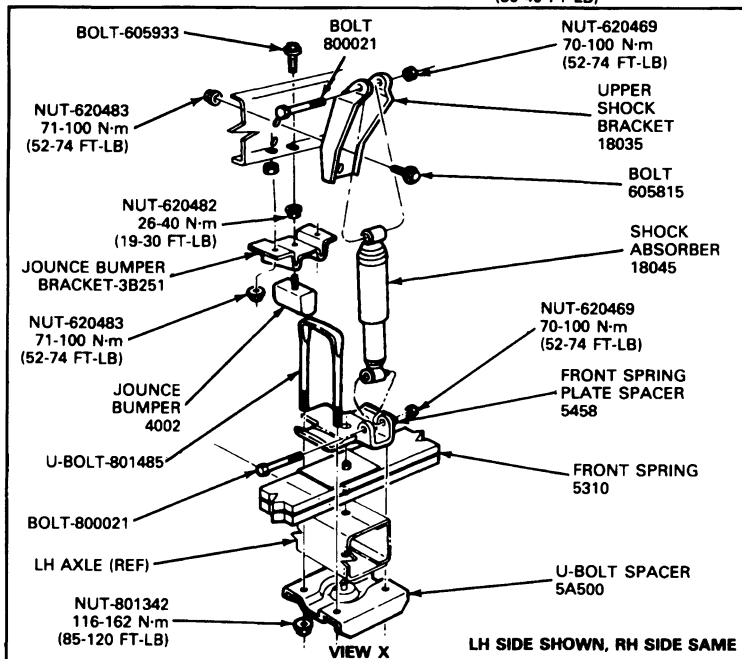
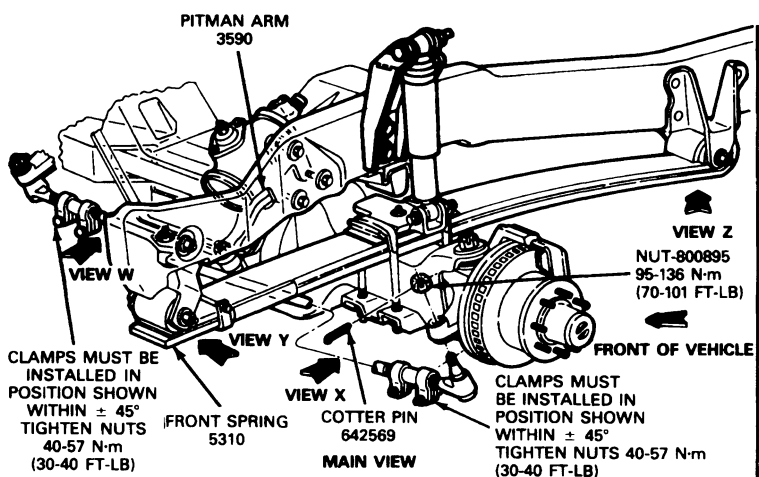
F-250 4x4 with Dana Model 50 Front Drive Axle

The F-250 4x4 Independent Front Suspension (IFS) system has a Dana Model 50 two-piece driving axle attached to the frame with two semi-elliptic, leaf-type springs. Each spring is clamped to the axle arm assembly with two U-bolts. The rear eye of the spring is attached to the hanger bracket. The front of the spring is attached to a shackle bracket.

The shock absorbers are the direct, double-acting type. They are attached to a frame bracket at the top and to the U-bolt spacer plate at the bottom.

DESCRIPTION AND OPERATION (Continued)

Front Suspension, F-250 4x4 with Dana Model 50 IFS Front Drive Axle



F2857-J

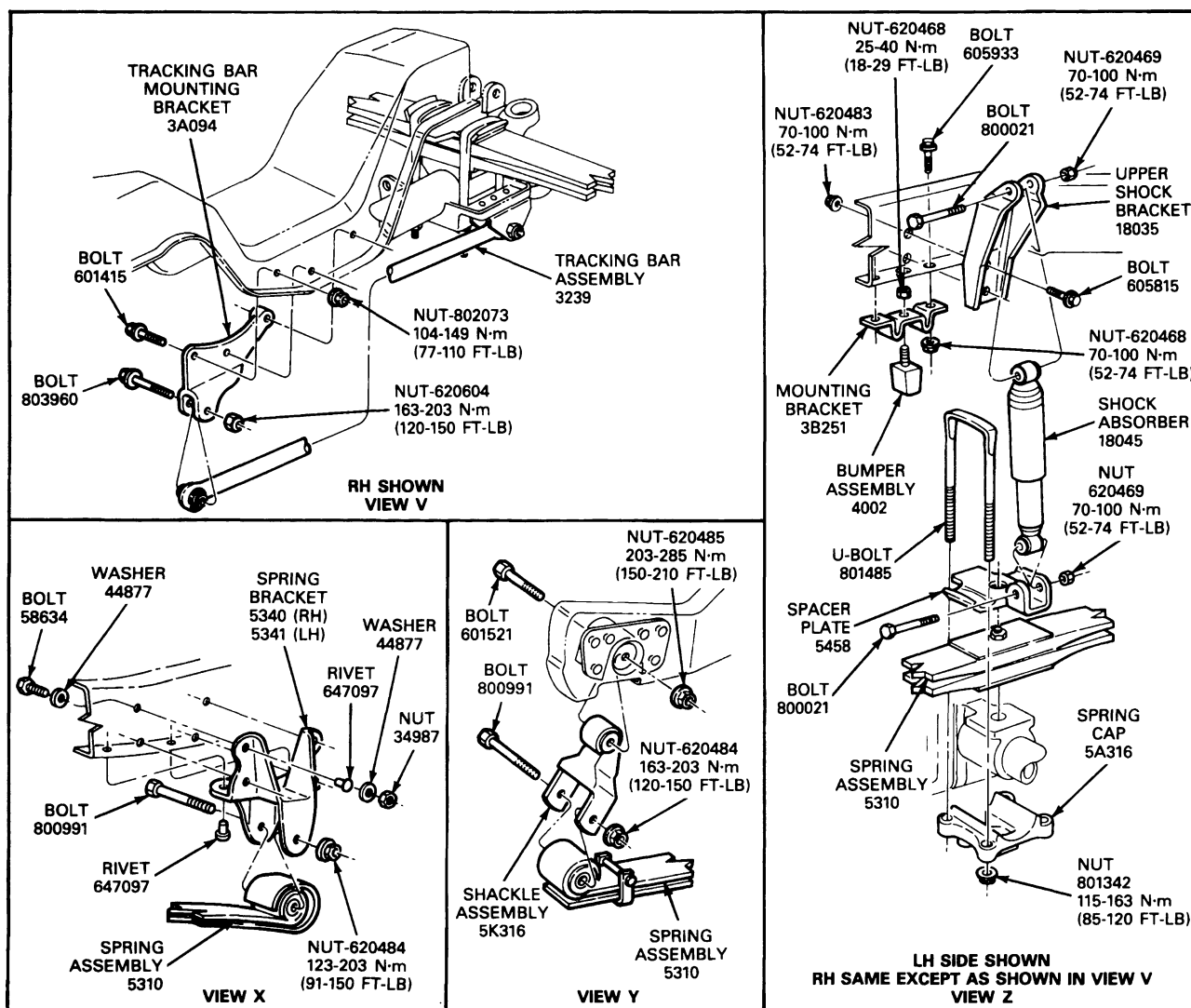
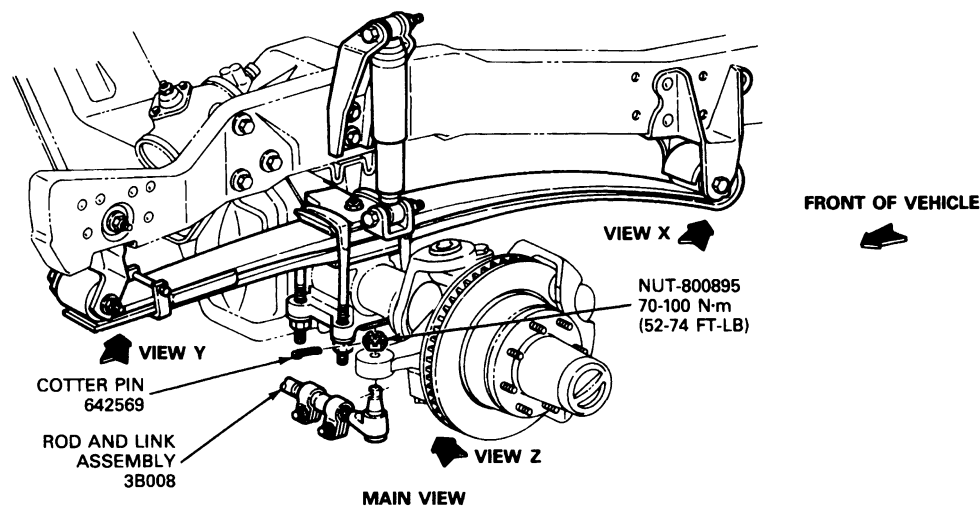
DESCRIPTION AND OPERATION (Continued)**F-350 4x4 with Dana Model 60 Monobeam Front Drive Axle**

The F-350 4x4 has a Dana 60 Model Monobeam one-piece driving axle attached to the frame with two semi-elliptical, leaf-type springs. Each spring is clamped to the axle assembly with two U-bolts. The rear eye of the spring is attached to the hanger bracket. The front of the spring is attached to a shackle bracket. On the right spring cap, a tracking bar is attached with the opposite end mounted on the crossmember.

The shock absorbers are the direct double-acting type. They are attached to a frame bracket at the top and to the U-bolt spacer plate at the bottom.

DESCRIPTION AND OPERATION (Continued)

Front Suspension, F-350 4x4 with Dana Model 60 Monobeam Front Drive Axle



F4418-E

REMOVAL AND INSTALLATION

Front Spring

Bronco and F-150 4x4

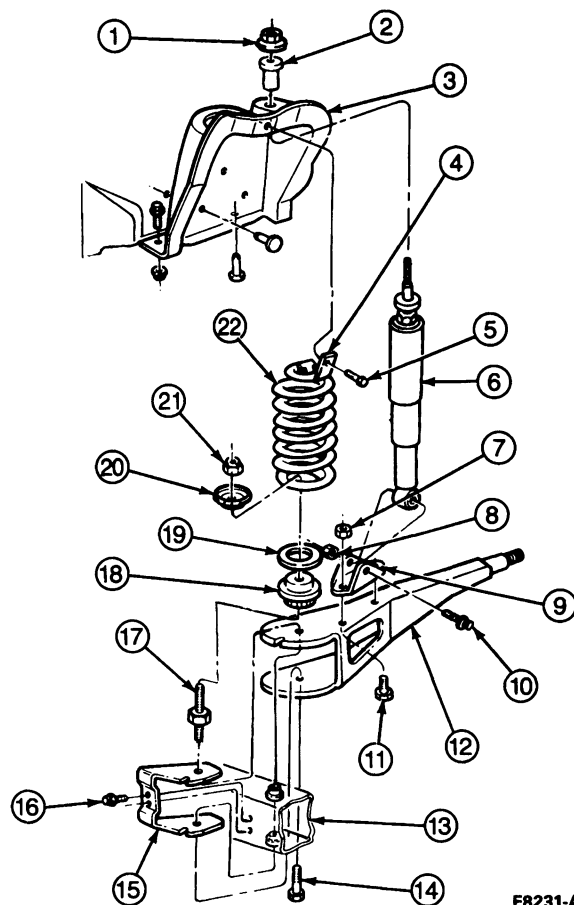
Removal

1. Raise the vehicle on a twin-post (axle contact type) hoist. If a frame hoist is used, raise the vehicle and position tall jack stands under the front axle. Lower the hoist until the axle is in the "normal ride height" position.
2. Remove the shock absorber-to-lower bracket attaching bolt and nut.
3. For vehicles equipped with quad shocks, remove the attaching nut and shock lower mount from the stud on the bracket.
4. Remove spring lower retainer attaching nut from inside of the spring coil.
5. Remove spring upper retainer attaching screw and upper retainer.
6. Position safety stands under the frame side rails and lower the axle enough to relieve tension from the spring. If a frame hoist is used, slowly raise the hoist enough to relieve tension on the front springs.

NOTE: The axle must be supported throughout spring removal and installation, and must not hang by the brake hose. If the length of the brake hose is not sufficient to provide adequate clearance for removal and installation of the spring, the disc brake caliper must be removed from the spindle according to the procedures specified in Section 06-03. After removal, the caliper must be placed on the frame or otherwise supported to prevent suspending the caliper from the caliper hose. These precautions are absolutely necessary to prevent serious damage to the tube portion of the caliper hose assembly.

7. Remove the spring lower retainer and the spring.

Front Spring, Bronco and F-150 4x4 with Dana Model 44 IFS



F8231-A

Item	Part Number	Description
1	N805348	Nut and Washer Assembly 34-48 N·m (25-35 Ft-Lb)
2	18198	Insulator
3	5B315 (LH) 5A318 (RH)	Spring and Shock Bracket
4	5A333	Upper Retainer
5	40949	Bolt 18-24 N·m (13-18 Ft-Lb)
6	18045	Shock
7	620468	Nut 37-50 N·m (27-37 Ft-Lb)
8	620469	Nut 71-100 N·m (52-74 Ft-Lb)
9	18126	Shock Bracket
10	805033	Bolt (Must Be Installed In Direction Shown)
11	605921	Bolt
12	3405 (RH) 3A292 (LH)	Radius Arm
13	—	Axle
14	58740	Bolt (Power-tighten) 364-440 N·m (269-325 Ft-Lb) (Hand-tighten) 434-461 N·m (320-340 Ft-Lb)

(Continued)

REMOVAL AND INSTALLATION (Continued)

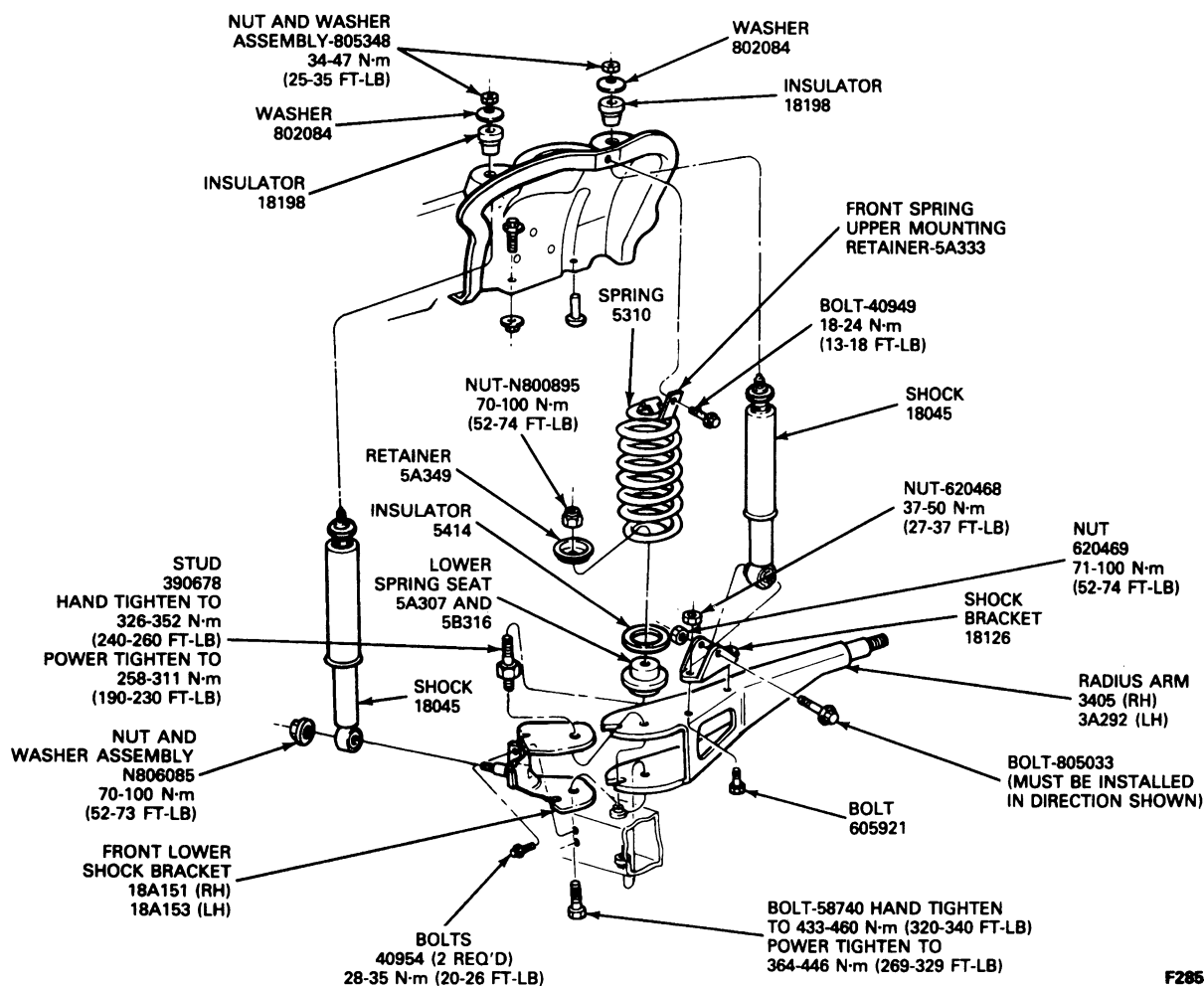
Item	Part Number	Description
15	3B446	Front Axle Radius Arm Bracket
16	40954	Bolt (2) 28-35 N·m (20-26 Ft-Lb)
17	390678	Stud (Power-tighten) 258-311 N·m (190-230 Ft-Lb) (Hand-tighten) 326-352 N·m (240-260 Ft-Lb)
18	5B316 and 5A307	Lower Spring Seat
19	5414	Insulator
20	5A349	Retainer
21	388833	Nut 94-134 N·m (70-100 Ft-Lb)
22	5310	Spring

TF8231A

Installation

1. Place the spring in position and slowly raise the front axle, or lower the hoist if a frame hoist being used. Make sure springs are positioned correctly in the upper spring seats.
2. Position the spring lower retainer over the stud and lower seat and install the attaching nut 94-134 N·m (70-100 ft-lb).
3. Position the upper retainer over the spring coil and install the attaching screws 18-24 N·m (13-18 ft-lb).
4. Position the shock absorber to the lower bracket and install the attaching bolt and nut with the bolt head towards the tire. Tighten the bolt and nut to 71-100 N·m (52-74 ft-lb).
If the vehicle has quad shocks, position the front shock in place and install the attaching nut. Tighten to 70-100 N·m (53-72 ft-lb).
5. Remove safety stands and lower the vehicle.

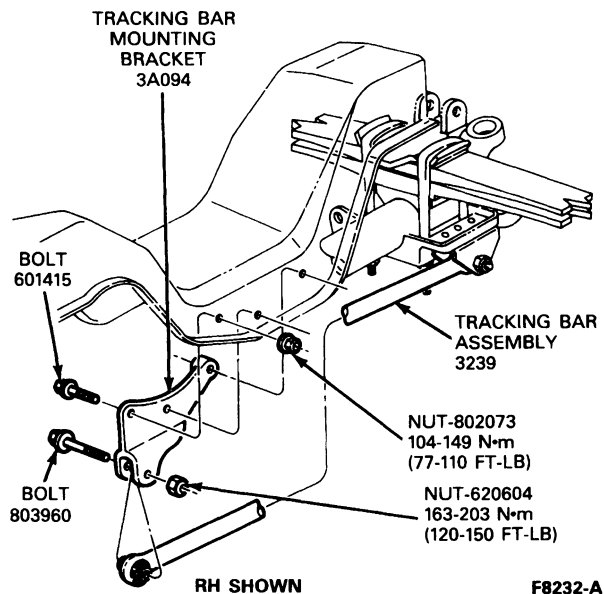
Quad Shocks, Installation, Bronco and F-150 4x4 with Dana Model 44 IFS Front Drive Axle



F2858-M

REMOVAL AND INSTALLATION (Continued)**F-250-350 4x4****Removal**

1. Raise the vehicle frame until the weight is off the front spring with the wheels still touching the floor. Support the axle to prevent rotation.
2. Disconnect the lower end of the shock absorber from the U-bolt spacer.
3. Remove the U-bolts, U-bolt cap and spacer. For vehicles equipped with a Dana Model 60 Monobeam front drive axle, remove two tracking bar-to right spring cap retaining bolts and tracking bar mounting bracket.



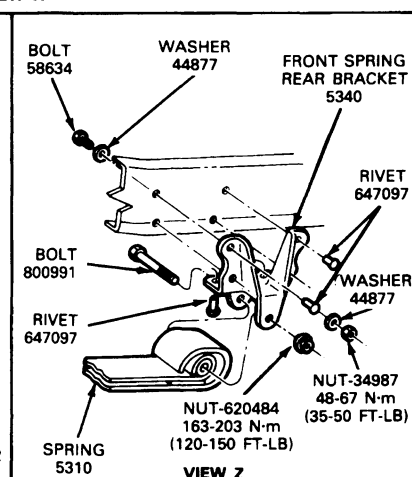
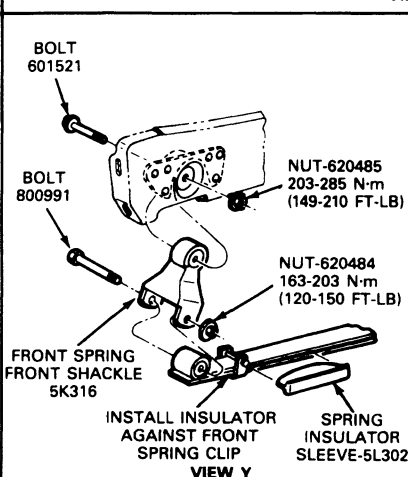
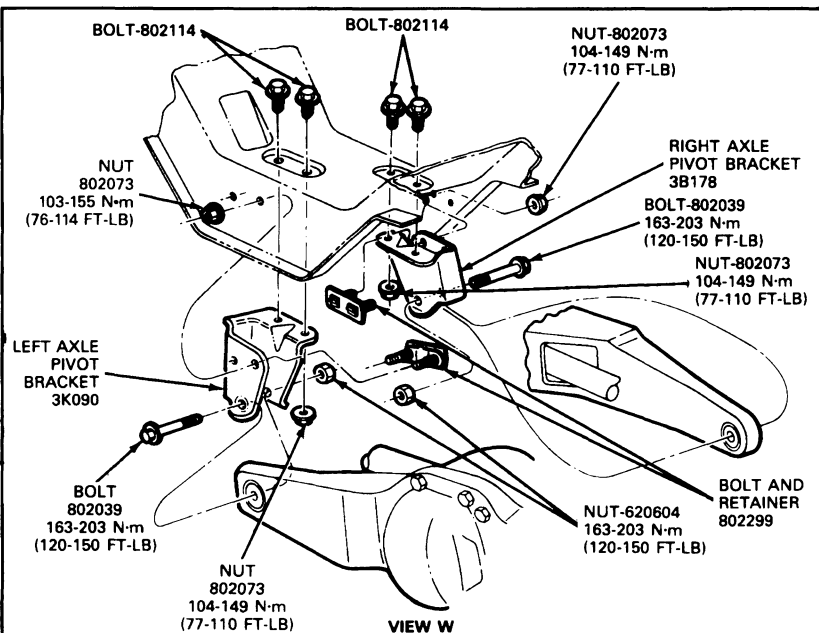
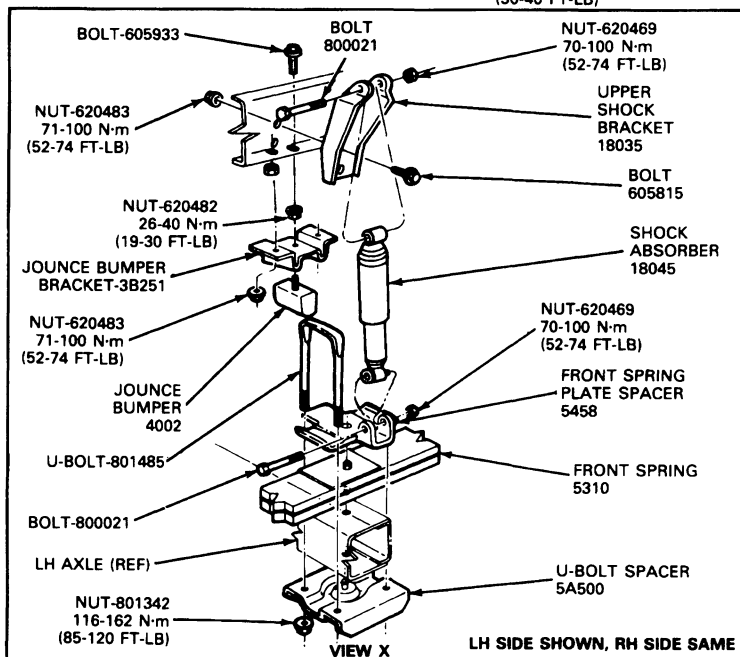
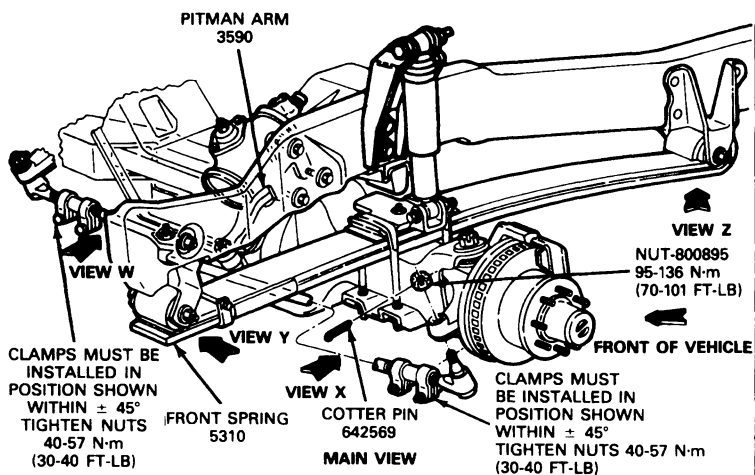
4. Remove the nut from the hanger bolt retaining the spring at the rear. Drive out the hanger bolt.
5. Remove front shackle connecting nut to spring eye.
6. Drive out the shackle bolt and remove the spring.

Installation

1. Position the new spring on the spring seat. Install the shackle bolt through the shackle and spring and tighten to 163-203 N·m (120-150 ft-lb).
2. Position rear of spring allowing rear hanger bolt to be installed. Install the nut and tighten to 163-203 N·m (120-150 ft-lb).
3. Position the U-bolt spacer and place the U-bolts in position through holes in the spring seat cap. Install but do not tighten the U-bolt nuts.
4. Make sure the spring center bolt is aligned with the indentation in the axle housing.
5. If vehicle is equipped with a tracking bar, connect mounting bracket and right spring cap retaining bolts.
6. Connect the lower end of the shock absorber to the U-bolt spacer.
7. Lower the vehicle and tighten the U-bolt nuts to 115-163 N·m (85-120 ft-lb).

REMOVAL AND INSTALLATION (Continued)

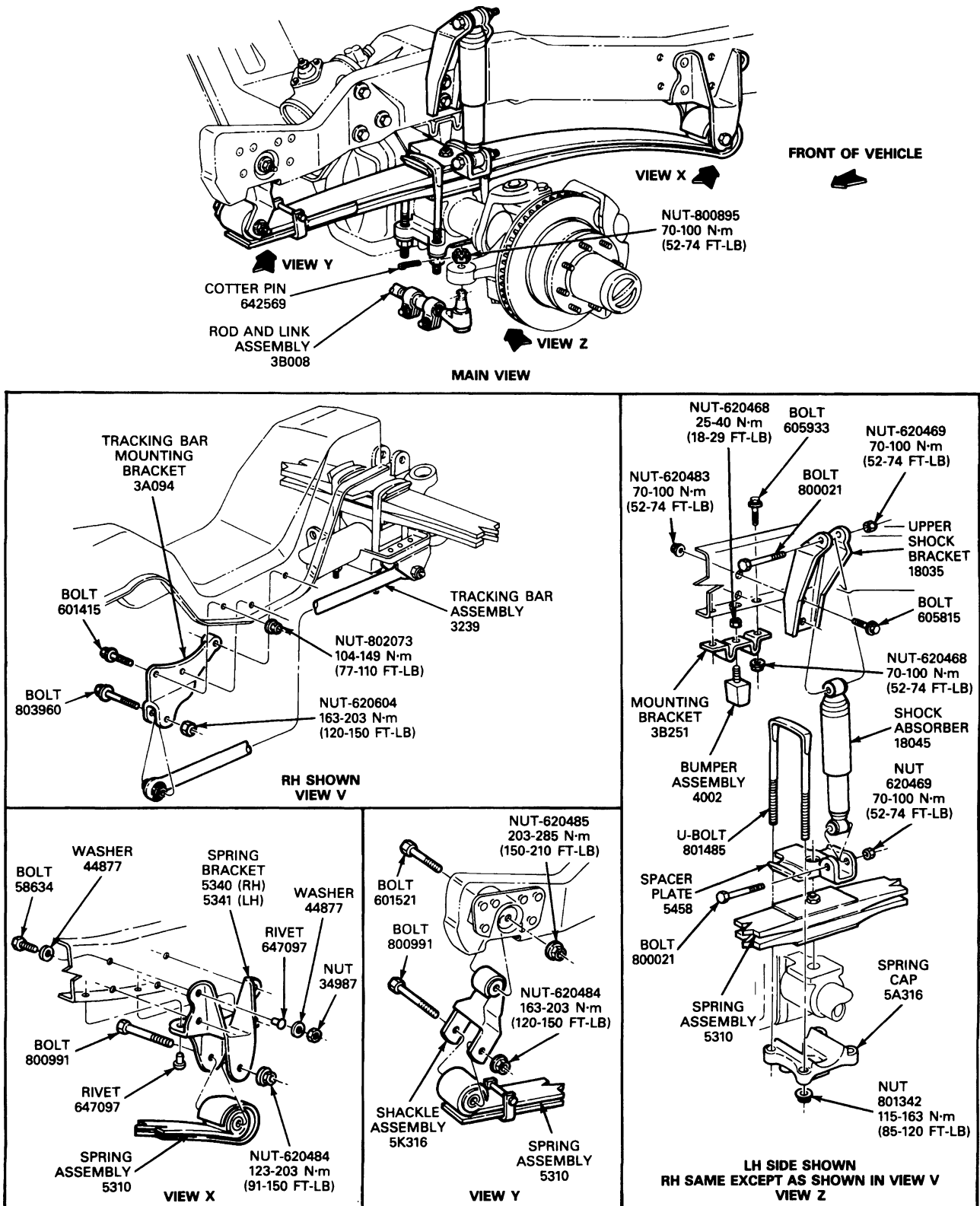
Front Suspension, F-250 4x4 with Dana 50 IFS Front Drive Axle



F2857-J

REMOVAL AND INSTALLATION (Continued)

Front Suspension, F-350 4x4 with Dana Model 60 Monobeam Front Drive Axle



F4418-E

REMOVAL AND INSTALLATION (Continued)**Front Wheel Spindle**

Refer to Section 05-02K and Section 05-02J.

Front Shock Absorber**F-250-350 4x4**

Refer to illustrations under Front Spring, F-250-350 4x4, Removal and Installation.

CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kPa (135 psi) for 1 inch and 1-3/16 inch bore, and 1034 kPa (150 psi) for 1-3/8 inch bore. Do not attempt to open, puncture or apply heat to the shock absorbers.

Removal

1. Remove shock absorber-to-upper shock bracket nut and bolt.
2. Disconnect the lower end of the shock absorber bolt and nut from the U-bolt plate.
3. Compress the shock absorber and remove.

Installation

1. Insert shock absorber into the upper shock bracket. Insert bolt and tighten nut to 70-100 N·m (52-74 ft·lb).
2. Attach the lower end of the shock absorber to the U-bolt plate by installing the nut and bolt. Tighten to 70-100 N·m (52-74 ft·lb).

F-150 4x4 and Bronco Equipped with Quad Front Shock Absorbers

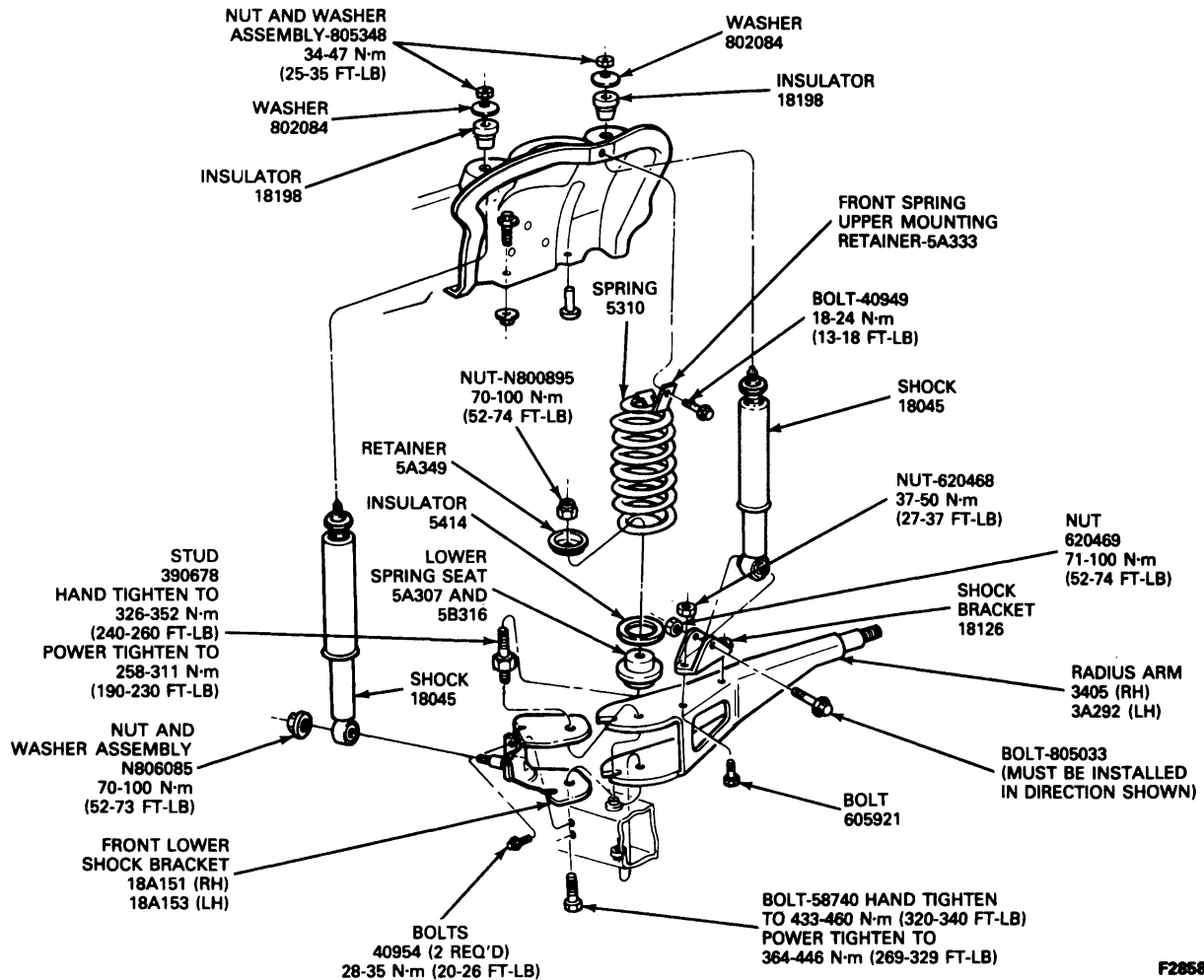
CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kPa (135 psi) for 1 inch and 1-3/16 inch bore and 1034 kPa (150 psi) for 1-3/8 inch bore. Do not attempt to open, puncture or apply heat to the shock absorbers.

Removal

1. For forward and rearward of front axle shock absorber installation, insert a wrench to hold the upper shock absorber retaining nut.
2. Loosen the stud by turning the hex on the exposed (lower) part of the stud. Remove nut and washer.
3. Disconnect the lower end of the shock absorber from the bracket, bolt and nut for rearward of front axle installation, and nut and washer for forward of front axle installation.
4. Compress the shock absorbers and remove.
5. Cut out insulators from upper spring seat.

Installation

1. Insert new one-piece insulators into the top surface of the upper spring seat (use soap solution to aid in installation).
2. Insert shock absorber stud through insulator. Replace steel washer and hand start nut.
3. While holding the nut as described in Step 1 of Removal, tighten to 34-47 N·m (25-35 ft·lb) by turning the hex provided on the stud.
4. For the rearward of front axle shock absorber installation, attach the lower end of the shock absorber to the bracket by installing the nut and bolt with the bolt head installed toward the tire. Tighten to 70-100 N·m (52-74 ft·lb).
5. For the forward of front axle shock absorber installation, attach lower end of shock absorber to the bracket by installing washer (concave surface to nut) and tighten nut to 95-136 N·m (70-100 ft·lb).

REMOVAL AND INSTALLATION (Continued)**Quad Shocks, Installation, Bronco and F-150 4x4 with Dana Model 44 IFS****Front Driving Axle**

Refer to Section 05-02K and Section 05-02J.

Radius Arm**Bronco and F-150 4x4****Removal**

Refer to illustrations under Front Spring, Bronco, F-150 4x4, Removal and Installation.

1. Raise the vehicle and position safety stands under the frame side rails and a jack such as Rotunda Hydraulic Floor Jack 077-00002 or equivalent under the axle.
2. Remove the front wheel and tire assembly. Refer to Section 04-04.

3. Disconnect the front stabilizer bar at the stabilizer link, if equipped.
4. Remove the shock absorber-to-lower bracket attaching bolt and nut and pull the shock absorber free of the radius arm.
5. On vehicles equipped with quad shocks, remove the attaching nut and forward shock lower mount from the stud on the bracket.
6. Remove spring lower retainer attaching bolt from inside of the spring coil.
7. Loosen the axle pivot bolt.
8. Remove radius arm-to-frame bracket nut.
9. Remove the radius arm rear plastic spacer and insulator.

REMOVAL AND INSTALLATION (Continued)

10. Lower the axle, remove the lower spring retainer, insulator and spring seat and allow the axle to move forward.

NOTE: The axle must be supported on the jack throughout radius arm removal and installation, and must not be permitted to hang by the brake hose. If the length of the brake hose is not sufficient to provide adequate clearance for removal and installation of the spring seat, the disc brake caliper must be removed from the spindle according to the procedures specified in Section 06-03. After removal, the caliper must be placed on the frame or otherwise supported to prevent suspending the caliper from the caliper hose. These precautions are absolutely necessary to prevent serious damage to the tube portion of the caliper hose assembly.

11. Remove the two bolts attaching the front axle to radius arm bracket to axle tube.
12. Remove spring retainer, insulator, lower spring seat, and stud.
13. Remove radius arm bracket-to-axle tube bolt.
14. Remove the front axle radius arm bracket.
15. Move the axle forward and remove the radius arm from the axle. Remove the radius arm from the frame bracket.

Installation

1. Clean all the mating surfaces between the radius arm, axle and bracket prior to re-assembly.
2. Position the forward washer and insulator on the rear of the radius arm and insert the radius arm into the frame bracket.
3. Position the rear spacer, insulator and washer on the radius arm and loosely install the attaching nut.
4. Position the radius arm, forward shock mount bracket (quad shock equipped vehicles) and front axle-to-radius arm bracket on the axle.
5. Loosely install a new stud and bolt attaching the radius arm to the axle.

NOTE: New stud and bolt are required because of the adhesive coating on the original bolts. If new fasteners are not available, thoroughly clean the old fasteners and apply Loctite No. 242 or equivalent to the threads of the fasteners.

6. Tighten the radius arm rear attaching nut to 108-163 N·m (80-120 ft-lb).
7. Install and tighten the bracket-to-axle attachment screws to 28-35 N·m (20-26 ft-lb).
8. Hand-tighten the radius arm to axle lower bolt to 434-461 N·m (320-340 ft-lb) and the upper stud type bolt to 326-351 N·m (240-260 ft-lb).
9. Position the spring lower seat with the locating tab positioned in the radius arm notch spring insulator.
10. Using Rotunda 077-00002 Floor Jack or equivalent, raise axle until spring is resting on lower spring seat.

11. Install lower spring retainer and nut. Tighten to 94-134 N·m (70-100 ft-lb).
 12. Position the shock absorber to the lower bracket. Install the attaching bolt and nut and tighten to 70-100 N·m (52-74 ft-lb).
- NOTE:** It is important that the bolt be installed with the head toward the tire to maximize clearance to brake system components.
13. Connect the front stabilizer bar to the stabilizer link, if equipped. Tighten nut to 70-100 N·m (52-74 ft-lb).
 14. Install front calipers if removed. Inspect brake hoses for damage. Refer to Section 06-03.
 15. Install the front wheel and tire assembly. Refer to Section 04-04.
 16. Lower vehicle and, with the weight on the suspension, tighten axle pivot bushing bolt and nut to 163-203 N·m (120-150 ft-lb).

Axle Housing Pivot Bushing**Removal and Installation**

Refer to Section 05-02K.

Axle Pivot Bracket**Bronco and F-150 4x4**

Refer to illustration under Front Spring, Bronco and F-150 (4x4), Removal and Installation.

Removal

1. Raise vehicle on a hoist. Place a tall jack stand under the axle arm near the pivot bracket and slowly lower the vehicle so axle is supported by the jack stand.
2. Remove the axle-to-bracket retainer bolt and nut.
3. Raise the hoist slowly to disengage the axle from the pivot bracket.

NOTE: It may be necessary to pry the axle out of the bracket.

4. Remove and discard all pivot-to-crossmember fasteners. Remove the axle pivot bracket.

NOTE: If required, raise the engine to provide access to the vertical fasteners in the top of the crossmember. Refer to the appropriate section in Group 3.

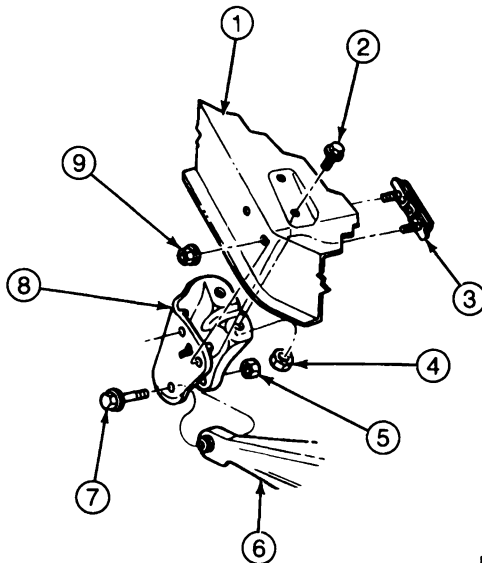
Installation

1. Position the axle pivot bracket to the crossmember. Loosely assemble the bolts, retainer assembly and nuts. Do not tighten at this time.

NOTE: The two rearward vertical fasteners must be installed with bolt heads adjacent to the engine oil pan to maintain required clearance. The bolt and retainer assembly must be installed with bolt heads on the inside of the pivot bracket surface.

REMOVAL AND INSTALLATION (Continued)

2. To ensure correct positioning of the axle pivot bracket.
 - Tighten the two forward fasteners to 103-155 N·m (76-114 ft-lb) first.
 - Then tighten the two rearward vertical nuts and bolts in the top of the crossmember to 149 N·m (110 ft-lb).
3. Lower the hoist until the axle engages the bracket. Install the bolt and nut. Tighten to 162-203 N·m (120-150 ft-lb).
4. Remove the jack stand and lower the vehicle.



F8233-A

Item	Part Number	Description
1	—	Crossmember
2	802114	Bolt
3	802246	Bolt
4	802073	Nut 104-149 N·m (77-110 Ft-Lb)
5	620604	Nut
6	—	Left Axle Arm
7	801079	Bolt 162-203 N·m (120-150 Ft-Lb)
8	3K090	Axle Pivot Bracket
9	802073	Nut 103-155 N·m (76-114 Ft-Lb)

TF8233A

F-250 4x4

Refer to illustration under Front Spring, F-250-350 4x4, Removal and Installation.

Removal

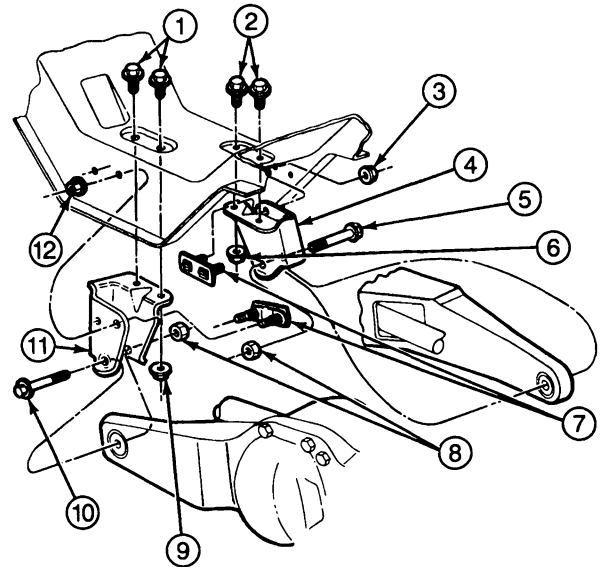
1. Raise vehicle on a hoist. Place supports securely under the axle arms near the pivot bracket and remove the axle pivot bolts.

WARNING: IF THE AXLE ARMS ARE NOT SECURELY SUPPORTED, THE AXLE ARMS WILL DROP SUDDENLY 101.6-152.4MM (4-6 INCHES).

2. If necessary, pry the axle out of the bracket and lower the axle.
3. Remove and discard all axle pivot bracket-to-crossmember fasteners and remove the axle pivot brackets.

NOTE: If necessary, raise the engine to provide access to the vertical fasteners in the top of the crossmember as follows:

- a. Loosen the right and left engine mount bolts.
- b. Align the fan blade to clear the shroud and raise the engine 50.8mm (2 inches). Check air cleaner does not come in contact with the firewall.
- c. Block engine securely in place.



F8234-A

Item	Part Number	Description
1	802114	Bolt
2	802114	Bolt
3	802073	Nut 104-149 (77-110 Ft-Lb)
4	3B178	Right Axle Pivot Bracket
5	802039	Bolt 163-203 N·m (120-150 Ft-Lb)
6	802073	Nut 104-149 N·m (77-110 Ft-Lb)
7	802299	Bolt and Retainer

(Continued)

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
8	620604	Nut 163-203 N·m (120-150 Ft-Lb)
9	802073	Nut 104-149 N·m (77-110 Ft-Lb)
10	802039	Bolt 163-203 N·m (120-150 Ft-Lb)
11	3K090	Left Axle Pivot Bracket
12	802073	Nut 104-149 N·m (77-110 Ft-Lb)

TF8234A

Installation

- Position the axle pivot bracket to the crossmember and loosely assemble the bolts, retainer assembly and nuts. Do not tighten at this time.

NOTE: The vertical fasteners for each pivot bracket must be installed with bolt heads adjacent to the engine oil pan to maintain required clearance. Horizontal fasteners must be installed with the bolt heads on the inside surface of the pivot brackets.
- To ensure correct positioning of the axle pivot brackets, tighten the horizontal fasteners in the side of the crossmember to 149 N·m (110 ft-lb). Tighten the vertical fasteners in the top of the crossmember to 149 N·m (110 ft-lb).
- Position the axles in the pivot bracket. Install the pivot bolt and tighten nut to 104-149 N·m (77-110 ft-lb).
- Remove the blocks under the engine and lower the engine into position. Tighten the bolts to specification listed in the appropriate engine section in Group 03.

Installation

- Position jounce bumper in forward set of holes in frame.

NOTE: The rearward set of holes on the right bumper only are for F-150-250-350 4x2 vehicles only. The forward set of holes are for F-150 4x4 and Bronco only.
- Install the hex head bolt and tighten to 19-29 N·m (14-22 ft-lb).

Front Stabilizer Bar**Bronco and F-150 4x4****Removal**

- Remove nuts, bolts and washers connecting the stabilizer bar to connecting links.
- Remove nuts and bolts of the stabilizer bar retainer.
- Remove stabilizer bar retainer.
- Remove the stabilizer bar and insulator.

NOTE: The stud does not have to be removed.

The bracket-to-frame assembly may be removed but not the No. 1A crossmember.

Installation

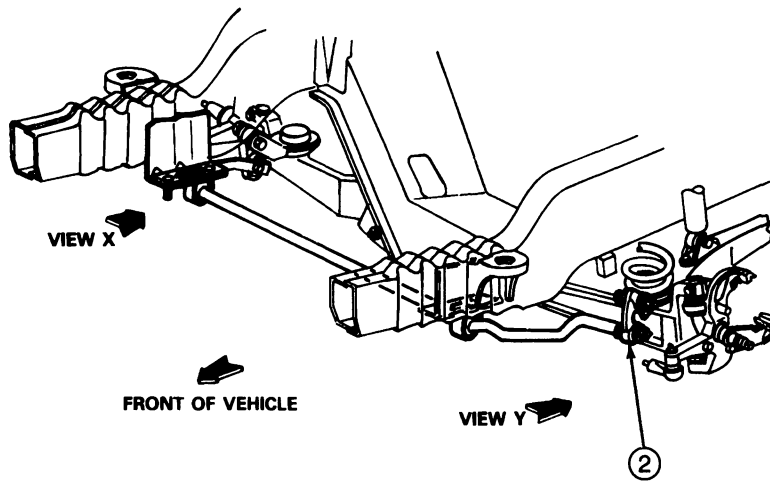
- Install insulators on stabilizer bar.
- Position stabilizer bar with insulators to mounting brackets and install attaching nuts and bolts. Tighten retainer nuts to 36-50 N·m (27-37 ft-lb).
- Install link to stabilizer attaching bolt and nut. Tighten to 71-100 N·m (52-74 ft-lb).

Jounce Bumper**Removal**

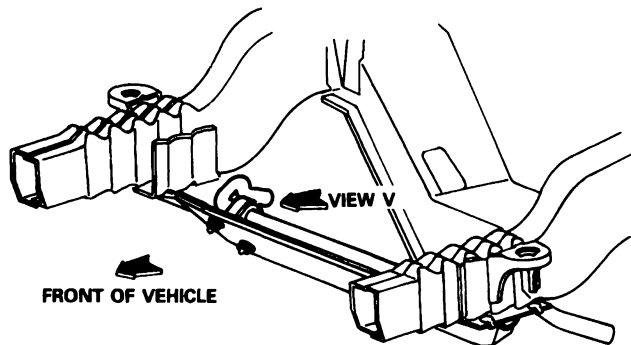
- Remove the hex head bolt or nut that holds jounce bumper to frame. Remove jounce bumper.

REMOVAL AND INSTALLATION (Continued)

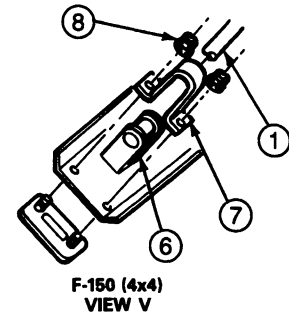
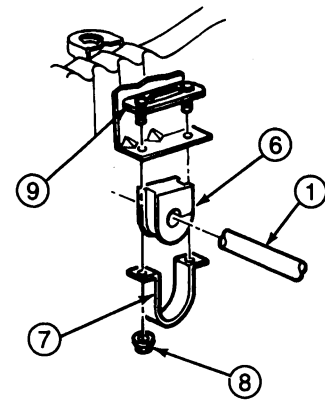
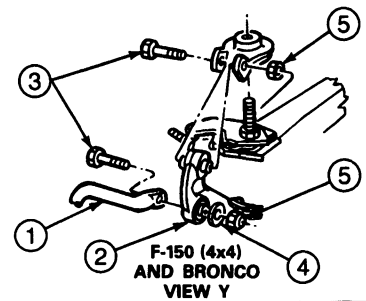
Front Stabilizer Bar, Bronco and F-150 4x4 with Dana Model 44 Front Drive Axle



BRONCO



F-150

F-150 (4x4)
VIEW VBRONCO
VIEW XF-150 (4x4)
AND BRONCO
VIEW Y

F7714-A

Item	Part Number	Description
1	5494	Bar, Stabilizer, Front
2	3C140	Link Assembly
3	N605704-S2	Bolt M12-1.75 x 65 Hex
4	N801527-S2	Washer 13 x 34 x 2.5
5	N620469-S2	Nut M12 x 1.75 71-100 N-m (52-74 Ft-Lb)

(Continued)

Item	Part Number	Description
6	5484	Insulator, Stabilizer Bar, Front
7	3B353	Retainer, Stabilizer Bar, Front
8	N620482-S36	Nut M12 x 1.75 Hex Flange 36-50 N-m (27-37 Ft-Lb)
9	N806789-S2	Bolt and Retainer M10-1.5 x 33.5 Hex

TF7715A

REMOVAL AND INSTALLATION (Continued)**F-250 4x4****Removal**

1. Remove bolts, washers and nuts securing the links to spring seat caps (both sides).
2. For vehicles equipped with a Dana Model 60 Monobeam Front Drive axle, remove the nut, washer, and bolt securing the links to the mounting brackets (both sides).
3. Remove nuts, washers and insulators connecting links to stabilizer bar.
4. Remove link assemblies.
5. Remove nuts and bolts securing retainers to mounting bracket and remove retainers.

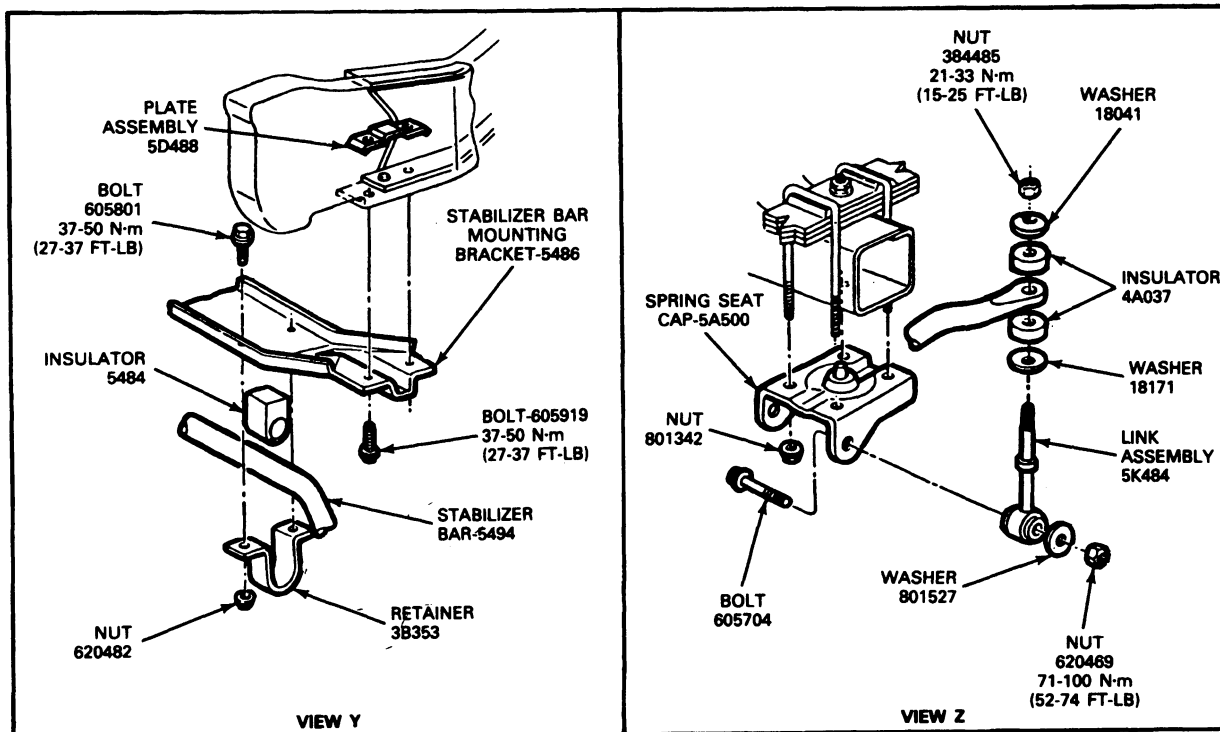
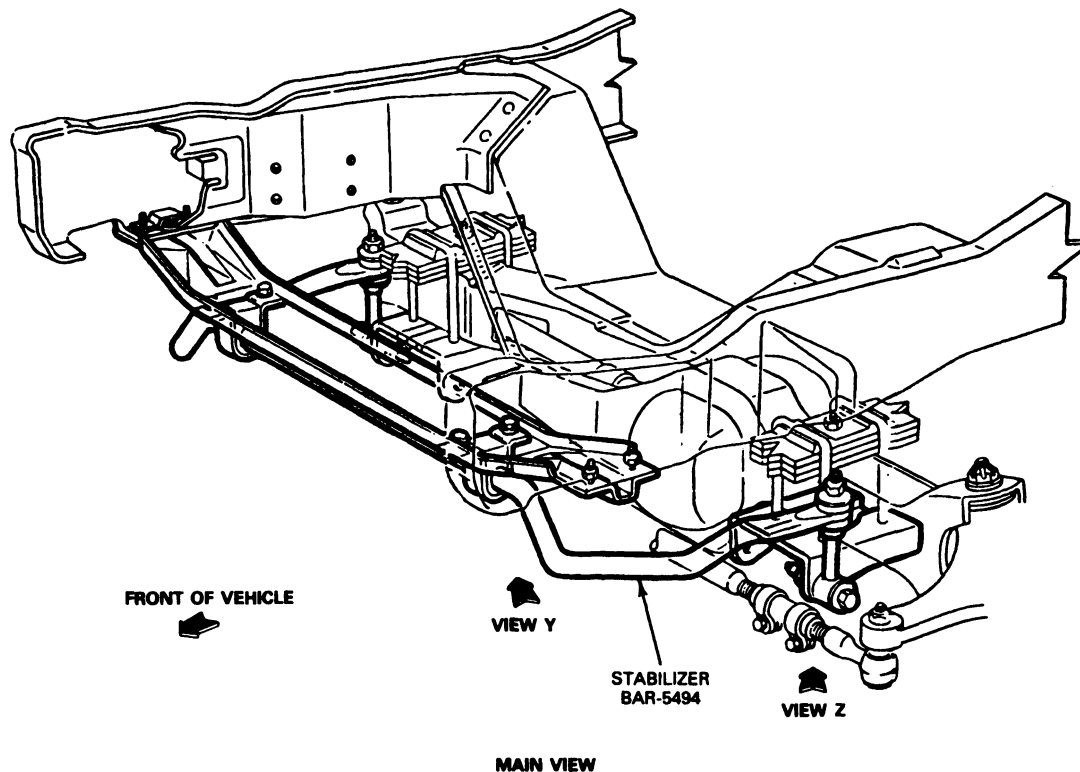
6. Remove stabilizer bar.

Installation

1. To reinstall, replace the components in reverse order of disassembly without tightening bolts.
2. Tighten nuts connecting links to spring seat caps on both sides 70-100 N·m (52-74 ft-lb).
3. Tighten nuts connecting links to stabilizer bar 21-33 N·m (15-25 ft-lb).
4. Tighten nuts and bolts connecting retainers to mounting bracket 35-50 N·m (27-37 ft-lb).

REMOVAL AND INSTALLATION (Continued)

Front Stabilizer Bar Installation, F-250 4x4 with Dana Model 50 IFS Front Drive Axle



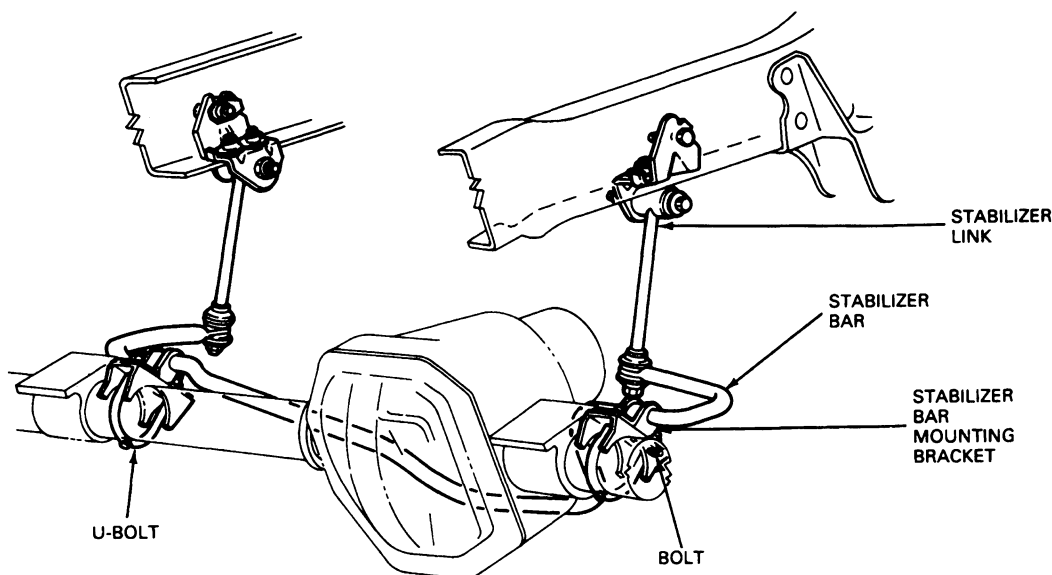
F2000-D

REMOVAL AND INSTALLATION (Continued)**F-350 4x4****Removal**

1. Disconnect left and right ends of the front stabilizer bar from the link assembly attached to the frame side rail mounting brackets.
2. Disconnect the retainer bolts and U-bolt. Remove the stabilizer bar from the front axle.
3. Remove stabilizer link from the frame side rail mounting brackets.

Installation

1. Loosely assemble the entire stabilizer bar system with both link assemblies loosely attached to the frame mounting brackets.
2. Position stabilizer bar on the axle.
3. Check to be sure stabilizer bar insulators are seated in the retainers, and stabilizer bar is centered between the front leaf springs.
4. Attach the stabilizer bar to the axle by assembling the retainers to the axle mounting brackets. Tighten retaining bolts and U-bolt to 48-68 N·m (35-50 ft-lb).
5. Install the link assemblies to the frame mounting brackets using the bolts, washers, and locknuts. Tighten the locknut to 70-100 N·m (52-74 ft-lb).
6. Install the link assembly to the stabilizer bar with two cup washers, two rubber insulators, and one locknut. Tighten the locknut to 21-32 N·m (15-25 ft-lb).

Stabilizer Bar Installation, F-350 4x4 with Dana Model 60 Monobeam Front Drive Axle

E6336-2A

SPECIFICATIONS**FRONT SUSPENSION TORQUE LIMITS, F-150-250 (4x4) AND BRONCO**

Description	Lb-Ft	N·m
Radius Arm to Axle, Upper Stud Bronco, F-150 (4x4)	240-260 (Hand Tighten)	326-352
Radius Arm to Axle, Lower Bolt Bronco, F-150 (4x4)	320-340 (Hand Tighten)	434-461
Front Spring to Axle U-Bolt F-250 (4x4)	85-120	115-163
Front Spring Assembly to Hanger Bracket F-250 (4x4)	120-150	163-203
Front Spring Shackle to Shackle Bracket F-250 (4x4)	150-210	203-285

(Continued)

FRONT SUSPENSION TORQUE LIMITS, F-150-250 (4x4) AND BRONCO (Cont'd)

Description	Lb-Ft	N·m
Front Spring to Shackle F-250 (4x4)	120-150	163-203
Radius Arm to Bracket Bronco, F-150 (4x4)	80-120	109-163
Spring Retainer to Spring Seat and Shock Bracket Bronco, F-150 (4x4)	13-18	18-24
Lower Spring Retainer to Radius Arm Bronco, F-150 (4x4)	70-100	94-134
Front Shock Bracket to Frame F-250 (4x4)	52-74	71-100

(Continued)

SPECIFICATIONS (Continued)**FRONT SUSPENSION TORQUE LIMITS, F-150-250 (4x4)
AND BRONCO (Cont'd)**

Description	Lb-Ft	N-m
Front Shock to Shock Bracket — Lower Bronco, F-150 (4x4)	52-74	71-100
Front Shock Absorber Stud — Upper Bronco, F-150 (4x4)	25-35	34-47
Front Shock to Front Spring Plate Spacer — Lower F-250 (4x4)	52-74	70-100
Front Shock to Bracket — Upper F-250 (4x4)	52-74	70-100
Front Jounce Bumper to Bumper Bracket F-250 (4x4)	19-30	26-41
Bumper Bracket to Frame F-250 (4x4)	52-74	71-100
Front Jounce Bumper to Upper Spring Seat Bronco, F-150 (4x4)	14-22	19-30
Radius Arm Pivot Bracket to Frame Bronco, F-150 (4x4)	76-114	103-155
Stabilizer Bar Link to Bracket Bronco, F-150 (4x4)	52-74	71-100
Stabilizer Bar Link to Stabilizer Bar Bronco, F-150 (4x4)	52-74	71-100
Stabilizer Bar Retainer to Bracket and Bracket to Frame Bronco, F-150 (4x4) — SuperCab	27-37	37-50
Stabilizer Bar Retainer to Bracket Bronco, F-150 (4x4) SuperCab	27-37	37-50
Stabilizer Bar Bracket to Frame (R.H.) Bronco, F-150 (4x4) SuperCab	52-74	71-100
Stabilizer Bar Retainer to Crossmember and Mounting Bracket F-150 (4x4) Regular Cab	27-37	37-50
Axle Pivot Bracket to Frame F-150 (4x4) Bronco	76-114	103-155
Axle Pivot Bracket to Frame F-250 (4x4)	76-114	103-155

**FRONT SUSPENSION TORQUE LIMITS, F-350 4x4 WITH
DANA 60 MONOBEAM FRONT DRIVE AXLE**

Description	Lb-Ft	N-m
Bumper to Mounting Bracket to Frame	52-74	70-100
Bumper to Mounting Bracket	18-29	25-40

(Continued)

**FRONT SUSPENSION TORQUE LIMITS, F-350 4x4 WITH
DANA 60 MONOBEAM FRONT DRIVE AXLE (Cont'd)**

Description	Lb-Ft	N-m
Front Shock Bracket to Frame	52-74	70-100
Front Shock to Shock Bracket—Upper	52-74	70-100
Front Shock to Spacer Plate Bracket—Lower	52-74	70-100
Front Spring Assembly to Shackle	120-150	163-203
Front Spring Assembly to Spring Bracket	120-150	163-203
Front Spring Shackle to Frame	150-210	203-285
Stabilizer Bar Link Assembly Mounting Bracket to Frame	35-50	48-68
Stabilizer Bar Link Assembly to Mounting Bracket	52-74	70-100
Stabilizer Bar to Link Assembly	15-25	21-33
Tie Rod End to Spindle Arm	52-74	70-100
Tracking Bar Assembly to Mounting Bracket	120-150	163-203
Tracking Bar Mounting Bracket to Crossmember	77-110	104-149
U-Bolt to Front Spring Cap	85-120	115-163
U-Bolt to Stabilizer Bar Mounting Bracket—R.H.	35-50	48-68
Stabilizer Bar to Mounting Bracket—L.H.	35-50	48-68

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
077-00002	Hydraulic Floor Jack

SECTION 04-02 Suspension, Rear

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Service Spring Clip Installation	04-02-19	Rear Shock Absorber, F-150-250-350, Lightning, F-Super Duty Chassis Cab and Bronco	04-02-2
Tip Liner Installation	04-02-19	Rear Shock Absorber, F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles	04-02-2
Vehicle Lean	04-02-18	Rear Spring	04-02-4
F-150-250-350 4x2 and 4x4, F-Super Duty Chassis Cab and Bronco	04-02-18	E-150-250-350	04-02-12
F-Super Duty Commercial Chassis	04-02-19	F-150-250-350 4x2 and 4x4, Lightning, F-Super Duty Chassis Cab, Commercial Chassis, Motorhome Chassis and Bronco	04-02-4
F-Super Duty Motorhome	04-02-19	Rear Stabilizer Bar	04-02-13
DESCRIPTION AND OPERATION		SPECIAL SERVICE TOOLS/EQUIPMENT	04-02-21
Rear Suspension	04-02-1	SPECIFICATIONS	04-02-20
DIAGNOSIS AND TESTING		VEHICLE APPLICATION	04-02-1
Rear Leaf Spring	04-02-1		
Vehicle Lean Check	04-02-1		
REMOVAL AND INSTALLATION			
Rear Shock Absorber, E 150-250-350	04-02-2		

VEHICLE APPLICATION

Econoline, F-150-250-350, Lightning, F-Super Duty Series and Bronco Vehicles

DESCRIPTION AND OPERATION

Rear Suspension

Semi-elliptic, leaf-type springs are used for the rear axle suspension. The forward end of each spring is attached to a bracket on the frame sidemember. The rear end of each spring is shackled to a bracket on the frame sidemember.

Optional auxiliary rear springs are mounted on top of the main spring with free ends. These provide load carrying capacity and stability. Auxiliary springs are standard on all F-350 and all F-Super Duty series vehicles (except F-Super Duty Motorhome Stripped Chassis).

DIAGNOSIS AND TESTING

Vehicle Lean Check

Refer to Section 04-00 for diagnosis and testing.

Rear Leaf Spring

CONDITION	POSSIBLE SOURCE	ACTION
Squeak	<ul style="list-style-type: none"> Loose mounting bolts. Loose shackle bushing. Loose spring. 	<ul style="list-style-type: none"> Tighten. Replace. Install spring tip liners (if none currently installed). Refer to Tip Liner Installation in this section.
Spring clip damaged.	<ul style="list-style-type: none"> Service damage. 	<ul style="list-style-type: none"> Install new service clip. Refer to Service Clip Installation in this section.
Metal burrs rubbing between the leaves.	<ul style="list-style-type: none"> Clip rivet. 	<ul style="list-style-type: none"> Remove burrs.

TF8244A

REMOVAL AND INSTALLATION

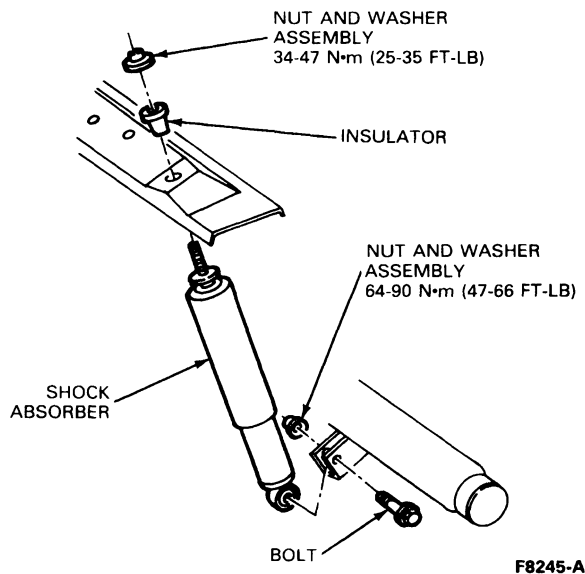
Rear Shock Absorber, E 150-250-350

CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kPa (135 psi). Do not attempt to open, puncture or apply heat to the shock absorbers.

Removal and Installation

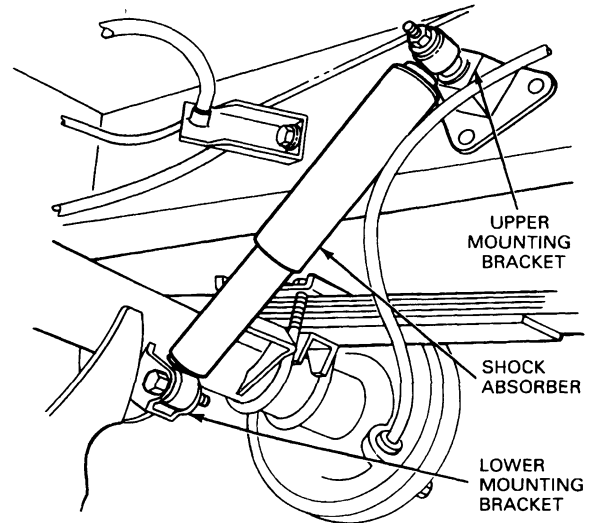
1. Raise the vehicle on a hoist.
2. Remove the shock absorber lower attaching nut and bolt, and swing the lower end free of the mounting bracket on the axle housing.
3. Remove the attaching nut from the upper end of mounting stud.
4. Remove the shock absorber. Use a back-up wrench on the upper shock stud to prevent rotation.

For installation, for removal procedures in reverse order. Tighten upper nut and washer to 34-47 N·m (25-35 ft·lb) and lower nut and washer to 64-90 N·m (47-66 ft·lb).



F8245-A

2. Remove the shock absorber lower attaching nut and bolt, and swing the lower end free of the mounting bracket on the axle housing.
3. Remove the nut from the upper shock absorber mount.



F5635-B

For installation, follow removal procedures in reverse order. Tighten upper and lower nuts to specifications listed at the end of this section.

Rear Shock Absorber, F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles

CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kPa (135 psi). Do not attempt to open, puncture, or apply heat to shock absorbers.

Removal and Installation

1. Raise vehicle on hoist.
2. Remove shock absorber lower nut, bolt, and washers.
3. Swing lower end of shock out of axle bracket.
4. Remove nut, bolt, and washer securing top end of shock and remove.

For installation, follow removal procedures in reverse order. Tighten fasteners to 300-405 N·m (200-300 ft·lb).

Rear Shock Absorber, F-150-250-350, Lightning, F-Super Duty Chassis Cab and Bronco

CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kPa (135 psi). Do not attempt to open, puncture or apply heat to the shock absorbers.

Removal and Installation

1. Raise the vehicle on a hoist.

REMOVAL AND INSTALLATION (Continued)

Rear Shock Absorber, F-Super Duty Commercial Chassis and Motorhome Chassis

U-BOLTS 5705

BOLT 58749

WASHER 44882

WASHER 44882

NUT 300-405 N-m (220-300 FT-LB)

NUT 155-230 N-m (114-170 FT-LB)

BRACKET 18169

SHOCK ABSORBER 18125

WASHER 44882

BOLT 58749

CAP 5796

NUT 300-405 N-m (220-300 FT-LB)

WASHER 44882

U-BOLTS 5705

PLATE 5796

BOLT 605843

WEDGE 4357

F6457-D

Item	Part Number	Description
1	5705	U-Bolts
2	58749	Bolt
3	44882	Washer
4	44882	Washer
5	34992	Nut 300-405 N-m (220-300 Ft-Lb)
6	5705	U-Bolts
7	605843	Bolt
8	5796	Plate
9	4357	Wedge (Commercial Only)

(Continued)

Item	Part Number	Description
10	34992	Nut 300-405 N-m (220-300 Ft-Lb)
11	44882	Washer
12	384032	Nut 300-405 N-m (220-300 Ft-Lb)
13	5796	Cap
14	58749	Bolt
15	44882	Washer
16	18125	Shock Absorber
17	18169	Bracket
18	N620485	Nut 155-230 N-m (114-170 Ft-Lb)

TF6457A

REMOVAL AND INSTALLATION (Continued)

Rear Spring

F-150-250-350 4x2 and 4x4, Lightning, F-Super Duty Chassis Cab, Commercial Chassis, Motorhome Chassis and Bronco

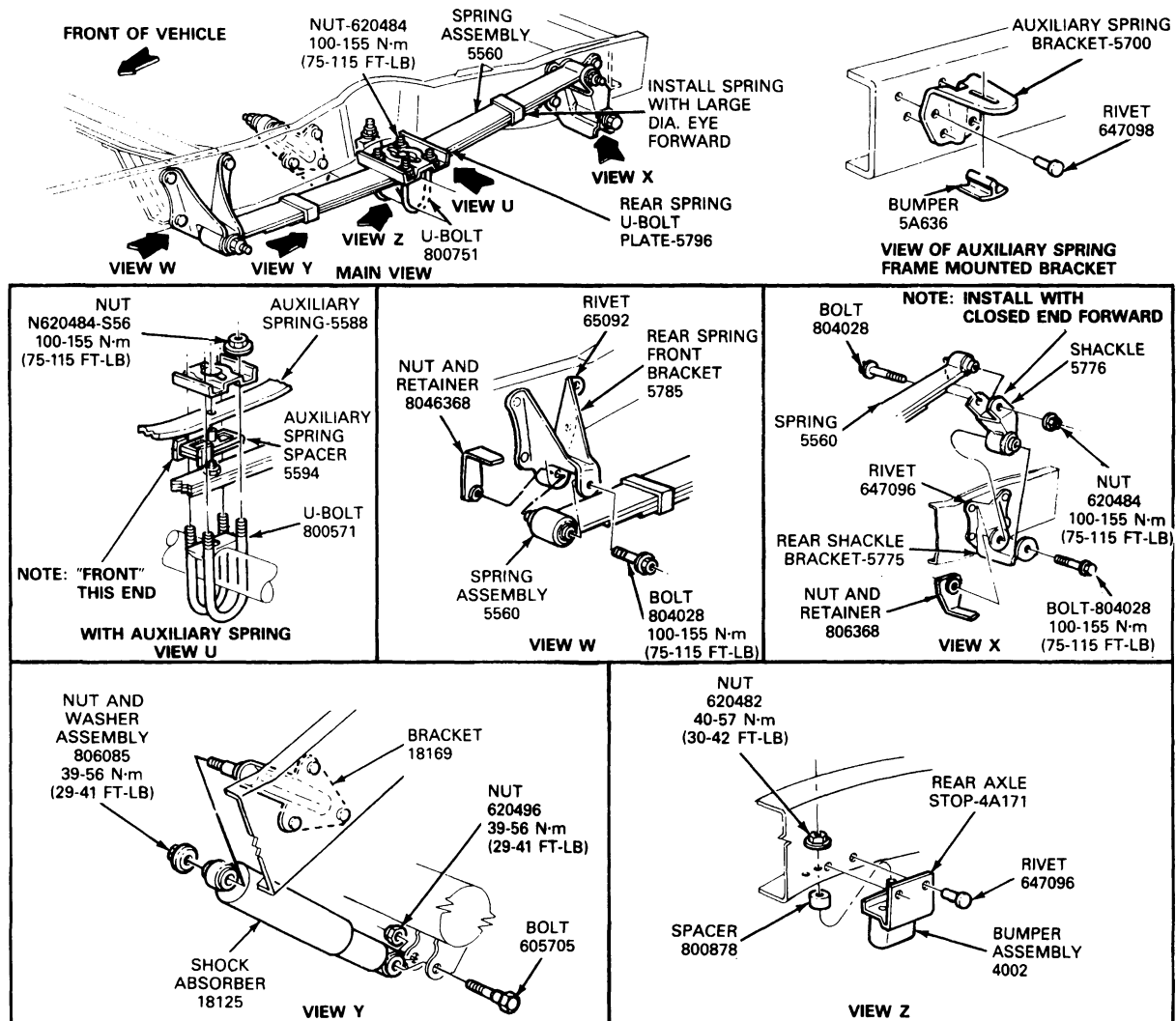
Removal and Installation

1. Raise the vehicle frame until the weight is off the rear spring, with the tires still touching the floor.
2. Remove the nuts from the spring U-bolts and drive the U-bolts from the U-bolt plate.
3. If equipped, remove the auxiliary spring and spacer.

4. Remove the spring-to-bracket nut and bolt at the front of the spring.
5. Remove the shackle lower nuts and bolts at the rear of the spring.
6. Remove the spring and shackle assembly from the rear shackle bracket.
7. Remove the bolt and nut that secures the shackle to the spring.

For installation, follow removal procedures in reverse order. Tighten the spring U-bolt nuts to specifications as listed at the end of this section. Tighten the front spring bolt and nut and the rear shackle bolts and nuts to specifications as listed at the end of this section.

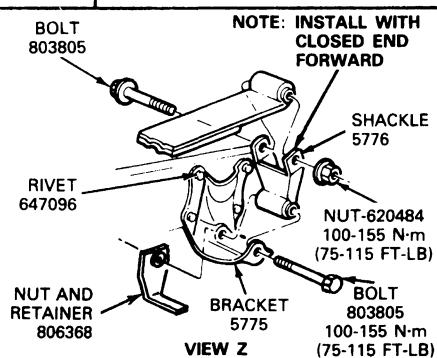
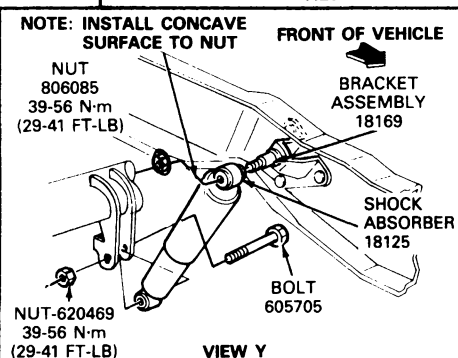
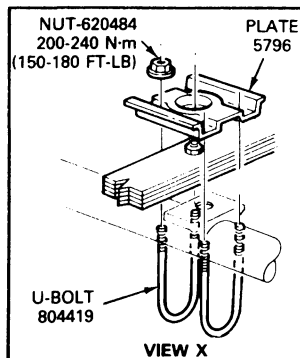
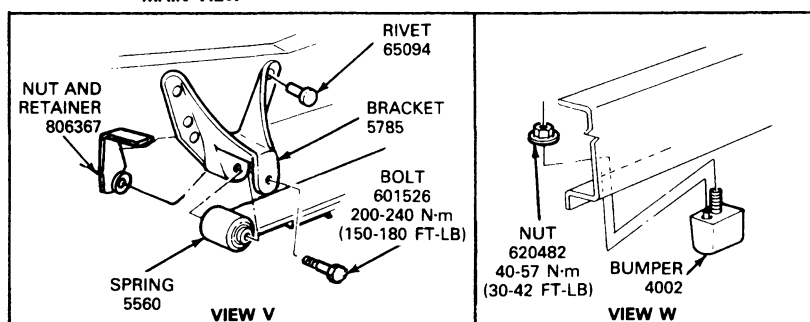
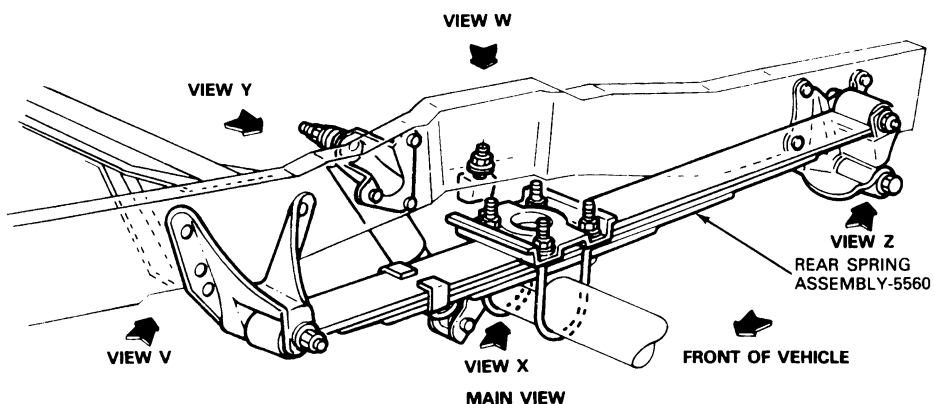
Rear Spring Installation, F-150 4x2, Lightning Similar



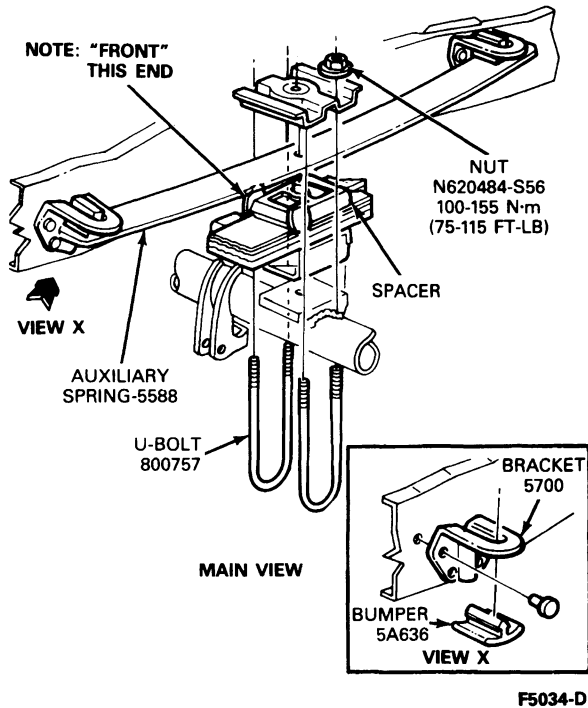
F2846-L

REMOVAL AND INSTALLATION (Continued)

Rear Spring Installation, Conventional, F-250-350 4x2 Regular Cab and SuperCab

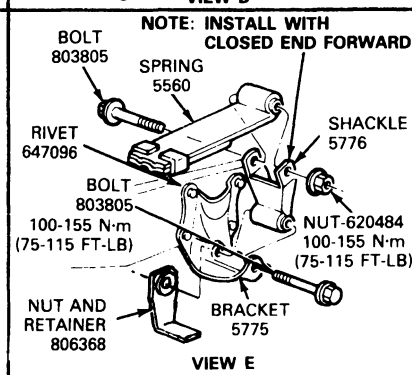
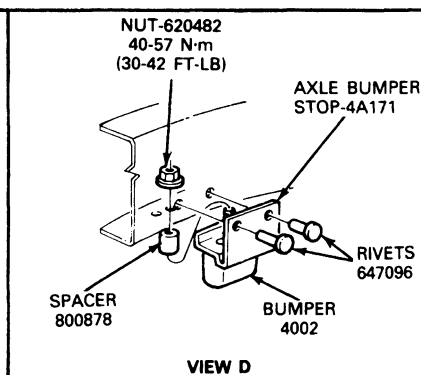
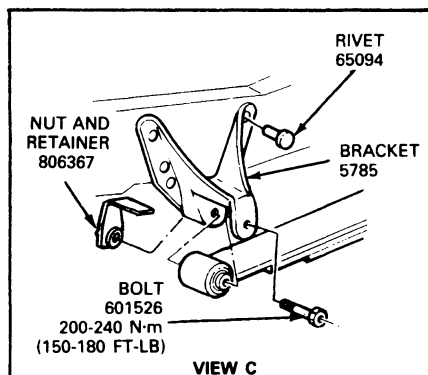
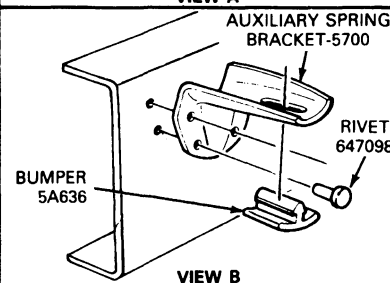
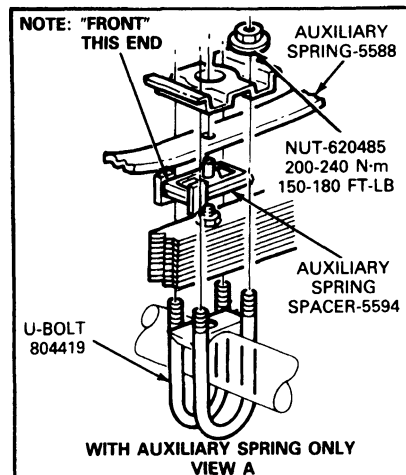
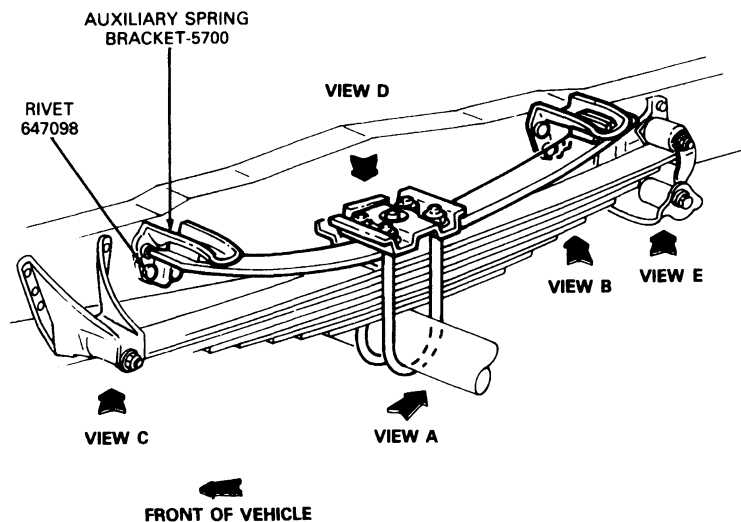


F5029-D

REMOVAL AND INSTALLATION (Continued)**Rear Spring Installation with Auxiliary Spring,
F-150-250-350 4x4**

REMOVAL AND INSTALLATION (Continued)

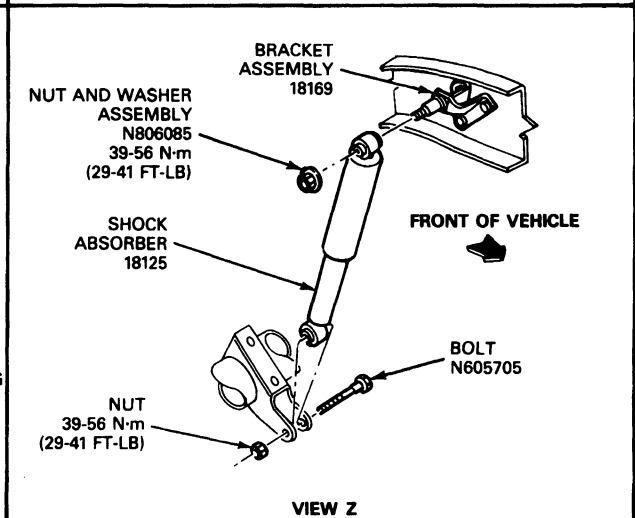
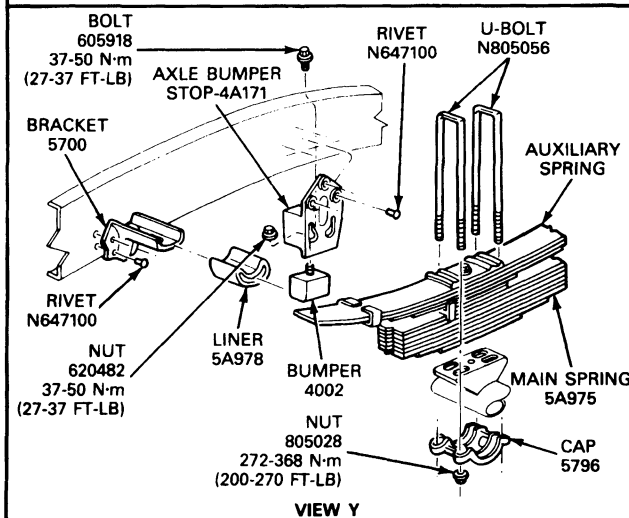
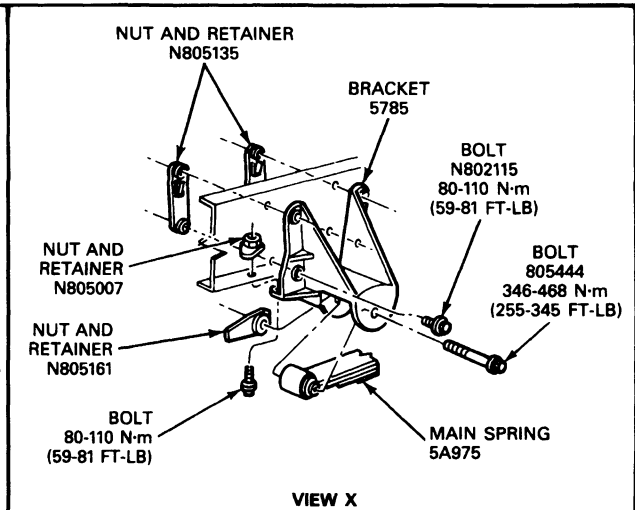
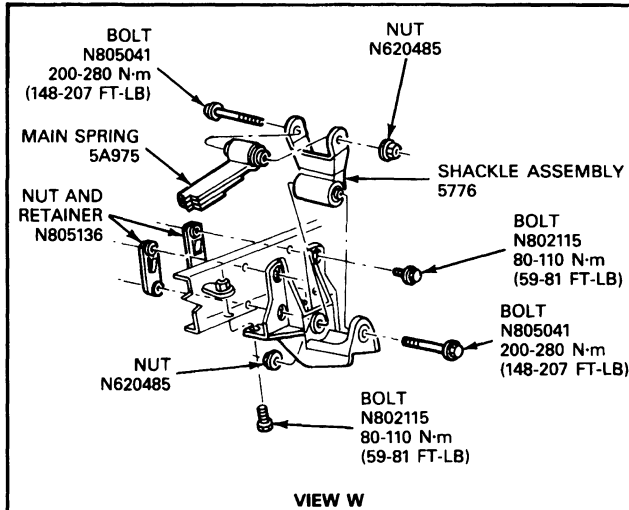
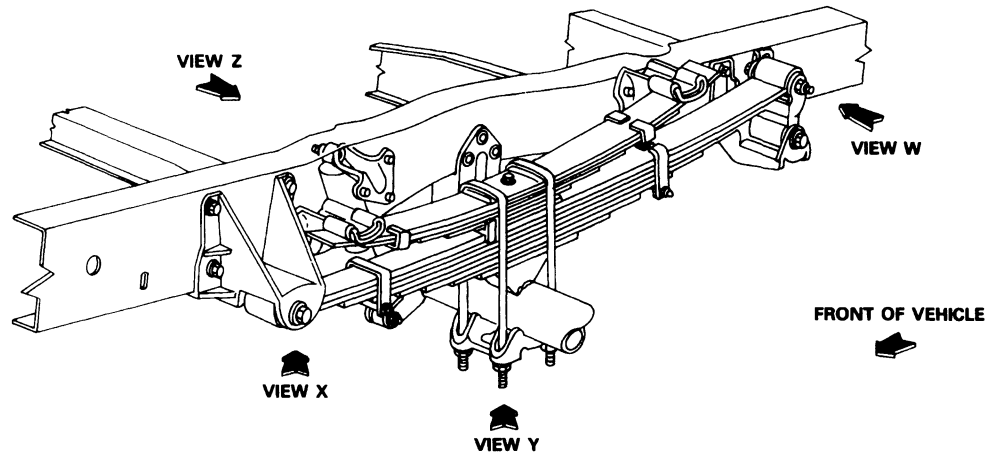
Rear Spring Installation with Auxiliary Spring, F-250-350 4x2, Regular and SuperCab



F5030-C

REMOVAL AND INSTALLATION (Continued)

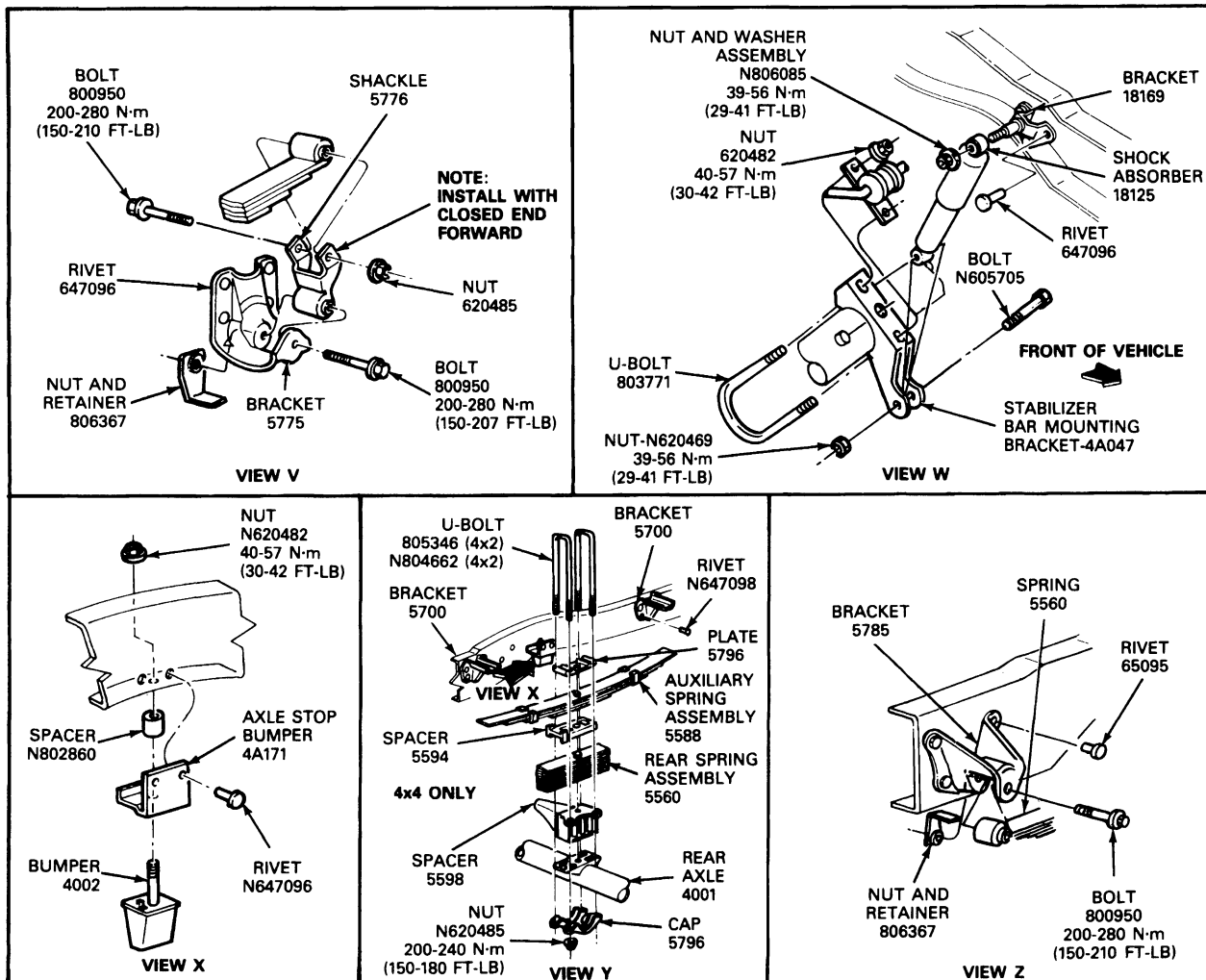
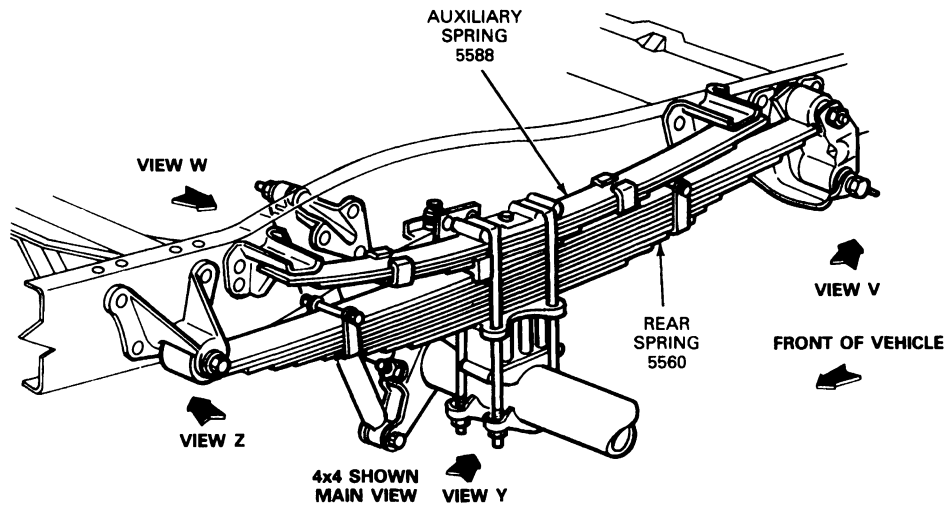
Rear Spring Installation, F-Super Duty Chassis Cab



F5649-E

REMOVAL AND INSTALLATION (Continued)

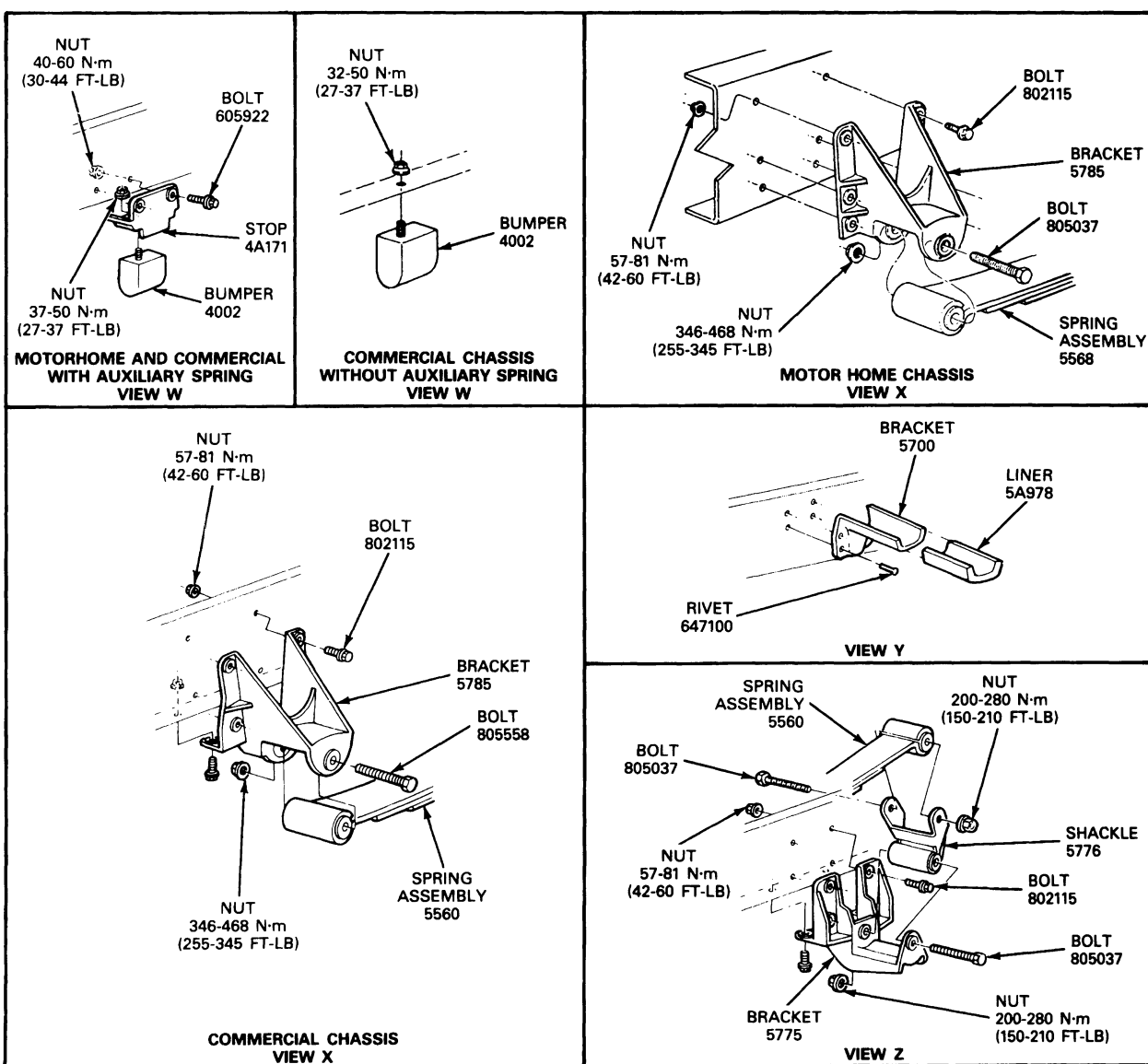
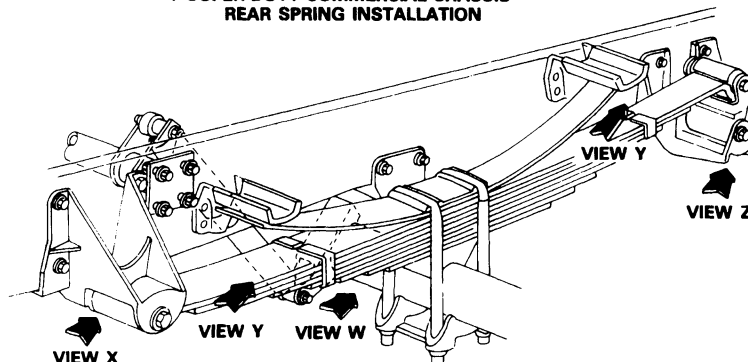
Rear Spring Installation, F-350 4x2 and 4x4 Chassis Cab



F5031-F

REMOVAL AND INSTALLATION (Continued)

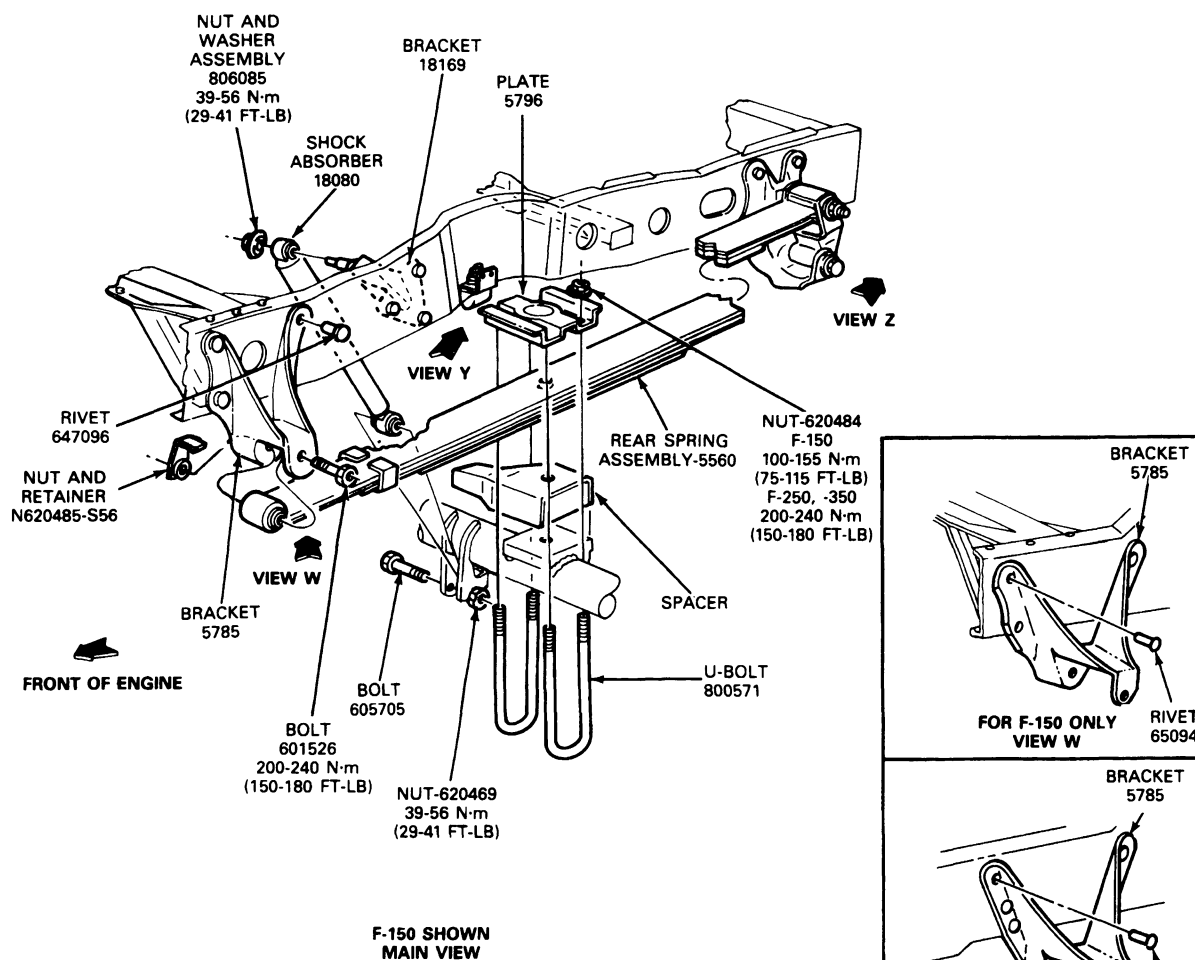
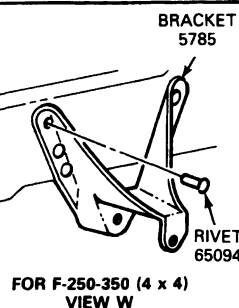
Rear Spring Installation, F-Super Duty Commercial Chassis and Motorhome Chassis

F-SUPER DUTY COMMERCIAL CHASSIS —
REAR SPRING INSTALLATION

F6458-C

REMOVAL AND INSTALLATION (Continued)

Rear Spring Installation, F-150-250-350 4x4

FOR F-150 ONLY
VIEW WNUT-620482
40-57 N-m
(30-42 FT-LB)BUMPER
4002

VIEW Y

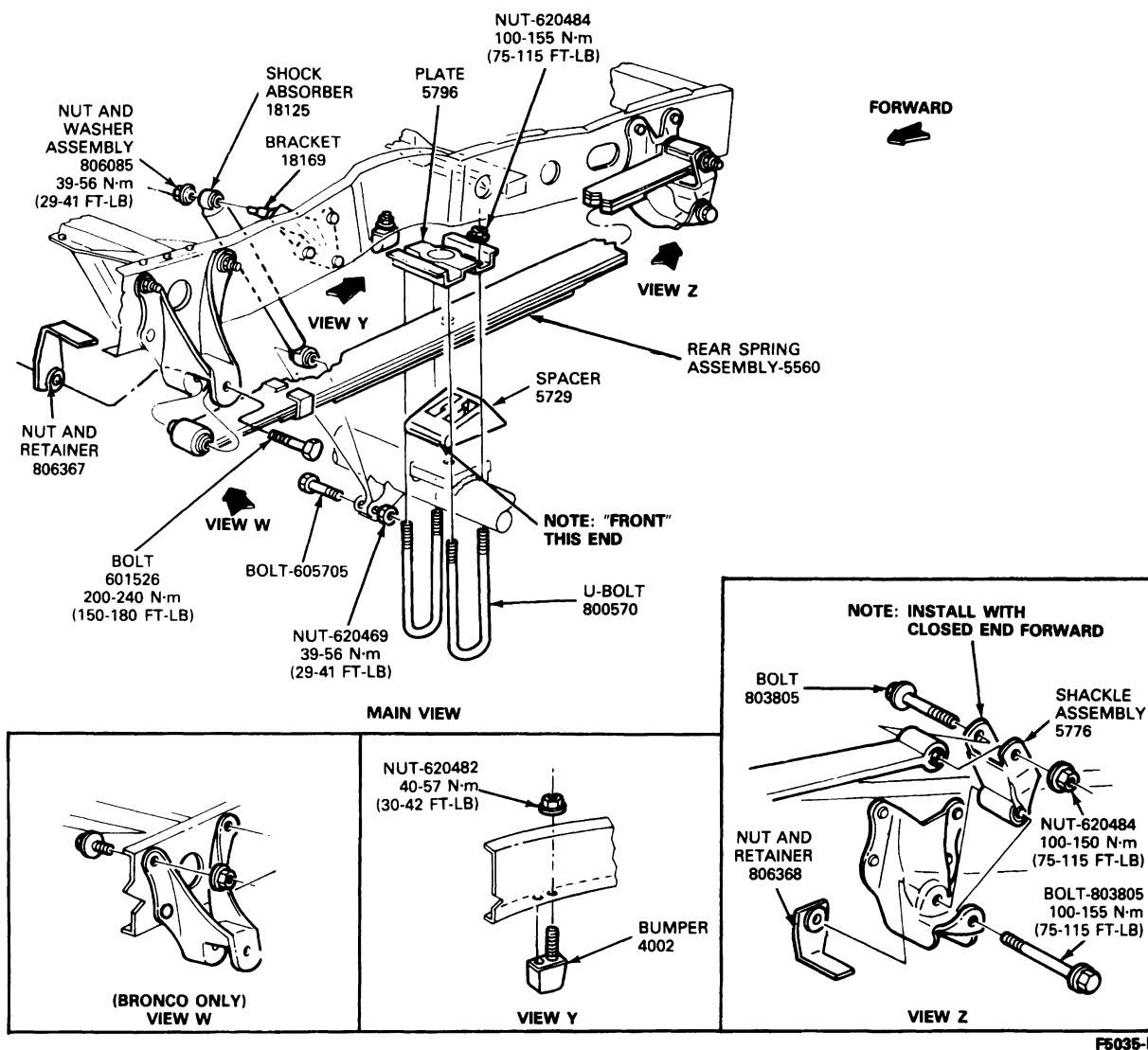
NUT-620482
40-57 N-m
(30-42 FT-LB)SPACER
800878BUMPER
4002WITH STOP AXLE BUMPER
VIEW YBUMPER
BRACKET
4A171RIVET
647096BOLT
803805NOTE:
INSTALL WITH
CLOSED END FORWARDNUT AND
RETAINER
8026368SHACKLE
ASSEMBLY
5776NUT-620484
100-155 N-m
(75-115 FT-LB)BRACKET
5775BOLT
803805
100-155 N-m
(75-115 FT-LB)

VIEW Z

F5033-F

REMOVAL AND INSTALLATION (Continued)

Rear Spring Installation, Bronco



E-150-250-350

Removal and Installation

1. Raise the rear end of the vehicle and support the chassis with safety stands. Support the rear axle with a floor jack or hoist.
2. Disconnect the lower end of the shock absorber from the bracket on the axle housing.
3. Remove the two spring U-bolts and U-bolt plate.
4. Lower the axle.
5. Remove the spring front bolt from the hanger.
6. Remove attaching bolts from rear shackle-to-frame.

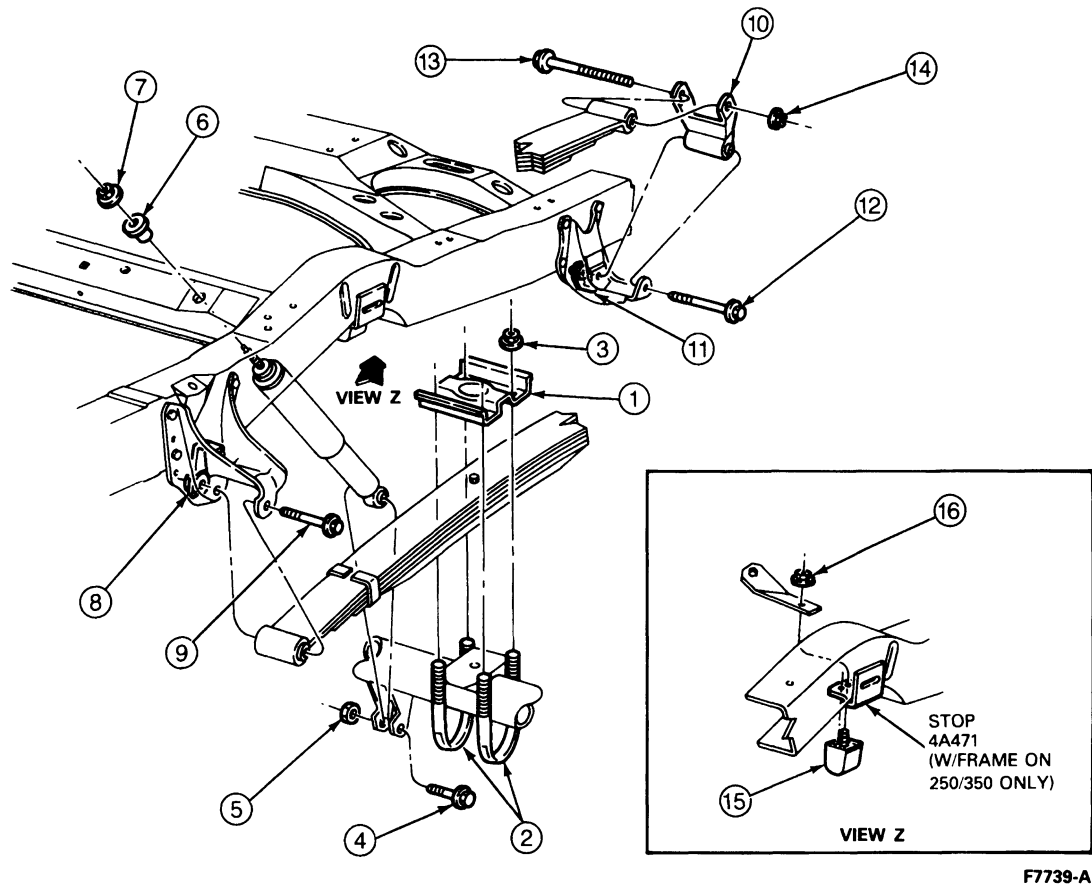
7. Remove spring and shackle from vehicle.
8. Remove shackle from spring.

NOTE: For vehicle lean diagnosis information refer to the procedures under Inspection in Section 04-00.

For installation, follow removal procedures in reverse order. Tighten the spring front mounting bolt and nut, the rear shackle nuts and spring U-bolt nuts. Tighten to specifications as listed at the end of this section.

REMOVAL AND INSTALLATION (Continued)

Rear Spring Installation, E-150-250-350



Item	Part Number	Description
1	5798	RR Spring Plate
2	N800751-S60	U-Bolt E-150
2	N803914-S60	U-Bolt E-250-350
3	N803956-S60	Nut 98-133 N·m (72-98 Ft·Lb) E-150
3	N620485-S60	Nut 148-202 N·m (109-148 Ft·Lb) E-250-350
4	N605704-S2	Bolt
5	N806496-S100	Nut 68-92 N·m (50-68 Ft·Lb)
6	18198	Insulator
7	N806246-S56	Nut & Washer 34-46 N·m (25-34 Ft·Lb)
8	N805367-S60	Nut & Retainer E-150
8	N807044-S36	Nut & Retainer E-250-350

(Continued)

Item	Part Number	Description
9	N807046-S60	Bolt & Washer 150-185 N·m (110-136 Ft·Lb) E-150
9	N806967-S56	Bolt 325-393 N·m (240-290 Ft·Lb) E-250-350
10	5776	Shackle Assembly
11	N806368-S60	Nut & Retainer
12	N806567-S60	Bolt & Washer 113-153 N·m (83-113 Ft·Lb) E-150
12	N806568-S60	Bolt & Washer 113-153 N·m (83-113 Ft·Lb) E-250-350
13	N806567-S60	Bolt E-150
13	N806568-S60	Bolt & Washer E-250-350
14	N620484-S60	Nut 113-153 N·m (83-113 Ft·Lb)
15	4002	Bumper Assembly
16	N803811-S36	Nut 34-46 N·m (25-34 Ft·Lb)

Rear Stabilizer Bar

F-150-250-350 4x2 and 4x4, F-Super Duty Chassis Cab, Motorhome Chassis and Bronco

Removal and Installation

1. Remove nut from lower end of stabilizer bar link.

2. Remove outer washer and insulator. Disconnect stabilizer bar from link.
3. Remove inner insulators and washers. Disconnect link from frame by removing nuts and bolts.

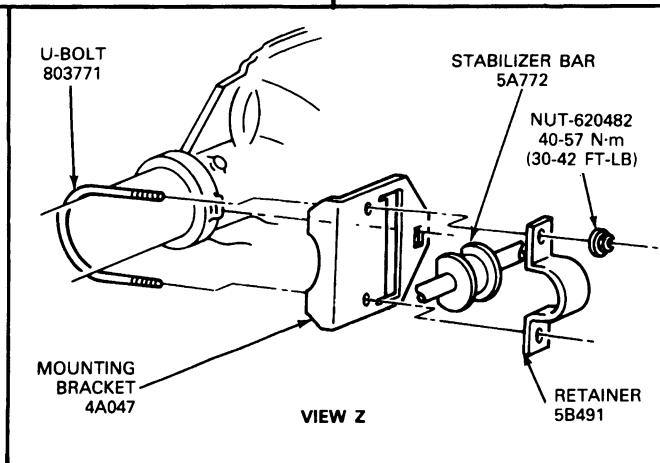
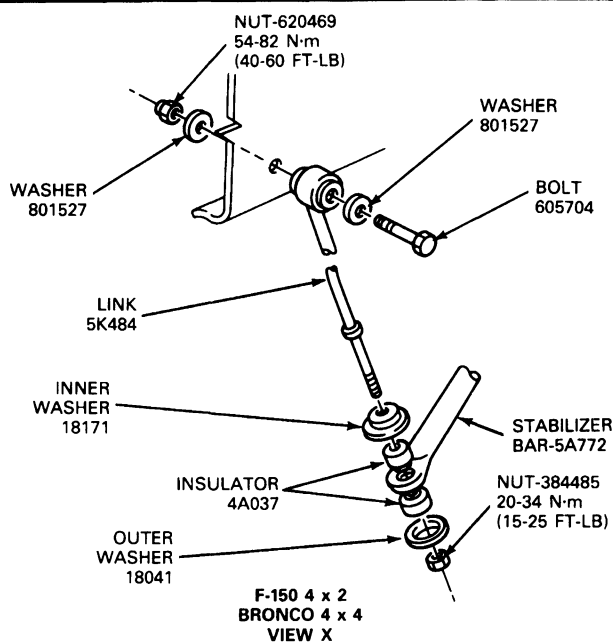
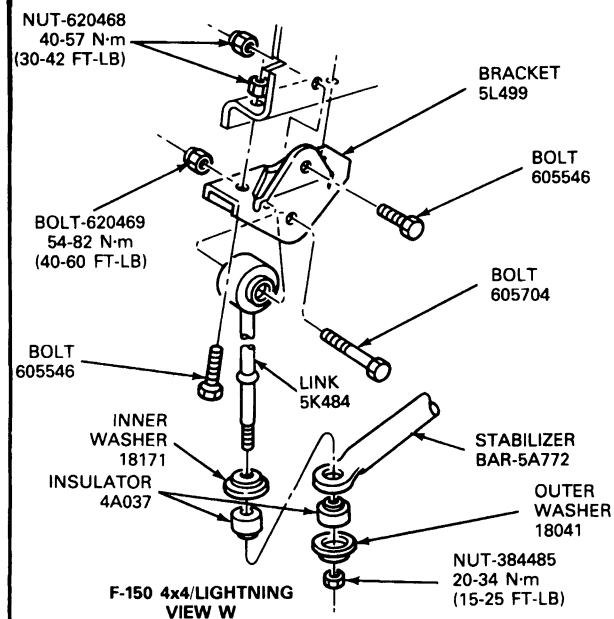
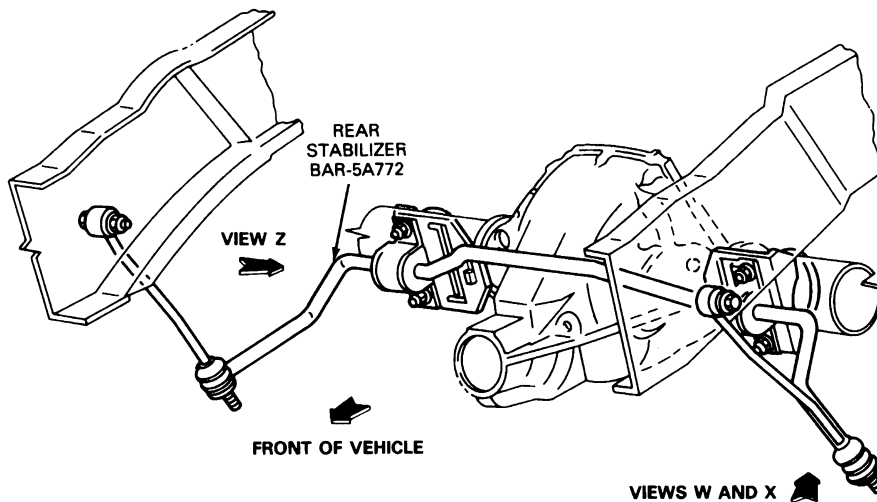
REMOVAL AND INSTALLATION (Continued)

4. Remove nuts or bolts which fasten U-bolts, brackets and retainers to rear axle.

For installation, follow removal procedures in reverse order. Tighten fastener to specifications.

REMOVAL AND INSTALLATION (Continued)

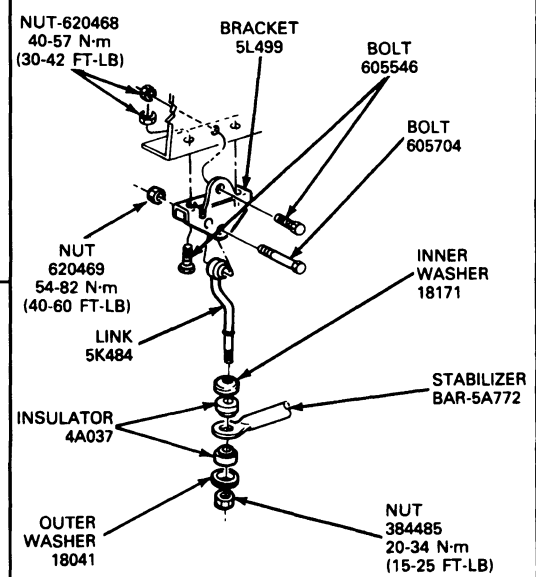
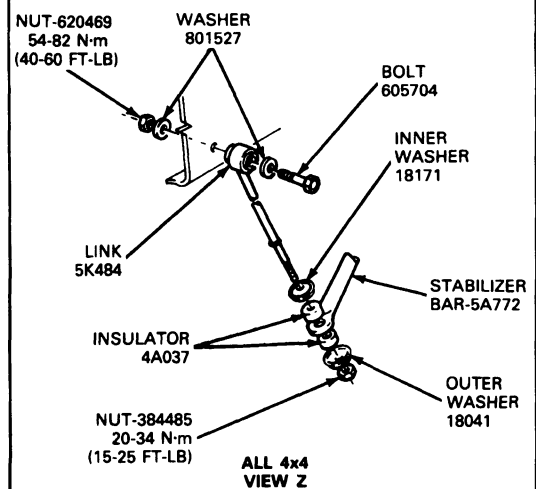
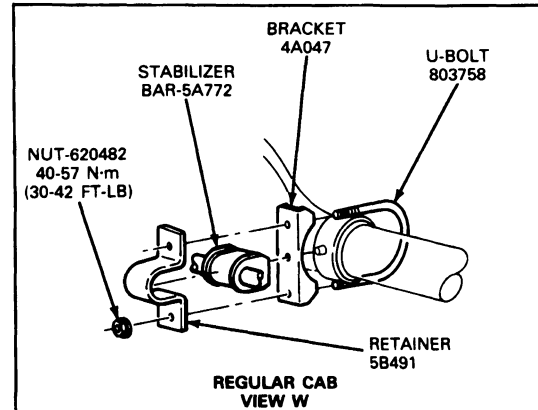
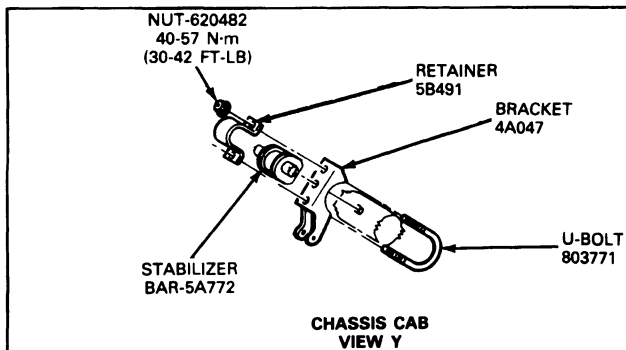
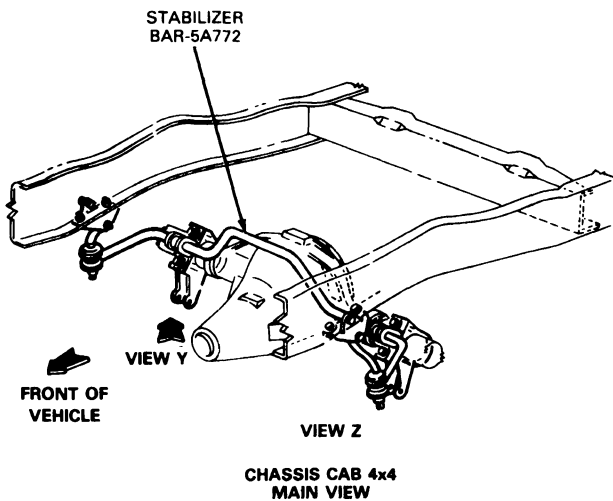
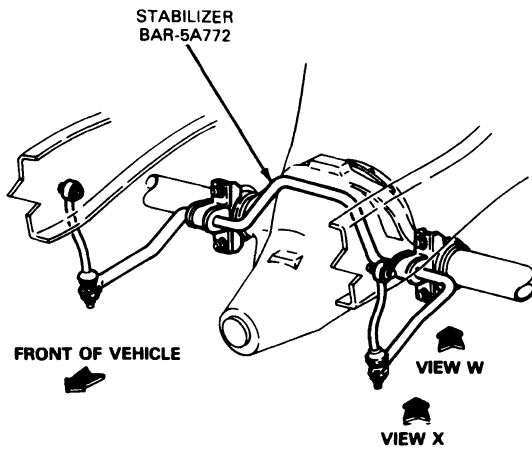
Rear Stabilizer Bar Installation, Bronco, F-150 4x2 and 4x4 and Lightning



F3713-H

REMOVAL AND INSTALLATION (Continued)

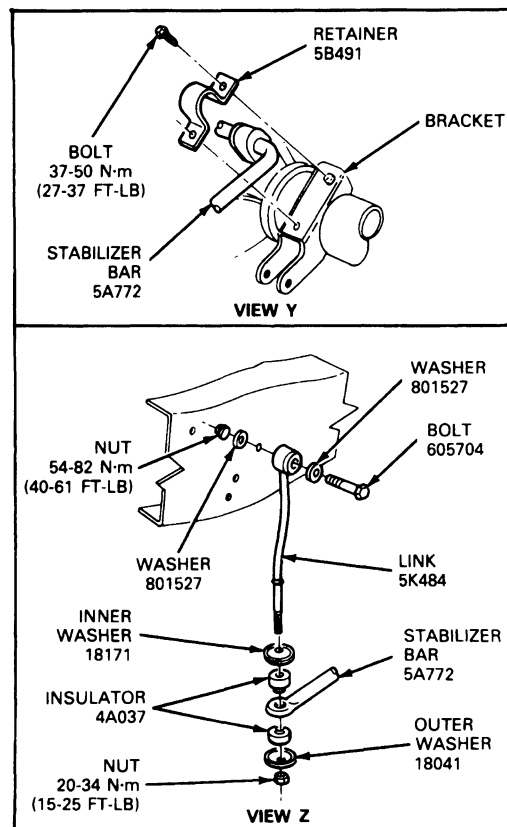
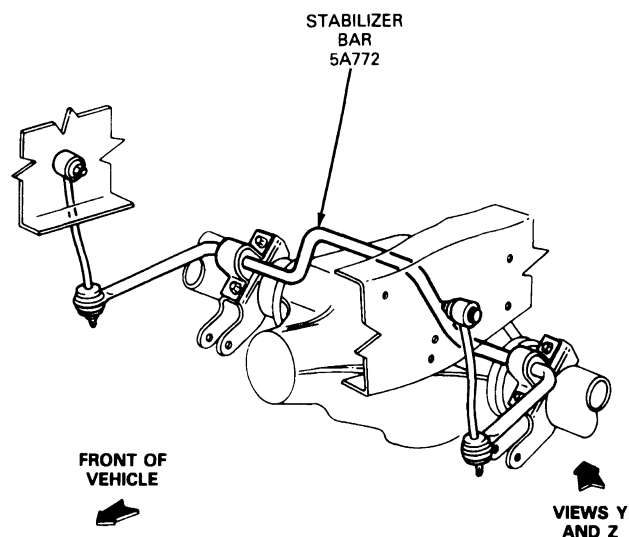
Rear Stabilizer Bar Installation, F-250-350



F3714-G

REMOVAL AND INSTALLATION (Continued)

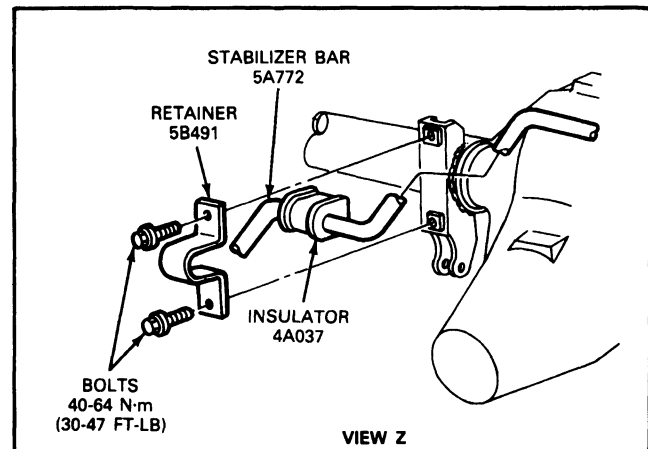
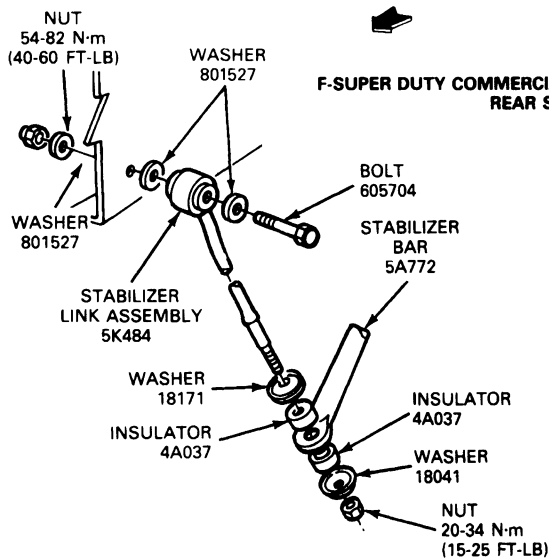
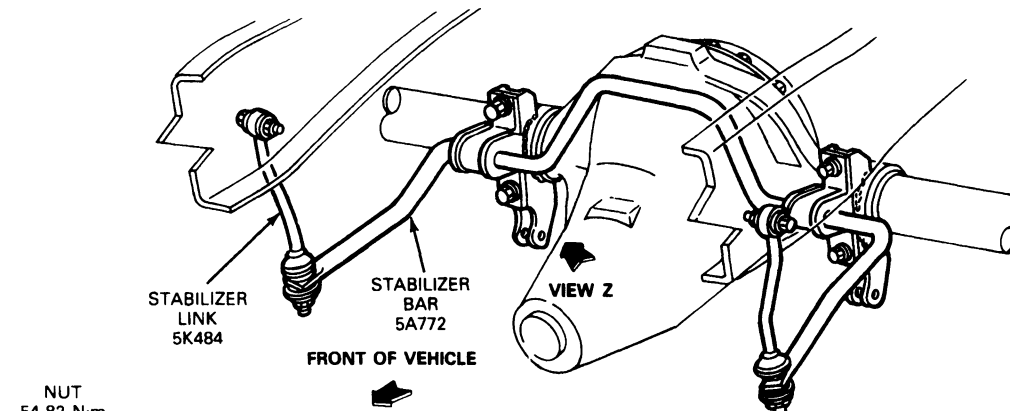
Rear Stabilizer Bar Installation, F-Super Duty Chassis Cab



F5650-B

REMOVAL AND INSTALLATION (Continued)

Rear Stabilizer Bar Installation, F-Super Duty Motorhome Chassis



F6459-C

ADJUSTMENTS

Vehicle Lean

F-150-250-350 4x2 and 4x4, F-Super Duty Chassis Cab and Bronco

A side-to-side lean at the rear of the vehicle can be adjusted by approximately 9.52mm (3/8 inch) by:

- Installing a shim between the rear spring and axle on the low side of the vehicle.
- A "low at the rear" vehicle can be raised approximately 9.52mm (3/8 inch) by installation of one shim on each side.
- If side-to-side lean at rear is greater than 12.70mm (1/2 inch), switch the rear springs side-to-side. Use the following procedure to install the shim (D7TA-5742-AA):

1. Raise the vehicle frame until the weight is off the rear springs with the tires still touching the floor.
2. Loosen the spring U-bolts to allow the axle to separate from the spring approximately 12.70mm (1/2 inch).
3. Position the shim (D7TA-5742-AA) between the spring and axle with the long edge of the shim parallel to the side of the spring and the spring tie bolt head through the hole in the shim. On 4x4 vehicles, position the shim between the rear spring and axle space. Tape may be used to hold the shim in position.
4. Make sure spring leaves are properly aligned and the spring U-bolts contact the edges of the spring assembly or axle seat.

ADJUSTMENTS (Continued)

5. Tighten the spring U-bolt sufficiently so the spring tie bolt head that extends through the shim enters the hold in the axle seat.

NOTE: For additional vehicle lean information, refer to the procedures under Inspection in Section 04-00.

F-Super Duty Commercial Chassis

1. Shift load to level out the vehicle.
2. Install auxiliary rear springs.

F-Super Duty Motorhome

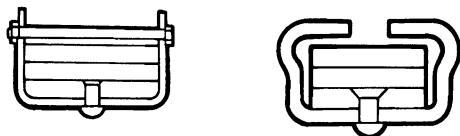
Front — Obtain Vehicle Attitude Kit F1TD-5K648-AA and follow installation instructions in kit.

Rear — Obtain Rear Spring (Raise) Kit F1TD-5A581-AA and follow installation instructions in kit.

Tip Liner Installation

1. Raise the vehicle by the frame so the rear axle hangs freely.
2. Provide clearance between the leaves of the spring to allow insertion of the tip liners. This will require either the removal of the restraining bolt on the spring clip, or the bending of the wrap-around clip ends, depending upon the type of clip. A prybar may be used at time of tip liner insertion to gain additional clearance.

SPRING CLIPS



F7738-A

3. Slide the liner (5586) between the leaves until the liner extends approximately 6.35mm (0.25 inch) beyond the tip of the lower leaf.

NOTE: Do not attempt to install a liner between the lowest primary leaf and the short, 12.70mm (0.50 inch) thick secondary leaf found at the bottom of the leaf stack on some assemblies.

4. Position a jack, such as Rotunda Transmission Jack 066-00016 or equivalent and raise the rear axle to load the rear leaf springs placing the leaves in contact with one another at the clip locations.

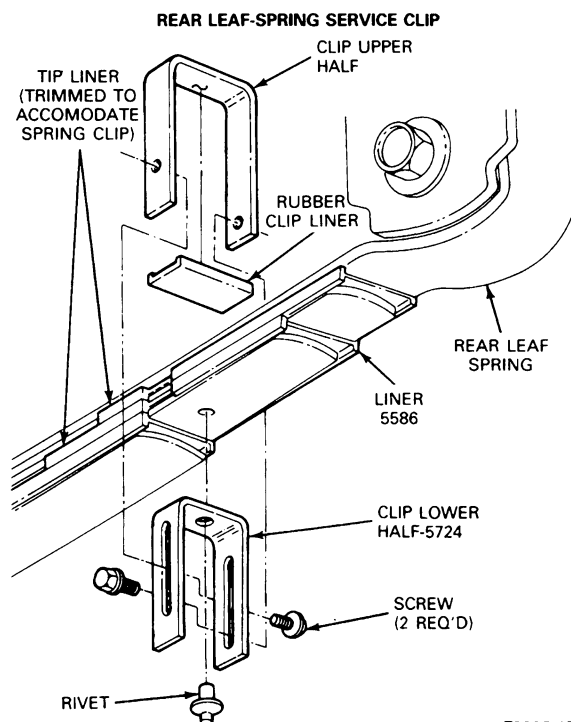
5. Install production clips or install the replacement service clip.

NOTE: On some of the tip liners, sections of the edge used to center the liner on the spring leaves may need to be trimmed off to accommodate the spring clip.

Service Spring Clip Installation

1. Load the rear leaf springs with the rear of the vehicle supported, either directly by the rear axle or by the tires.

NOTE: The spring leaves should all be in contact with one another at the intended clip location.



F3305-1B

2. Remove the damaged clip by either removing the restraining bolt or by prying back the ends of the clip which are folded across the leaf spring until the clip can be freed from the spring. On some clips it will also be necessary to pry the locating pin out of the locating hole. (Locating holes are the holes punched out of the lowest leaf the clip encircles which indicated the proper spring clip location.)
3. Make sure locating hole is clean and free of debris.
4. Position the lower part of the service clip (5724) across the width of the underside of the spring aligning hole in the clip with the locating hole in the spring. The legs of the clip lower half should extend down from the bottom of the spring.

ADJUSTMENTS (Continued)

5. Insert the drive rivet, that comes with the clamp, through the hole in the lower part of the service clip into the hole in the spring leaf. The flat face of the rivet flange should rest against the clip lower half.
6. Fully seat the rivet with a hammer. If there is not enough room to hit the rivet directly with a hammer, a punch may be used. The slotted legs of the clip lower half should extend downward, the outer surface of the legs flush with the sides of the leaf spring.
7. Place the rubber service clip liner across the top of the leaf spring, directly above where the bottom half of the clip attaches to the spring, with the flat surface against the leaf and the clip locating edges extending upward.
8. Place the clip upper half between the locating edges of the rubber liner.
9. Align the threaded holes in the clip upper half with the slots in the clip lower half.
10. Hand start the two screws through the clip lower half slot into the clip upper half threaded hold. The screw heads will be located under the spring, against the inner surface of the clip lower half.
11. Squeeze the clip to the spring with one hand while tightening the screws. Tighten to 21-27 N-m (15-20 ft-lb).

SPECIFICATIONS**TORQUE SPECIFICATIONS, F-SUPER DUTY COMMERCIAL CHASSIS AND MOTOR HOME CHASSIS**

Description	N-m	Lb-Ft
Jounce Bumper to Frame Nut	37-50	27-37
Leaf Spring to Axle U-Bolt Nut	300-405	220-300
Leaf Spring to Front Bracket Nut and Bolt	346-468	255-345
Leaf Spring to Rear Shackle Bracket Nut and Bolt	200-280	150-210
Rear Shackle to Frame Mounted Bracket Nut and Bolt	200-280	150-210
Shock Absorber (Lower Mount) to Axle Nut and Bolt	300-405	220-300
Shock Absorber (Upper Mount) to Bracket Nut and Bolt	300-405	220-300
Shock Absorber Upper Bracket to Frame Nuts and Bolts	300-405	220-300
Stabilizer Bar to Axle Bolt	40-64	30-47
Stabilizer Link to Frame Nut and Bolt	54-82	40-60
Stabilizer Link to Stabilizer Bar Nut	20-34	15-25

TORQUE SPECIFICATIONS, F-150-250-350 4x2 AND 4x4, F-SUPER DUTY CHASSIS CAB AND BRONCO

Description	N-m	Lb-Ft
Jounce Bumper to Frame Nut, All	40-57	30-42
Leaf Spring to Axle U-Bolt Nut F-150-250 (under 8500 GVW), Lightning	100-155	75-115
F-250-350 4x2 Chassis Cab (over 8500 GVW)	200-280	150-210
F-Super Duty	272-368	200-270
Leaf Spring to Front Bracket Nut and Bolt F-250-350 4x2 and Bronco	200-280	150-210
F-150 4x2, Lightning	100-155	75-115
F-150-250-350 4x4	200-240	150-177
F-Super Duty	346-468	255-345
Leaf Spring to Rear Shackle Nut and Bolt All Except F-250-350 4x2 Chassis Cab	100-150	75-115
F-250-350 4x2 Chassis Cab and F-Super Duty	200-280	150-210
Rear Shackle to Frame Nut and Bolt All Except F-250-350 4x2 Chassis Cab	100-150	75-115
F-250-350 4x2 Chassis Cab and F-Super Duty	200-280	150-210
Shock Absorber (Lower Mount) to Axle Nut and Bolt, All Except F-150 Performance Truck	70-100	52-74
Shock Absorber (Upper Mount) to Frame Nut, All	54-81	40-60
Shock Absorber / Stabilizer Bar Bracket to Axle Nut, F-250-350 4x2 Chassis Cab	40-57	30-42
Stabilizer Bar to Axle Nut, All	40-57	30-42
Stabilizer Bar to Axle Bolt, F-Super Duty	37-50	27-37
Stabilizer Link Bracket to Frame Nut and Bolt, All 4x4 Vehicles	40-57	30-42
Stabilizer Link to Bracket Nut and Bolt, All 4x4 Vehicles	54-82	40-60
Stabilizer Link to Frame Nut and Bolt, All 4x2 Vehicles	54-82	40-60
Stabilizer Link to Stabilizer Bar Nut, All	20-34	15-25

TF3715A

TORQUE SPECIFICATIONS, E-150-250-350

Description	N-m	Ft-Lbs
Jounce Bumper to Frame Nut, E-150-250-350	34-46	25-34
Leaf Spring to Axle U-Bolt Nut E-150 E-250, E-350	98-133 148-202	72-98 109-149

(Continued)

SPECIFICATIONS (Continued)**TORQUE SPECIFICATIONS, E-150-250-350 (Cont'd)**

Description	N·m	Ft-Lbs
Leaf Spring to Front Bracket Bolt E-150 E-250-E350	150-185 325-393	110-137 240-290
Leaf Spring to Rear Shackle Nut and Bolt, E-150-250-350	113-153	153-207
Shock Absorber (Lower Mount) to Axle Nut and Bolt, E-150-250-350	68-92	50-68
Shock Absorber (Upper Mount) to Frame Nut, E-150-250-350	34-46	25-34

TF8247A

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
066-00016	Transmission Jack

SECTION 04-04 Wheels and Tires

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DIAGNOSIS AND TESTING (Cont'd.)	
Front Wheel Bearings	04-04-21	Tire and Wheel Runout	04-04-4
Off-Vehicle Balancing	04-04-20	Tire Runout	04-04-5
Straightening Wheels	04-04-22	Tires	04-04-4
Tire and Wheel Balance	04-04-20	Wheel Bolt Runout	04-04-5
Tire Inflation	04-04-21	Wheel Runout	04-04-5
Tire Rotation, Single Rear Wheels	04-04-21	REMOVAL AND INSTALLATION	
Tread Wear Indicators	04-04-21	Front Wheel Lugnut Stud	04-04-16
Vibration	04-04-21	Front Wheel Replacement, F-350, E-350, F-Super Duty Chassis Cab and F-Super Duty Commercial Chassis Vehicles Equipped with Dual Rear Wheels	04-04-12
CLEANING AND INSPECTION		Lugnut Torque Requirement	04-04-16
Aluminum Wheels and Rims	04-04-19	Rear Wheel Lugnut Stud	04-04-17
Rim and Wheel Maintenance	04-04-18	Rear Wheel Replacement, F-350, E-350, F-Super Duty and F-Super Duty Commercial Chassis Vehicles Equipped with Dual Rear Wheels	04-04-14
Tires	04-04-19	Wheel Replacement, F-150-250-350, E-150-250-350 and Bronco Equipped with Single Rear Wheels	04-04-12
Valves	04-04-20	SAFETY	04-04-2
Wheel and Tire Checking Procedure	04-04-18	SPECIAL SERVICE TOOLS/EQUIPMENT	04-04-25
DESCRIPTION AND OPERATION		SPECIFICATIONS	04-04-22
Four Wheel Disc Brake Hub and Rotor, F-Super Duty and F-Super Duty Commercial Chassis	04-04-2	VEHICLE APPLICATION	04-04-1
Front Wheel Assembly, Four-Wheel Drive	04-04-1		
Front Wheel Assembly, Rear Wheel Drive	04-04-1		
Rear Wheel Assembly	04-04-2		
DIAGNOSIS AND TESTING			
Diagnosis Guides	04-04-6		
Match Mounting Tires	04-04-5		

VEHICLE APPLICATION

All E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab, F-Super Duty Commercial Chassis and
Bronco Vehicles

DESCRIPTION AND OPERATION

Front Wheel Assembly, Rear Wheel Drive

Each front wheel and tire assembly is attached by wheel lugnuts to its respective front hub and rotor assembly. Two opposed tapered roller bearings are installed in each front hub and rotor assembly. A grease retainer is installed at the inner end of the hub to prevent lubricant from leaking. The entire assembly is retained on its spindle by the adjusting nut, nut lock and cotter pin. Refer to Section 04-01A.

Front Wheel Assembly, Four-Wheel Drive

A description of the front axle used on vehicles equipped with 4-wheel drive is found in Section 05-02J or Section 05-02K. The locking hub assemblies are described in Section 04-01B.

DESCRIPTION AND OPERATION (Continued)**Rear Wheel Assembly**

Information on rear wheels (hubs and drums) is found in Group 05. For semi-floating wheel hubs and bearings, refer to the appropriate rear axle section in Group 05. For full floating wheel hubs and bearings, refer to Section 05-02B or 05-02E.

E-350, F-350, and F-Super Duty Commercial Chassis vehicles equipped with dual wheel rear axles have the wheel and tire assembly attached with integral two-piece swiveling lugnuts.

Four Wheel Disc Brake Hub and Rotor, F-Super Duty and F-Super Duty Commercial Chassis

The hub and rotor assembly is designed as a two-piece assembly so it can be replaced as individual components or as an assembly. The front and rear brake rotors are the same and are attached to either the front or rear hub assembly with 10 screw and washer assemblies tightened to 100-120 N·m (74-89 ft-lb).

Remove the front or rear hub and rotor assembly as outlined in Section 06-03.

For vehicles with two-piece hub and rotor assemblies, remove and install the wheel studs as outlined in this section under Rear Wheel Lugnut Stud Removal and Installation.

SAFETY

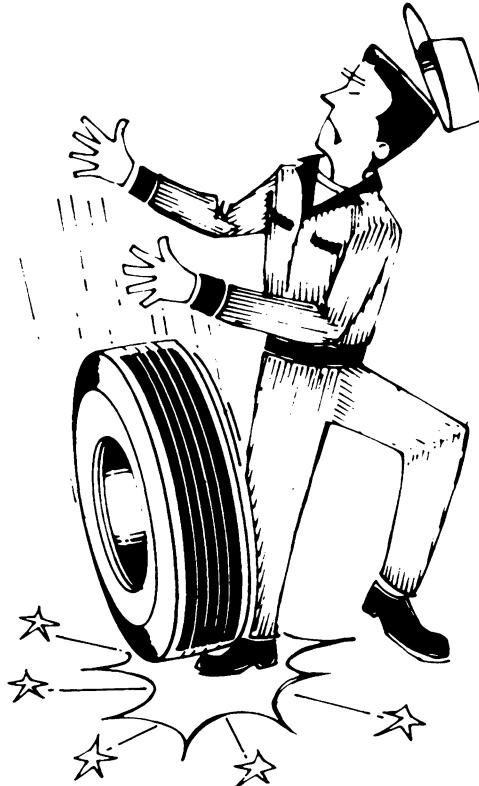
WARNING: ON VEHICLES EQUIPPED WITH A TRACTION-LOK AXLE, NEVER RUN THE ENGINE WITH ONE WHEEL OFF THE GROUND, SUCH AS WHEN CHANGING A TIRE. THE WHEEL STILL ON THE GROUND COULD CAUSE THE VEHICLE TO MOVE.

1. Follow the safety procedures described in this manual and obtain safety literature from the wheel and rim manufacturer, NHTSA or OSHA. If you have any questions, consult the distributor or manufacturer directly. The load carrying requirements of each vehicle should also be determined before selecting the proper tire / wheel combination.
2. Always remember the weakest weight carrying component of the vehicle (i.e., tire, wheel, axle, bearings, etc.) determines its overall maximum and safe load carrying capacity for the vehicle.
3. When replacing tires, use the same size, load range and construction type (bias, bias belted or radial) as originally installed on the vehicle, or a type that meets Ford specifications for the vehicle.

4. When replacing wheels, use original equipment manufacturer's wheels or equivalent available from your Ford dealer with equivalent capacity, width, offset and mounting configuration as those originally installed on your vehicle.

NOTE: Use of improper replacement wheels and tires may adversely affect ride, handling, load carrying capacity, wheel bearing life, tire clearance to body and chassis components, vehicle ground clearance, vehicle width and brake cooling.

- When changing tires, remove the wheel and tire from the truck, as changing tires with the wheel on the truck is hazardous, more difficult, and takes more time.
- In servicing of all tires use caution not to drop them (or the wheels or assemblies) on the feet, hands or body, or heavily on the floor.
- Practice good methods of lifting; use your legs as well as your arms and your body. This will help to prevent painful, internal injury.
- When carrying tires or wheels don't step in oil or grease. Keep the floor clean and dry.

HANDLE WHEELS AND TIRES SAFELY

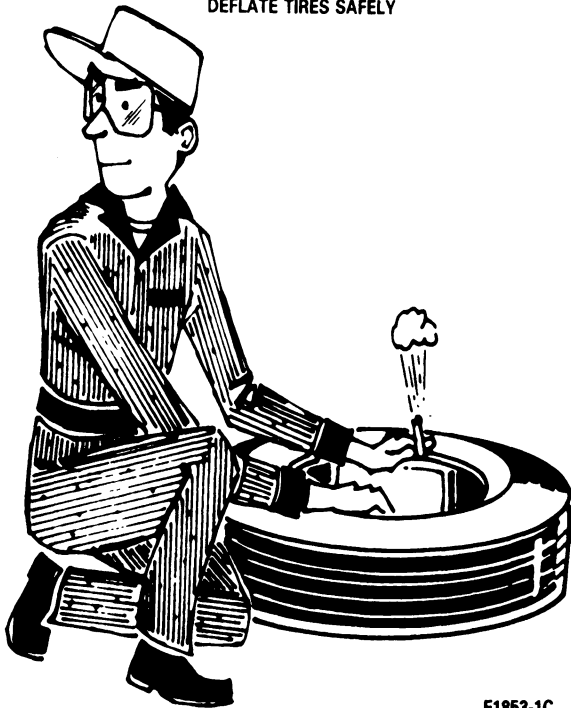
F1857-1B

SAFETY (Continued)

- When deflating a tire, reduce the pressure as much as you possibly can by pushing the valve core plunger. **Only then should you remove the valve core.** Keep your eyes away from the valve.

NOTE: If the tire is to be reinstalled on an original equipment wheel, mark the tire at the valve stem hole so that they can be reassembled in the same relative position.

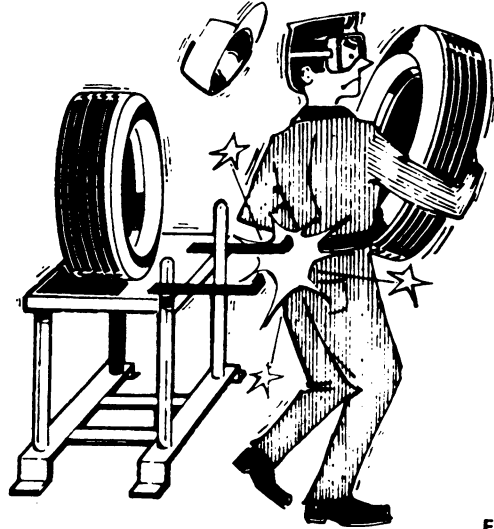
DEFLATE TIRES SAFELY



F1853-1C

- Use only standard tire mounting tools and equipment. The use of makeshift tools, screwdrivers or pliers to force tires on or off rims or wheels is dangerous. This can help prevent cuts on hands and wrists and will make it unnecessary to use a mallet for unseating the tire beads.
- Always lubricate tire beads to assure sealing of tire beads on rim with Rubber Lubricant D9AZ-19583-A (ESA-M1B6-A) or equivalent.
- The Rotunda Deluxe Tire Changer 104-00110 or equivalent includes a bead seater / inflator using an automatically adjustable inflation ring, which aids in properly seating the bead for inflation. To properly operate the Rotunda tire changer, follow the instructions provided.
- Inspect tire and perform necessary repairs. A tire spreader Rotunda Number 104-00111 is very helpful, but use care when working around it. Keep the spreader arms closed when the machine is idle.

USE CAUTION BY TIRE SPREADERS



F1860-1C

Inspect and replace damaged or corroded parts. Abuse during road operations or in mounting tires can cause damage that may weaken the parts. Parts that are excessively corroded are weakened. Always inspect for and replace damaged or heavily rusted parts.

Inspect and remove light rust and other foreign matter. Accumulation of such material on the engagement surfaces of the rim base and side can prevent the proper fit of these parts. Use of a rust preventative during mounting will minimize rust.

Tires and rims often require a buffing operation before being mounted once the regular repairs have been made.

CAUTION: Always wear safety goggles, or a face shield when performing any buffing operation.

- Avoid hammering rims with steel hammers. Small bits of steel may be broken off the hammer or rim, flying into the eyes (wear safety goggles), face or body. Use rubber-covered, steel-headed hammers wherever possible. Rubber mallets only should be used on tires; although with modern tire changing equipment no pounding is necessary.
- Stand as far as possible from the valve stem while inflating tires. Avoid a position where the face or body is immediately over the work being done on any tire in which there is pressure.
- Always use a safety cage, such as Rotunda Inflation Chamber 104-00118 or equivalent, or portable safety device while inflating tires. Protect yourself from possible improper assembly, inadvertently mis-matched parts and other assembly errors.
- Use only accurate, tested gauges to ensure proper air pressure as specified on the Certification Label attached to the vehicle. Check all gauges regularly with a master gauge.

SAFETY (Continued)

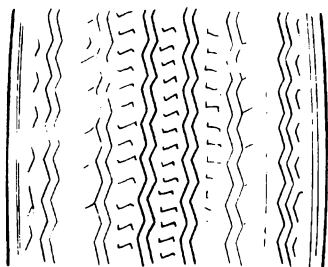
- Do not exceed the recommendations of load rating capacity specified on the vehicle safety certification decal (located on door pillar) relative to front and rear GAWR and vehicle GVWR.
- A jack is provided for wheel and tire maintenance only. Never run the engine when the vehicle is supported by a jack.

DIAGNOSIS AND TESTING

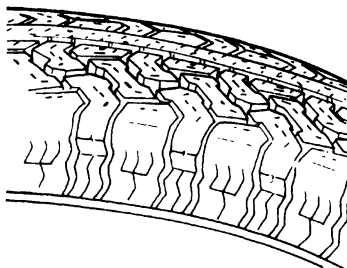
Tires

- To maximize tire performance, inspect for signs of improper inflation and uneven wear, which may indicate a need for balancing, rotation, or front suspension alignment.
- Check tires for:
 - cuts
 - stone bruises
 - abrasions
 - blisters
 - embedded objects
- More frequent inspections are recommended when rapid or extreme temperature changes occur, or where road surfaces are rough or occasionally littered with debris.
- Tread wear indicators are molded into the bottom of the tread grooves. Replace tire when indicator bends become visible.

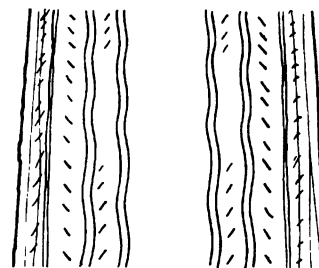
Tire Irregularities



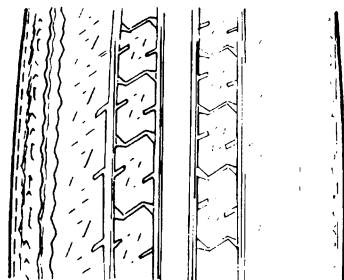
UNDERINFLATION



CUPPING

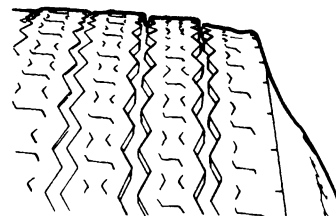


OVERINFLATION



INCORRECT TOE-IN OR EXTREME CAMBER

UNDERINFLATION AND/OR MECHANICAL IRREGULARITIES SUCH AS OUT-OF-BALANCE CONDITION OF WHEEL AND/OR TIRE, AND BENT OR DAMAGED WHEEL. POSSIBLE LOOSE OR WORN STEERING TIE-ROD OR STEERING IDLER ARM. POSSIBLE LOOSE, DAMAGED OR WORN FRONT SUSPENSION PARTS.



FEATHERING DUE TO MISALIGNMENT

F3050-C

Tire and Wheel Runout

Excessive radial and lateral runout of a wheel and tire assembly can cause roughness, vibration, wheel tramp, tire wear, and steering wheel tremor.

Before checking runout and to avoid false readings caused by temporary flat spots in the tires, check runout only after the vehicle has been driven far enough to warm tires.

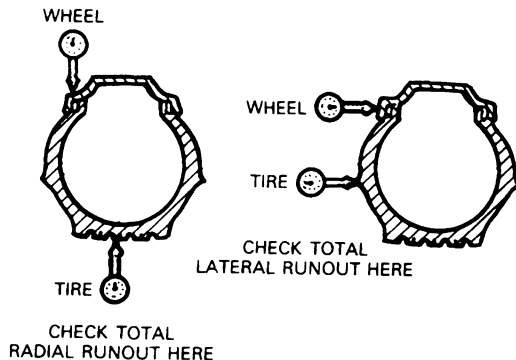
The extent of the runout is measured with Radial Runout Gauge Rotunda 007-00014 or equivalent. All measurements are made on the vehicle with the tires inflated to recommended inflation pressures and with the front wheel bearings adjusted to specifications.

DIAGNOSIS AND TESTING (Continued)**Tire Runout**

Using Rotunda Radial Runout Gauge 007-000 14 or equivalent, measure radial runout of the tire at the center and outside ribs of the tread face. Measure lateral runout of the tire just above the buffing rib on the tire sidewall. Mark the high points of lateral and radial runout for future reference. On tires, radial runout should not exceed 1.016mm (0.040 inch), and lateral runout should not be more than 1.524mm (0.060 inch).

Wheel Runout

Measure radial and lateral wheel runout at the positions shown in the illustration. Runout should not exceed 1.143mm (.045 inch) in either position.

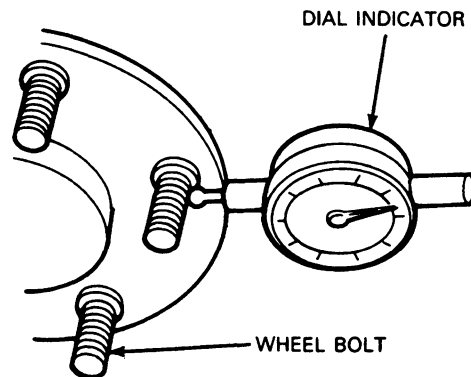


F3347-1B

Wheel Bolt Runout

Wheel bolt runout can affect wheel runout. When measuring the runout on the wheel bolts, the feeler will not be in contact with the bolts at all times. Only the measurements taken at the high point of contact of each bolt should be considered.

1. Using a broad point indicator, locate the feeler perpendicular to the bolt, as close to the flange face as possible. Zero the indicator so the pointer can deflect either way, ensuring an accurate reading at the lowest as well as the highest contact point.

WHEEL BOLT RUNOUT

Y2371-1B

2. Rotate the shaft until the next bolt is contacted. Again, record and continue until you have one reading for each point of contact (each bolt). The absolute difference between the maximum and minimum contact reading will be the total indicator reading (or total runout). Wheel bolt circle runout should not exceed .41mm (0.016 inch) TIR (Total Indicated Runout).

Match Mounting Tires

Match mounting is a technique used to reduce radial runout and tire spring rate on tire and wheel assemblies. Excessive runout is a source of ride complaints and match mounting can be used to minimize the runout. There are two ways to use match mounting: positioning of the tire on the wheel and positioning the wheel on the hub.

1. Measure the total indicated runout on the center of the tire tread rib, and record it. Mark the tire and rim at the center of the tread rib, and record the reading. Mark the tire at the location of the valve stem for reference.
2. Break down the tire and remount it 180 degrees on the rim so the valve stem reference mark is opposite the valve stem on the wheel.
3. Reinflate the tire and measure the total indicated runout, and again mark the high spot.
4. If the runout is reduced to acceptable guidelines the tire is ready to be put back into service. If the runout is still excessive, one of the following steps must be performed:
 - If the high spot is within 100mm (4 inches) of the first high spot on the wheel, the wheel may be out of tolerance, check the wheel for runout.
 - If the high spot is within 100mm (4 inches) of the first high spot on the tire, and is still outside of guidelines, replace the tire.

DIAGNOSIS AND TESTING (Continued)

- If the high spot is not within 100mm (4 inches) of either original high spot of the tire and rim, then draw an arrow from the second high spot to the first high spot (in the shortest direction) and rotate the tire on the rim 90 degrees in that direction. This will normally reduce the runout to an acceptable level.

In the majority of cases, the first 180-degree turn of the tire will either fix the problem or indicate which item to replace.

NOTE: Refer to Vibration in this section for runout specification.

Diagnosis Guides

CONDITION	POSSIBLE SOURCE	ACTION
Tires show excess wear on edge of tread.	<ul style="list-style-type: none"> ● Under-inflated tires. ● Vehicle overloaded. ● High-speed cornering. ● Incorrect toe setting. 	<ul style="list-style-type: none"> ● Adjust air pressure in tires. ● Correct as required. ● Correct as required. ● Set toe to specification. Refer to Section 04-00.
Tires show excess wear in center of tread.	<ul style="list-style-type: none"> ● Tires over-inflated. 	<ul style="list-style-type: none"> ● Adjust air pressure in tires.
Other excessive tire wear problems.	<ul style="list-style-type: none"> ● Improper tire pressure. ● Incorrect tire / wheel usage. ● Loose or leaking shock absorbers. ● Front end out of alignment. ● Front wheel bearings out of adjustment. ● Loose, worn or damaged suspension components, bushings and ball joints. ● Wheels and tires out of balance. ● Excessive lateral or radial runout of wheel or tire. ● Tires need rotating. 	<ul style="list-style-type: none"> ● Adjust air pressure in tires. ● Install correct tire and wheel combination. ● Tighten or replace as necessary. Refer to Section 04-01 (Front) or 04-02 (Rear). ● Align front end. Refer to Section 04-00. ● Adjust front wheel bearings. ● Inspect, repair or replace as required. ● Balance wheels and tires. ● Check, repair or replace as required. Use dial indicator to accurately determine runout. ● Rotate tires.
Wheel mounting is difficult.	<ul style="list-style-type: none"> ● Improper application or mismatched parts, including studs and nuts. ● Corroded, worn or damaged parts. 	<ul style="list-style-type: none"> ● Follow manufacturers' specifications. ● Clean or replace.
Wheel-rust or corrosion.	<ul style="list-style-type: none"> ● Poor maintenance. 	<ul style="list-style-type: none"> ● Keep clean and protect with paint.
Wobble or shimmy affecting wheel runout.	<ul style="list-style-type: none"> ● Damaged wheel (eventually damaged wheel bearings and uneven tire wear). 	<ul style="list-style-type: none"> ● Inspect wheel rims for dents. Repair or replace as required.
Excessive vehicle vibration, rough steering, or severe tire wear.	<ul style="list-style-type: none"> ● Loose or improper attaching parts. ● Overloading or unbalanced loads. 	<ul style="list-style-type: none"> ● Tighten or replace. ● Check wheel and tire specs against work load requirements. Recommend correct tire and rim. Check on loading procedure.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Vehicle vibrations.	<ul style="list-style-type: none"> • Tires / wheels mismatched. • Inflation pressure too high or low. • Uneven tire wear. • Out-of-balance wheel or tire or hub and drum assembly. • Bent or distorted wheel disc from overloading, road impact hazards or improper handling. • Out-of-round wheel or tire (excessive radial runout). • Improperly seated bead. • Excessive lateral runout (wheel or tire). • Loose wheel mountings — damaged studs, cap nuts, enlarged stud holes, worn or broken hub face or foreign material on mounting surfaces. • Defective wheel bearings. • Brake rotor imbalance. • Wheel stud runout. • Water in tires. • Loose or worn engine or transmission mounts. • Improper pinion angle. • Improper front end alignment. • Loose or worn driveline or suspension parts. • Excessive driveshaft runout or imbalance. • Worn or damaged U-joints. 	<ul style="list-style-type: none"> • Install correct tire / wheel combination. • Adjust air pressure in tires. • Refer to Tire Wear Conditions Chart. • Determine the out-of-balance component and balance or replace. • Replace wheel. Attempts to straighten wheel can result in fractures in the steel and weakening of the disc or the weld between disc and rim. Check loading and operating conditions and shop practices. • Use a dial indicator to accurately verify runout reading. Replace the wheel or tire and check for overloading and unbalanced loads, rugged operating conditions, proper wheel and tire specifications. • Verify correct tire / wheel usage and re-mount tire. • Use a dial indicator to accurately verify runout reading. Replace wheel or tire. • Tighten or replace worn or damaged parts. Clean mounting surfaces. • Replace defective bearing sets. • Check for uneven rotor wear. If present, turn both rotors. Check fins for caked mud or debris. If no external causes are evident, rotor may have a heavy spot. To confirm, substitute a known-good rotor or shift rotor to other side of vehicle and road test again. If heavy spot is indicated, replace rotor. • Replace hub or axle shaft. • Remove water. • Tighten or replace. • Realign assembly to specifications. If damaged, replace pinion and ring gear as a set. • Align front end. • Identify location of vibration carefully as it may be transmitted through frame making a rear end vibration appear to come from the front. Repair or replace loose and worn parts. • Balance or replace driveshaft as necessary. • Replace worn U-joints.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Cracked or broken wheel discs (center portion of wheel). Cracks develop in the wheel disc from hand hole to hand hole, from hand hole to rim, or from hand hole to stud. Stud holes become worn, elongated or deformed. Metal builds up around stud hole edges, cracks develop from stud hole to stud hole. Related driver complaints; unusual operating noise or vibration and on the road failures.	<ul style="list-style-type: none"> ● Metal fatigue resulting from abusive handling. ● Truck operated with loose wheel mounting. 	<ul style="list-style-type: none"> ● Replace wheel. Check position of wheel on vehicle for working load specifications. ● Replace wheel and check for: <ul style="list-style-type: none"> — Installation of correct studs and nuts, and recommended exact specifications. — Cracked or broken studs, and replace. — Worn hub face. Machine if not excessive, or replace if severe. — Broken or cracked hub barrel, replace. — Worn stud grooves, replace or install recommended serrated bolts. — Clean mounting surfaces and re-torque cap nuts periodically. — Rust streaks fanning out from stud holes are a sure indication that the cap nuts are or have been loose.
Cracks develop in rim base back (rim bead seat) or the gutter area (drop well radii).	<ul style="list-style-type: none"> ● Overloading or abusive use. ● Improper use of tools. 	<ul style="list-style-type: none"> ● Replace wheel. Check loading and operating conditions. Avoid over inflation of tires. Check specs for rim load capacity, working loads, tire size, ply rating and tire construction. ● Check mounting, demounting, and maintenance procedures.
Dual tires rubbing (kissing).	<ul style="list-style-type: none"> ● Insufficient wheel spacing. ● Overloading. ● Underinflation. 	<ul style="list-style-type: none"> ● Check tire and wheel sizes. Make certain proper size tire and wheels are used. ● Reduce weight. ● Inflate tires to specifications.
Damaged stud threads.	<ul style="list-style-type: none"> ● Sliding wheel across studs during assembly. 	<ul style="list-style-type: none"> ● Replace studs. Follow proper wheel installation procedure.
Loose drum.	<ul style="list-style-type: none"> ● Stud too long. 	<ul style="list-style-type: none"> ● Replace stud with proper length stud.
Loose inner wheel.	<ul style="list-style-type: none"> ● Excessive stud standout from mounting face of hub permitting wheel nut to bottom out. 	<ul style="list-style-type: none"> ● Replace stud with proper length stud.
Broken studs.	<ul style="list-style-type: none"> ● Loose lugnuts. ● Overloading. 	<ul style="list-style-type: none"> ● Replace studs. Follow proper torque procedure. ● Replace studs. Compare actual load against vehicle load ratings.
Stripping threads.	<ul style="list-style-type: none"> ● Excessive torque. 	<ul style="list-style-type: none"> ● Replace studs. Follow proper torque procedure.
Rust streaks from stud holes.	<ul style="list-style-type: none"> ● Loose lugnuts. 	<ul style="list-style-type: none"> ● Check complete assembly. Replace damaged parts. Follow proper torque procedure.
Damaged lugnuts.	<ul style="list-style-type: none"> ● Loose wheel assembly. ● Over tightened lugnuts. 	<ul style="list-style-type: none"> ● Replace lugnuts. Follow proper torque procedure.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Frozen lugnuts.	<ul style="list-style-type: none"> Corrosion or galling. Overloading. 	<ul style="list-style-type: none"> If corrosion is slight, wire brush away corrosion. If corrosion is excessive, replace studs and nuts. If condition persists, lubricate first three threads of each stud with a graphite-based lubricant. CAUTION: Do not permit lubricant to get on cone seats of stud holes or on cone angle of lugnuts. Reduce weight.

TF6555D

TIRE/WHEEL CONDITIONS — TEST A

NOTE: On vehicles equipped with all-terrain type tires, a vibrating, drumming or beating noise is often misdiagnosed as a driveline vibration. For noise, vibration and harshness diagnosis, refer to Section 00-04. If condition is still present, refer to the procedure below.

TEST STEP		RESULT	ACTION TO TAKE
A1	EXCESSIVE WEAR OR CUPPING		
	<ul style="list-style-type: none"> Check tires for excessive wear or cupping. Are tires OK? 	Yes No	GO to A2. REPLACE severely worn tires. CHECK tire inflation, vehicle alignment and suspension. REPAIR, REPLACE or ADJUST as required. GO to A2.
A2	WHEEL BEARING END PLAY		
	<ul style="list-style-type: none"> Check wheel bearing end play. Rotate wheel and check for roughness. Is wheel bearing end play OK? 	Yes No	GO to A3. REPLACE wheel bearings, if required. ADJUST to correct end play. ROAD TEST to verify correction. Refer to appropriate section in Group 04.
A3	TIRE WHEEL BALANCE		
	<ul style="list-style-type: none"> Check tire / wheel balance. Is balance OK? 	Yes No	GO to A4. BALANCE tire / wheel assembly. If assembly cannot be balanced, REPLACE wheel and / or tire. ROAD TEST to verify correction.
A4	REINDEX TIRE		
	<ul style="list-style-type: none"> Reindex tire 180 degrees and rebalance on wheel. Is balance OK? 	Yes No	ROAD TEST to verify correction. GO to A5.
A5	TIRE RUNOUT		
	<ul style="list-style-type: none"> Check tire runout. Is tire runout within specifications? 	Yes No	GO to A7. GO to A6.
A6	WHEEL STUD RUNOUT		
	<ul style="list-style-type: none"> Check wheel stud runout. Is wheel stud runout within specifications? 	Yes No	GO to A7. REPLACE hub or axle shaft. ROAD TEST to verify correction. Refer to appropriate section in Group 05.

DIAGNOSIS AND TESTING (Continued)

TIRE / WHEEL CONDITIONS — TEST A

NOTE: On vehicles equipped with all-terrain type tires, a vibrating, drumming or beating noise is often misdiagnosed as a driveline vibration. For noise, vibration and harshness diagnosis, refer to Section 00-04. If condition is still present, refer to the procedure below. (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A7	ALIGNMENT, SUSPENSION, DRIVELINE, BRAKES, ENGINE / TRANSMISSION MOUNTS		
	<ul style="list-style-type: none"> Check front end alignment if not done during Step 1. Refer to Section 04-00. Check suspension components for looseness or wear if not done during Step 1. Refer to appropriate section in Group 04. Check U-joint condition. Refer to Section 05-01. Check driveshaft for runout or imbalance. Refer to Section 05-01. Check drums / rotors for imbalance. Refer to appropriate section in Group 06. Check engine and transmission mounts for looseness or wear. Refer to appropriate section in Group 07. Are all systems operating properly? 	Yes No	GO to A8 . REPAIR, REPLACE, or ADJUST as required. ROAD TEST to verify correction.
A8	WHEEL RUNOUT		
	<ul style="list-style-type: none"> Check wheel runout. Is wheel runout within specifications? 	Yes No	REPLACE tire. ROAD TEST to verify correction. REPLACE wheel and rebalance. ROAD TEST to verify correction.

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TIRE / WHEEL CONDITIONS, NOISE OR VIBRATION, 4x4 VEHICLES ONLY — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Verify the condition by road-testing the vehicle. <p>NOTE: Verify the condition by driving the vehicle with known quality conventional tires.</p>	Condition disappears Condition still exists	SERVICE or REPLACE tires as described in the appropriate portion of this section. GO to B2 .
B2	REMOVE FRONT DRIVESHAFT		
	<ul style="list-style-type: none"> Unlock the front hubs and remove the front driveshaft. Place the transfer case in the two-wheel drive position (2H) and road test the vehicle. 	Condition disappears Condition still exists	SERVICE the front driveshaft or front drive axle. Refer to appropriate section in Group 05. GO to B3 .
B3	REMOVE REAR DRIVESHAFT		
	<ul style="list-style-type: none"> Reinstall the front driveshaft. Lock the front hubs and remove the rear driveshaft. Place the transfer case in 4-high (4H), the four-wheel drive position. Road test the vehicle. 	Condition disappears Condition still exists	SERVICE the rear driveshaft or rear axle as described in the appropriate section of this manual. REFER to driveline diagnosis in Section 05-00.

TF6667D

DIAGNOSIS AND TESTING (Continued)**VEHICLE VIBRATION ANALYSIS PROCEDURE — TEST C**

TEST STEP		RESULT	ACTION TO TAKE
C1	INITIAL CHECKS		
	<ul style="list-style-type: none"> ● Check that all tires are the same size and type. ● Inflate all tires to correct pressure. ● Check tires for wear or damage. ● Check that tire beads are properly seated. ● Ask customer to explain concern symptoms. ● Test drive vehicle and experience vibration concern. Note speed and suspect wheel position. ● Do the tires and wheels check OK? 	Yes No	GO to C2 . REPLACE damaged equipment as required.
C2	TIRE RUNOUT CHECK		
	<ul style="list-style-type: none"> ● Check tire runout. ● Is there excessive runout? 	Yes No	GO to C3 . GO to C4 .
C3	MATCH MOUNTING PROCEDURE		
	<ul style="list-style-type: none"> ● Perform match mounting procedure. ● Is high runout still present? 	Yes No	PERFORM wheel stud runout procedure. REPLACE high runout wheels or tires as required. GO to C4 .
C4	STATIC BALANCE CHECK		
	<ul style="list-style-type: none"> ● Mark a stud bolt and the corresponding position on the rim so the assembly can be replaced on the vehicle in its original position. ● Leave existing balance weights in place. ● Balance tire. ● Does re-balance require more than 14.18 gr (0.5 oz.), but less than 85 gr (3 oz.) on either flange? 	Yes No, less than 14.18 gr (0.5 oz.). No, more than 85 gr (3 oz.).	RETURN tire and wheel to service. GO to C6 . GO to C5 .
C5	TIRE AND WHEEL ASSEMBLY CHECK		
	<ul style="list-style-type: none"> ● Spin the assembly on balancer in static mode. ● Mark location and weight required on sidewall. Do not balance assembly. ● Remove assembly from balancer, deflate and rotate tire 180°. ● Re-inflate tire and recheck on balancer. ● Mark location and weight required on sidewall. ● Are the marks neither opposite nor together? 	Yes No, marks are within 100mm (4 in). No, marks are within 100mm (4 in) of being opposite each other.	PERFORM match mounting procedure. REPLACE wheel. REPLACE tire.
C6	ROAD TEST		
	<ul style="list-style-type: none"> ● Road test vehicle. ● Is concern eliminated? 	Yes No	Vehicle checks OK. CHECK for the following: Brake drum or rotor imbalance, worn or damaged engine or transmission mounts, excessive drive shaft runout or imbalance, improper pinion angle, or worn or damaged wheel bearings.

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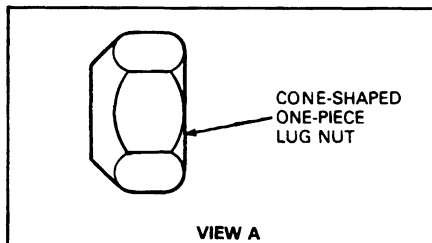
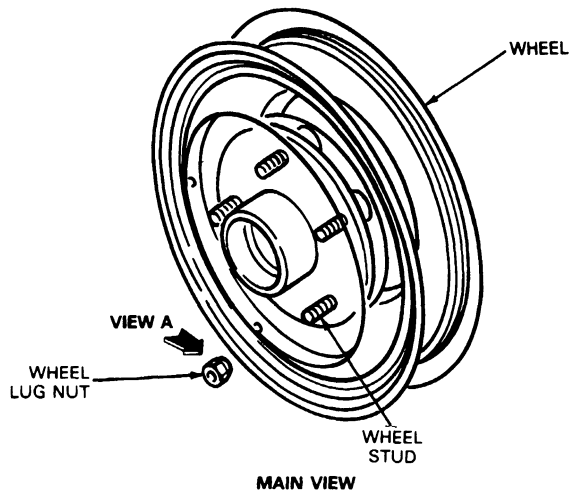
REMOVAL AND INSTALLATION

Wheel Replacement, F-150-250-350, E-150-250-350 and Bronco Equipped with Single Rear Wheels**Removal**

WARNING: AFTERMARKET WHEEL ASSEMBLIES MAY NOT BE COMPATIBLE WITH THE VEHICLE. USE OF INCOMPATIBLE WHEEL ASSEMBLIES MAY RESULT IN EQUIPMENT FAILURE AND POSSIBLE INJURY. USE ONLY APPROVED WHEEL ASSEMBLIES.

WARNING: ON VEHICLES EQUIPPED WITH A TRACTION-LOK AXLE, NEVER RUN THE ENGINE WITH ONE WHEEL OFF THE GROUND, SUCH AS WHEN CHANGING A TIRE. THE WHEEL STILL ON THE GROUND COULD CAUSE THE VEHICLE TO MOVE.

1. Set parking brake and block diagonally opposite wheel. On vehicles equipped with an automatic transmission, place selector lever in the PARK position. On vehicles equipped with a manual transmission place the shift lever in reverse.
On 4-wheel drive vehicles, the transfer case must be engaged in gear, not neutral.
2. If equipped, remove the hub cap or wheel cover.



F4251-1A

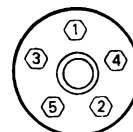
3. With the weight of the vehicle still on the tires, break the lugnuts loose. DO NOT REMOVE AT THIS TIME.
4. Raise the vehicle until the wheel and tire clear the floor.

5. Remove the wheel lugnuts. Remove the wheel and tire assembly.

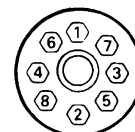
Installation

WARNING: WHENEVER A WHEEL IS INSTALLED, ALWAYS REMOVE ANY CORROSION, DIRT OR FOREIGN MATERIAL PRESENT ON THE MOUNTING SURFACES OF THE WHEEL OR THE SURFACE OF THE HUB, DRUM OR ROTOR THAT CONTACTS THE WHEEL. INSTALLING WHEELS WITHOUT PROPER METAL-TO-METAL CONTACT AT THE WHEEL MOUNTING SURFACES CAN CAUSE THE WHEEL LUGNUTS TO LOOSEN AND COULD ALLOW THE WHEEL TO COME OFF WHILE THE VEHICLE IS IN MOTION, CAUSING LOSS OF CONTROL.

1. Position the wheel on the hub and rotor or the axle flange and drum assembly.
2. Install the lugnut. Make sure the cone ends of the nuts face inward.
3. With the lugnuts loosely installed, turn the wheel until one nut is at the top of the bolt circle. Tighten the nut until snug. In a criss-cross type pattern, tighten the remaining nuts until snug to minimize runout.
4. Lower the vehicle.
5. Evenly tighten the nuts in the torque sequence shown in the illustration, to the torque listed in the Specifications portion of this section.



5 LUG WHEEL



8 LUG WHEEL

TIGHTEN LUG NUTS
IN THIS SEQUENCE

F3932-D

Front Wheel Replacement, F-350, E-350, F-Super Duty Chassis Cab and F-Super Duty Commercial Chassis Vehicles Equipped with Dual Rear Wheels

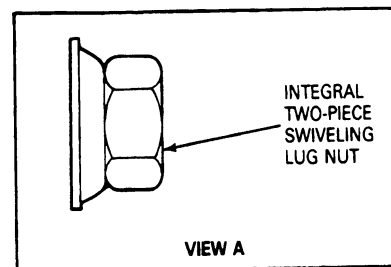
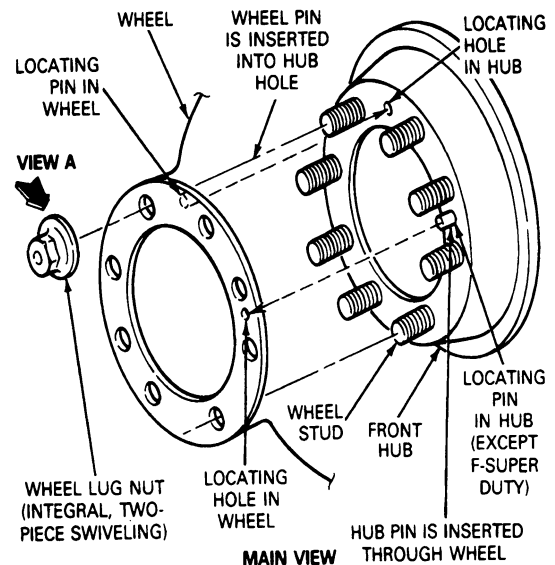
WARNING: AFTERMARKET WHEEL ASSEMBLIES MAY NOT BE COMPATIBLE WITH THE VEHICLE. USE OF INCOMPATIBLE WHEEL ASSEMBLIES MAY RESULT IN EQUIPMENT FAILURE AND POSSIBLE INJURY. USE ONLY APPROVED WHEEL ASSEMBLIES.

REMOVAL AND INSTALLATION (Continued)

WARNING: USE ONLY INTEGRAL TWO-PIECE SWIVELING LUGNUTS ON VEHICLES EQUIPPED WITH DUAL REAR WHEELS. DO NOT ATTEMPT TO USE CONE-SHAPED ONE-PIECE LUGNUTS ON THESE VEHICLES. IF USED, CONE SHAPED ONE-PIECE LUGNUTS CAN COME LOOSE IN VEHICLE OPERATION. DO NOT ATTEMPT TO USE PAST MODEL WHEELS, WHICH HAVE CONE SHAPED LUGNUT SEATS ON THIS VEHICLE. DO NOT ATTEMPT TO USE PRESENT DESIGN WHEELS AND LUGNUTS ON PAST MODEL WHEEL HUBS. ATTEMPTED USE OF INTERMIXED WHEELS CAN LEAD TO DAMAGE TO THE WHEEL MOUNTING SYSTEM AND COULD RESULT IN WHEELS COMING LOOSE.

Removal

1. Set parking brake and block diagonally opposite wheel.
 - On vehicles equipped with an automatic transmission, place selector lever in the PARK position.
 - On vehicles equipped with a manual transmission, place the shift lever in reverse.
2. If equipped, remove the hub cap or wheel cover.
3. With the weight of the vehicle still on the tires, break the lugnuts loose. **DO NOT REMOVE AT THIS TIME.**
4. Raise the vehicle until the wheel and tire clear the floor.
5. Remove the wheel lugnuts.
6. Remove the wheel and tire from the hub and rotor.



F4252-1B

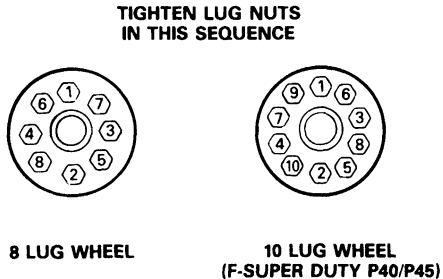
Installation

WARNING: WHENEVER A WHEEL IS INSTALLED, ALWAYS REMOVE ANY CORROSION, DIRT OR FOREIGN MATERIAL THAT MAY BE PRESENT ON THE MOUNTING SURFACES OF THE WHEEL OR THE SURFACES OF THE HUB AND ROTOR THAT CONTACTS THE WHEEL. INSTALLING WHEELS WITHOUT PROPER METAL-TO-METAL CONTACT AT THE WHEEL MOUNTING SURFACES CAN CAUSE THE WHEEL LUGNUTS TO LOOSEN AND COULD ALLOW THE WHEEL TO COME OFF WHILE THE VEHICLE IS IN MOTION, CAUSING LOSS OF CONTROL.

1. Mount the front wheel on the front hub and rotor with the wheel dish facing inboard. Align the wheel with the small indexing hole (located in the wheel between the stud holes) with the alignment pin in the hole in the gap. Make sure the wheel is flush with the hub mounting surface so there is no gap between the hub and wheel.
2. Install and tighten until snug the eight integral two-piece swiveling lugnuts (nut and washer assembly).
3. With the lugnuts loosely installed, turn the wheel until one nut is at the top of the bolt circle. Tighten the nut until snug. In a criss-cross type pattern, tighten the remaining lugnuts until snug to minimize runout. Lower the vehicle to the floor.

REMOVAL AND INSTALLATION (Continued)

4. Evenly tighten the nuts in the torque sequence shown in the illustration, to the torque listed in the Specifications portion of this section.



F7713-A

Rear Wheel Replacement, F-350, E-350, F-Super Duty and F-Super Duty Commercial Chassis Vehicles Equipped with Dual Rear Wheels

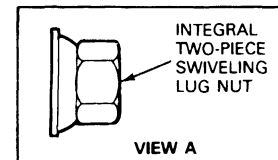
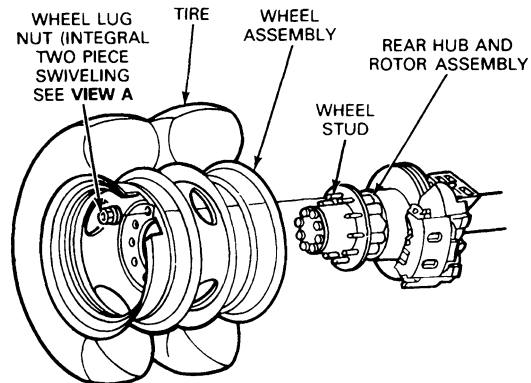
WARNING: AFTERMARKET WHEEL ASSEMBLIES MAY NOT BE COMPATIBLE WITH THE VEHICLE. USE OF INCOMPATIBLE WHEEL ASSEMBLIES MAY RESULT IN EQUIPMENT FAILURE AND POSSIBLE INJURY. USE ONLY APPROVED WHEEL ASSEMBLIES.

WARNING: USE ONLY INTEGRAL TWO-PIECE SWIVELING LUGNUTS ON VEHICLES EQUIPPED WITH DUAL REAR WHEELS. DO NOT ATTEMPT TO USE CONE SHAPED ONE-PIECE LUGNUTS ON THESE VEHICLES. IF USED, CONE SHAPED ONE-PIECE LUGNUTS CAN COME LOOSE IN VEHICLE OPERATION. DO NOT ATTEMPT TO USE PAST MODEL WHEELS, WHICH HAVE CONE SHAPED LUGNUT SEATS ON THIS VEHICLE. DO NOT ATTEMPT TO USE PRESENT DESIGN WHEELS AND LUGNUTS ON PAST MODEL WHEEL HUBS. ATTEMPTED USE OF INTERMIXED WHEELS CAN LEAD TO DAMAGE TO THE WHEEL MOUNTING SYSTEM AND COULD RESULT IN WHEELS COMING LOOSE.

Removal

1. Set parking brake and block diagonally opposite wheel.
 - On vehicles equipped with an automatic transmission, place selector lever in the PARK position.
 - On vehicles equipped with a manual transmission, place the shift lever in reverse.
 - On 4-wheel drive vehicles, the transfer case must be engaged in gear, not neutral.
2. If equipped, remove the hub cap or wheel cover.
3. With the weight of the vehicle still on the tires, break the lugnuts loose. **DO NOT REMOVE AT THIS TIME.**
4. Raise the vehicle until the wheel and tire clear the floor.
5. Remove the wheel lugnuts. Remove the wheel and tire assembly from the hub and drum.

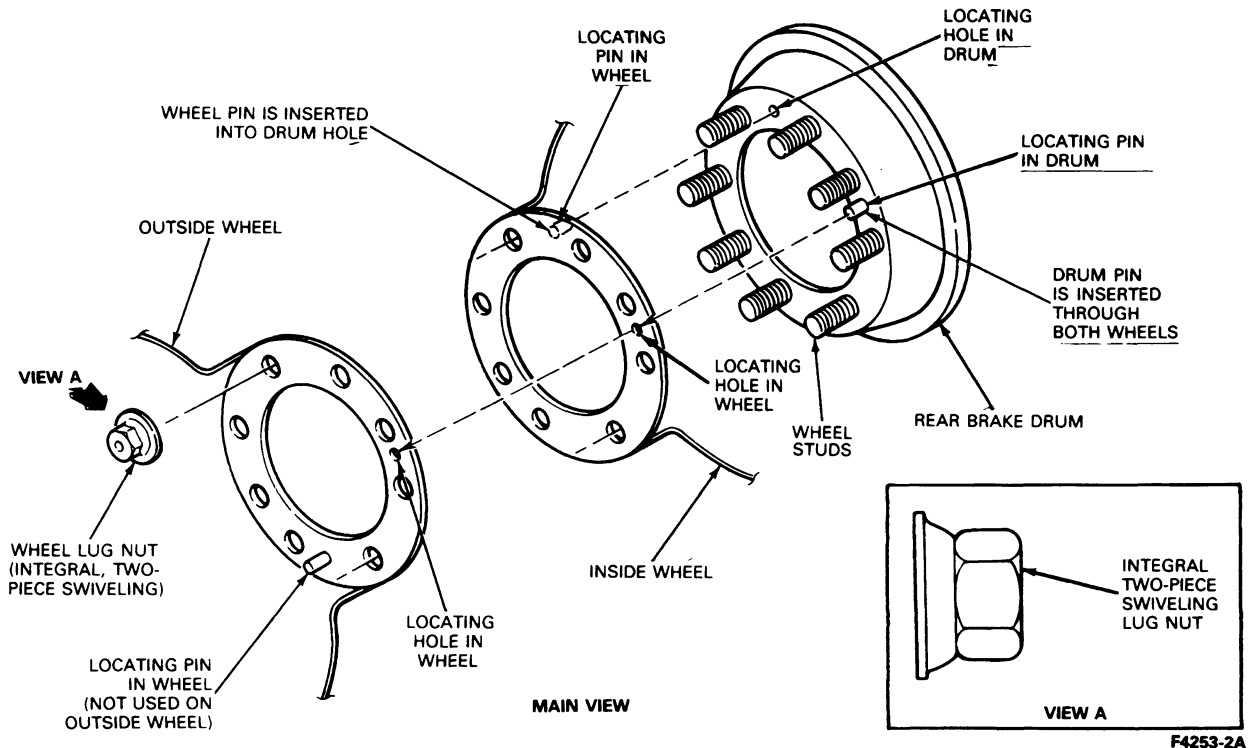
F-Super Duty and F-Super Duty Commercial Chassis



F5647-1A

REMOVAL AND INSTALLATION (Continued)

F-350 and E-350 with Dual Rear Wheels

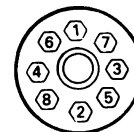


Installation

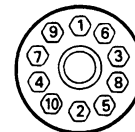
WARNING: WHENEVER A WHEEL IS INSTALLED, ALWAYS REMOVE ANY CORROSION, DIRT OR FOREIGN MATERIAL THAT MAY BE PRESENT ON THE MOUNTING SURFACES OF THE WHEELS OR THE SURFACES OF THE HUB AND DRUM THAT CONTACTS THE WHEEL. INSTALLING WHEELS WITHOUT PROPER METAL-TO-METAL CONTACT AT THE WHEEL MOUNTING SURFACES CAN CAUSE THE WHEEL LUGNUTS TO LOOSEN AND COULD ALLOW THE WHEEL TO COME OFF WHILE THE VEHICLE IS IN MOTION, CAUSING LOSS OF CONTROL.

1. Mount the inner wheel on the rear hub with the wheel dish facing inboard.
2. Align the wheel with the small indexing hole, located in the wheel between the stud holes, with the alignment pin in the hole in the hub. Refer to the previous illustration.
3. Make sure the wheel is flush with the hub mounting surface so there is no gap between the hub and wheel.
4. Install the outer rear flush against the inner wheel with the hub alignment pin protruding through the wheel index hole.
5. Install and tighten until snug the integral two-piece swiveling lugnuts (nut and washer assembly).

6. With the lugnuts loosely installed, turn the wheel until one nut is at the top of the bolt circle. Tighten the nut until snug. In a criss-cross type pattern, tighten the remaining lugnuts until snug to minimize runout.
7. Lower the vehicle to the floor.
8. Evenly tighten the nuts in the torque sequence shown in the illustration, to the torque listed in the Specifications portion of this section.

TIGHTEN LUG NUTS
IN THIS SEQUENCE

8 LUG WHEEL

10 LUG WHEEL
(F-SUPER DUTY P40/P45)

F7713-A

REMOVAL AND INSTALLATION (Continued)

Lugnut Torque Requirement

WARNING: LUGNUTS MUST BE RETIGHTENED TO PROPER TORQUE SPECIFICATION AT 800 KM (500 MILES) OF NEW VEHICLE OPERATION AND VEHICLES WITH DUAL REAR WHEELS. RETIGHTEN TO PROPER TORQUE SPECIFICATION AT 160 KM (100 MILES) AND ALSO AT 800 KM (500 MILES) OF NEW OPERATION AND AT THE INTERVALS SPECIFIED IN SECTION 10-02, MAINTENANCE.

RETIGHTEN TO PROPER TORQUE SPECIFICATIONS AT 800 KM (500 MILES) AFTER ANY WHEEL CHANGE OR ANY OTHER TIME THE LUGNUTS HAVE BEEN LOOSEENED.

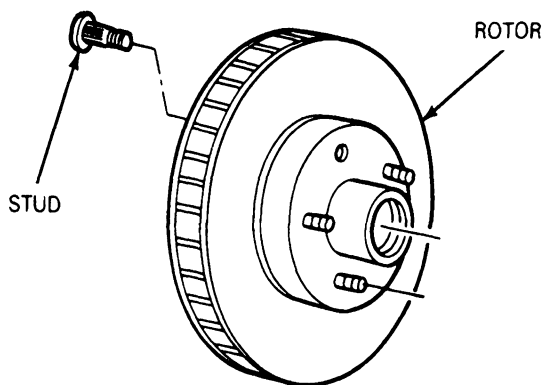
IMPROPERLY TIGHTENED WHEEL LUGNUTS COULD ALLOW THE WHEEL TO COME OFF WHILE THE VEHICLE IS IN MOTION, CAUSING LOSS OF CONTROL.

WARNING: REPLACE WHEELS IF THEY ARE BENT, CRACKED, LEAKING AIR OR HEAVILY RUSTED OR IF THE LUGNUTS OFTEN BECOME LOOSE. DO NOT USE BENT WHEELS THAT HAVE BEEN STRAIGHTENED AND DO NOT USE INNER TUBES IN LEAKING WHEELS. DO NOT REPLACE WHEELS WITH USED WHEELS. WHEELS THAT HAVE BEEN STRAIGHTENED OR ARE LEAKING AIR OR ARE USED, MAY HAVE STRUCTURAL DAMAGE AND COULD FAIL WITHOUT WARNING. CHECK FOR DAMAGE THAT COULD AFFECT THE RUNOUT OF THE WHEELS. WOBBLE OR SHIMMY WILL EVENTUALLY DAMAGE THE WHEEL BEARINGS.

Front Wheel Lugnut Stud

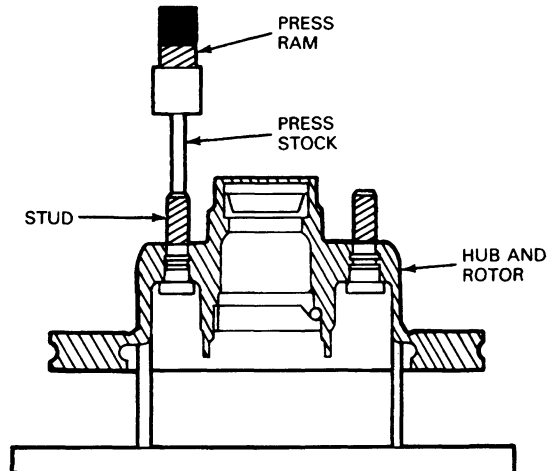
Removal

1. Raise the vehicle and install safety stands.
2. Remove the wheel and tire assembly as described in this section.
3. Remove the rotor as described in Section 06-03.



H4507-1B

4. Position the rotor in a press so ram pressure is not directly exerted on the rotor surface. With appropriate press stock, press the lugnut stud from the rotor. Discard the stud.



CAUTION: DO NOT SUPPORT OR APPLY RAM PRESSURE TO THE ROTOR BRAKING SURFACE

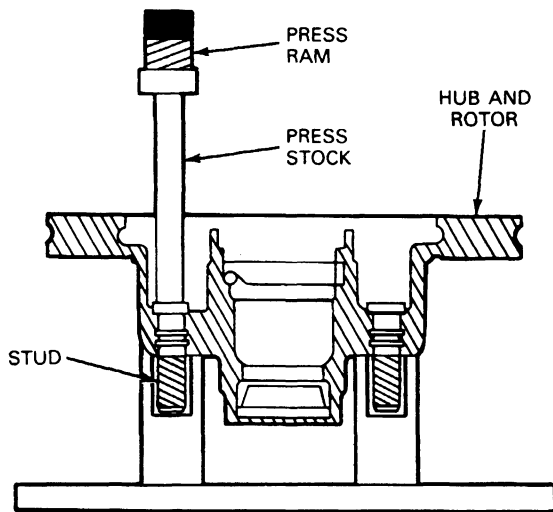
H4508-1A

Installation

1. Position a new stud in the hole. Align the serrations of the new stud with the serration marks from the old stud. With a hammer, lightly tap the stud until the serrations on the stud are started in the hole.
NOTE: Make sure the stud is not installed in an "off-center" position in the rotor hub.
2. Position the rotor in a press so the rotor is supported on the wheel mounting flange. Allow enough clearance for the stud to pass through the hole. Do not apply ram pressure directly on the rotor surface.
3. With appropriate press stock, press the stud in position until the stud is flush against the inner surface of the rotor hub.
4. Install the rotor as described in Section 06-03.

REMOVAL AND INSTALLATION (Continued)

5. Install the wheel and tire as described in this section.



CAUTION: DO NOT SUPPORT OR APPLY RAM PRESSURE TO THE ROTOR BRAKING SURFACE

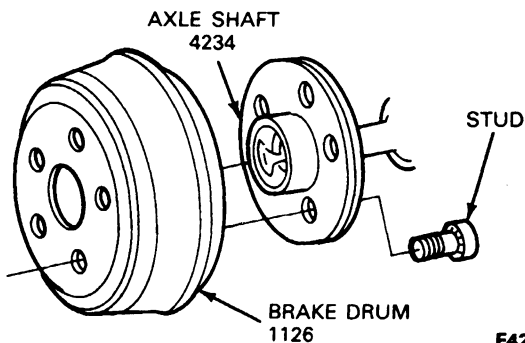
H4509-1A

Rear Wheel Lugnut Stud

Removal

CAUTION: Never use a hammer to remove the stud. Damage to the hub or bearing may result.

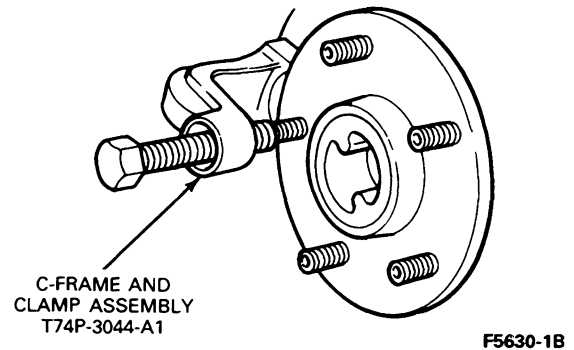
1. Raise the vehicle and install safety stands.
2. Remove the wheel and tire assembly as described in this section.
3. Remove the brake drum or rotor from the axle shaft or hub studs as described in the appropriate section in Group 06.



F4261-1A

4. Using C-Frame and Clamp Assembly T74P-3044-A1, press the stud from its seat in the hub. The stud may also be removed by pressing it out using an appropriate sized socket and C-clamp. Discard the stud.

WHEEL STUD REMOVAL

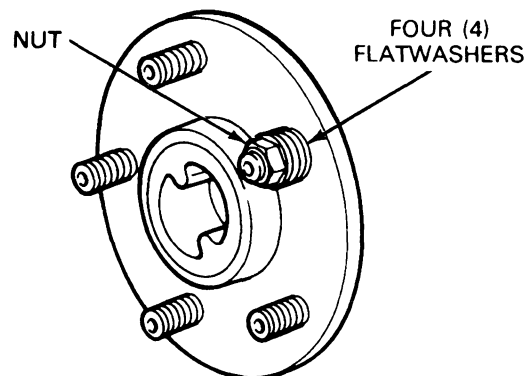


F5630-1B

Installation

1. Insert new stud in hole in the shaft or hub. Rotate stud slowly aligning serrations with those made by the original stud.
2. Place four flat washers over the outside end of the stud and thread the wheel nut with the flat side against the washers.
3. Tighten the wheel nut until the stud head seats against the back side of the shaft or hub.
- CAUTION: Do not use air tools as the serrations may be stripped from the stud.**
4. Remove wheel nut and washers.
5. Install brake drum or rotor and wheel as described in the appropriate section in Group 06.
6. Lower the vehicle.

WHEEL STUD INSTALLATION



F5631-1B

CLEANING AND INSPECTION

Rim and Wheel Maintenance

During Tire / Wheel Inspection

1. Check all metal surfaces thoroughly while making tire inspections, including areas between duals and on inboard side of wheel. Watch for:
 - excessive rust or corrosion build-up
 - cracks in metal
 - bent flanges, resulting from road obstructions
 - loose, missing or damaged nuts
 - bent or stripped studs

2. Remove damaged rims or wheels.

WARNING: EXCESSIVELY CORRODED OR CRACKED RIMS CAN BE DANGEROUS. DEFLATE TIRES PRIOR TO THE REMOVAL FROM THE WHEELS.

3. Mark damaged or hazardous areas with chalk so that part will be removed from service.
4. Replace parts as required.
5. Inflate tires only to recommended air pressures.
6. Check the wheel lugnut torque and retighten the lugnuts as specified at the end of this section.

During Tire Changes

1. Check all metal surfaces. Watch particularly for the following items:
 - Cracks in the rim bead seat or drop well radii areas. These are caused by deep rim tool marks, overloading and overinflating tires or using larger than recommended tire sizes.
 - Cracks in the wheel disc, between the stud holes or hand holes. These are caused by loose wheel nuts, improper installation procedures or the use of incorrect sizes or types of attaching parts.

WARNING: ALLOYS OR METAL SURFACES WITH CRACKS ARE VERY DANGEROUS. THESE COMPONENTS COULD FAIL WITHOUT WARNING DURING INFLATION OR LATER ON THE VEHICLE. DESTROY ALL PARTS THAT ARE CRACKED.

2. Replace the parts as necessary.

CAUTION: Make sure that replacements are made with the proper sizes and types of wheels.

3. Thoroughly remove rust, dirt and other foreign materials from all surfaces. Hand or electric wire brushes, sand blasting or chemical baths may be used. Bead seat areas of rim should be free of rust and rubber deposits. This is especially important for drop-center tubeless rims, because the bead seat is the air-sealing element.

4. Paint rim by brush or spray with a fast-drying metal primer. Surfaces should be clean and dry prior to painting. Make sure bare metal areas on the outside or tire side of rim are covered. This is especially important on drop-center tubeless rims, because warm and sometimes moist air is in constant contact with the metal surface on the tire side of the rim.
5. Lubricate the tire side of the rim base just prior to mounting tire.

NOTE: Avoid the use of any lubricant which contains water or solvent that is injurious to rubber such as WD40. A combination lubricant and rust-preventive compound is preferable such as Rubber Lubricant D9AZ-19583-A (ESA-M1B6-A) or equivalent. This protective measure is of particular importance with drop-center tubeless rims as the air in the tire is contained by the tire-side rim surface.

6. Inflate tire to recommended air pressure.

CAUTION: When mounting a tire on a wheel, do not inflate to more than 276 kPa (40 psi); then deflate tire.

NOTE: If the tire is to be reinstalled on the same wheel, mark the tire and wheel so they can be reassembled in the same position.

Punctured tires should be removed from the wheel and permanently serviced from the inside using a combination repair plug and vulcanized patch. When servicing a puncture, always follow the manufacturer's instructions for using the service kit.

Punctures in the tread area only are serviceable. Never attempt to service punctures in the tire shoulders or sidewalls. In addition, do not service any tire that has sustained the following damage:

- Bulges or blisters.
- Ply separation.
- Broken or cracked beads.
- Fabric cracks or cuts.
- Tires worn to the fabric, or if wear indicators are visible.
- Punctures larger than 6.35mm (1 / 4 inch) diameter.

WARNING: AFTERMARKET AEROSOL TIRE SEALANTS ARE EXTREMELY FLAMMABLE. ALWAYS QUESTION CUSTOMER TO MAKE SURE THESE PRODUCTS HAVE NOT BEEN USED.

Wheel and Tire Checking Procedure

Inspect tires for wear from incorrect mounting misalignment, loose wheel bearings, bent wheels, or cupping or scalping from imbalance. Tires which show irregularities and definite roughness must be replaced.

Make sure the brakes are not dragging and wheel bearings are properly adjusted before attempting to spin the wheels. On disc brakes, push the brake shoes into the caliper to free the rotor.

CLEANING AND INSPECTION (Continued)**Tires**

To clean tires, use a mild soap and water solution only, and rinse thoroughly with clear water. Do not use any caustic solutions or abrasive materials. Do not use steel wool, wire brushes or gasoline, paint thinner or similar materials having a mineral oil base. These materials are harmful to the tires and will eventually discolor the whitewalls and raised letters.

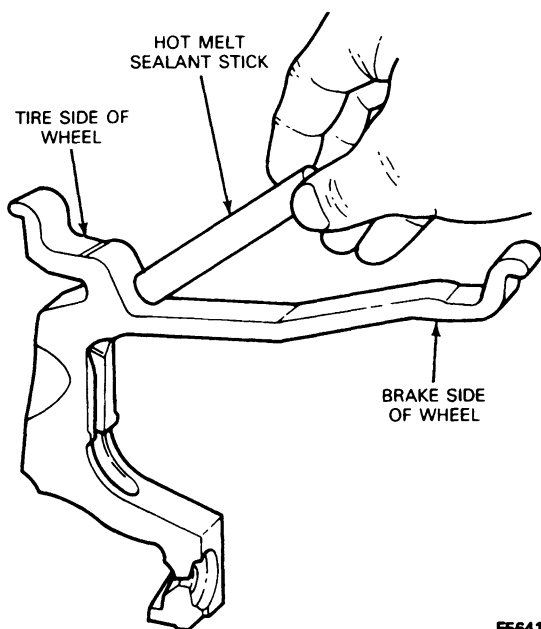
Aluminum Wheels and Rims**Cleaning**

Whenever a tire is removed, thoroughly examine the complete wheel. Remove all grease and road dirt and use a non-abrasive cleaner to remove the rubber from the bead seat.

Aluminum Wheel Leaks

Pinhole rim leaks in cast aluminum wheels can be repaired with Hot Melt Sealant Aluminum Wheel Repair Compound E7AZ-19554-A (ESA-M4G280-A), or equivalent using an electric heat gun such as Rotunda Model 107-00301 or equivalent.

NOTE: Forged aluminum wheels do not have pinhole leaks and should not be repaired with Hot Melt.



F5641-1A

Protection in Corrosive Environments

Aluminum wheels have a protective coating to resist corrosion. Care should be taken to avoid damaging the wheel or corrosion may occur. Washing them (do not use highly alkaline cleaning agents) when washing the rest of the vehicle will be enough to keep wheels looking good for many years. Certain environments, as created by some operations, can lead to corrosion. Some of these are: livestock hauling, salt, chloride compounds used for snow removal, dust control and highly alkaline materials. When these conditions are encountered, the following practice is recommended:

1. Clean frequently with steam or high-pressure water from a hose. Use of a mild detergent will speed up the cleaning process.
2. When tires are removed, the entire wheel should be cleaned and inspected. For maximum protection, there are various types of coatings which give good results. The following procedures are suggested:

Surface Preparation

1. Remove all the soil and oil from the wheel surface with either high-pressure steam or solvent. Suitable solvents would be mineral spirits and regular paint thinner, obtained in paint stores.
2. Remove any adherent soil or oxidation products by using a wire brush.
3. Clean the surface again with solvent, using mineral spirits to remove loose products.

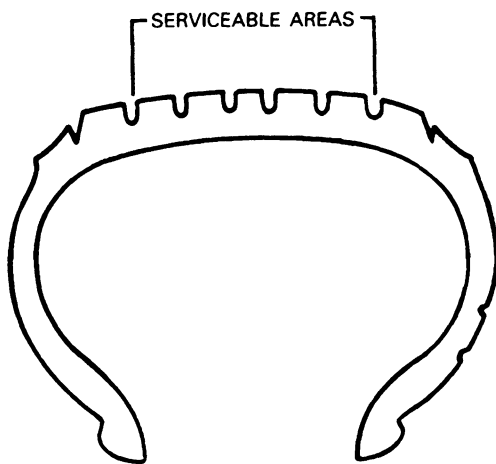
CLEANING AND INSPECTION (Continued)

Valves

Replacement wheels may need to have an air valve installed. If it becomes necessary to replace an air valve it should be installed using 19 N·m (14 ft-lbs) of torque on the hex nut, on those wheels equipped with brass valves. On wheels equipped with rubber valves, the rubber valve must be fully seated in the hole in the wheel.

CAUTION: Tire sealants that are injected through the valve stem are not to be used to service punctured tires because they can produce wheel rust and tire imbalance.

TIRE SERVICE AREAS



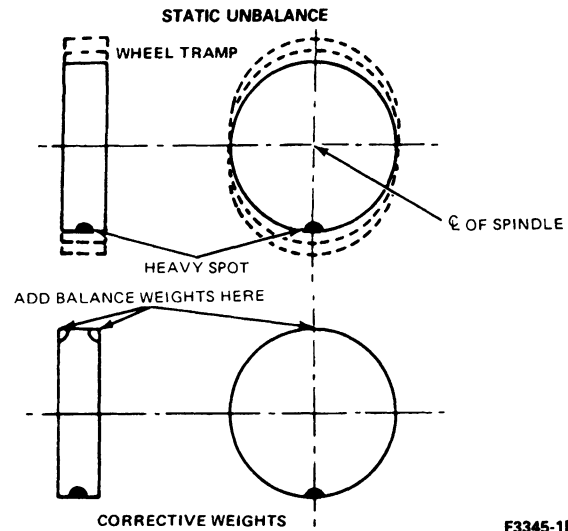
F3344-1B

ADJUSTMENTS

Tire and Wheel Balance

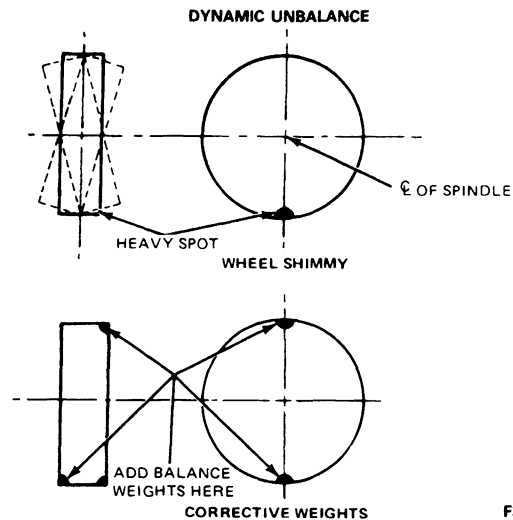
There are two types of wheel and tire balance: static and dynamic.

A static balance is the equal distribution of weight around the wheel. Wheels that are statically unbalanced cause a bouncing action called wheel tramp. This condition will eventually cause uneven tire wear.



F3345-1B

A dynamic balance is the equal distribution of weight on each side of the centerline, so that when the tire spins there is no tendency for the assembly to move from side to side. Unbalanced wheels may cause wheel shimmy.



F3346-1B

Clean deposits of mud, etc., from the inside of the rim. Remove stones from the tread. Inspect tire for any damage. Balance according to the equipment manufacturer's instructions.

Off-Vehicle Balancing

When balancing wheels off the vehicle, use a balancer which pilots the wheels the same way the wheel is piloted on the vehicle. If the wheel tramp and vehicle vibration is not corrected by the off-vehicle balance, refer to Section 00-04.

ADJUSTMENTS (Continued)

Vibration

If vehicle vibration persists after the wheels have been balanced, it may be caused by either tire, wheel or wheel bolt runout or other vehicle components or systems. Refer to Section 00-04 for diagnosis guides.

NOTE: Typical rotation patterns are shown. Many other rotation patterns are acceptable, however a single pattern should be consistently used to maximize the tread life of a tire set.

Tire Inflation

Tire inflation pressure is carefully calculated. Refer to the Vehicle Safety Compliance Certification Label for tire pressures. Refer to Section 00-01.

NOTE: The pressure value, located on the tire sidewall, is a **MAXIMUM** value and not necessarily correct for the vehicle.

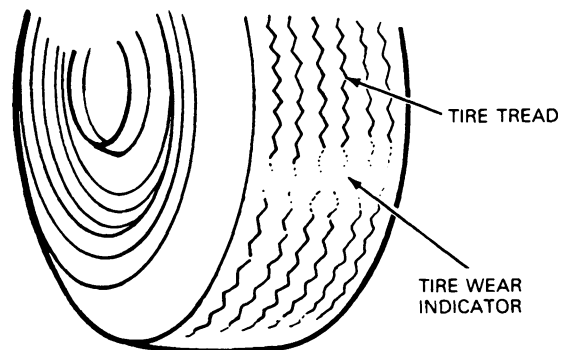
Refer to the chart in the Specifications portion of this section that gives the recommended cold tire inflation pressure. Measure cold tire inflation pressure after the vehicle has been parked for three hours or has been driven less than 5 km (3 miles).

WARNING: OVER- OR UNDER-INFLATED TIRES CAN REDUCE TIRE LIFE, ADVERSELY AFFECT VEHICLE HANDLING, AND POSSIBLY LEAD TO A SUDDEN FAILURE THAT COULD RESULT IN THE LOSS OF VEHICLE CONTROL WITHOUT WARNING.

Tread Wear Indicators

The original equipment tires have built-in tread wear indicators to show when tires need replacement. These indicators will appear as 12.7mm (1/2 inch) wide bands when the tire tread depth becomes 4mm (1/16 inch). When the indicators appear in two or more adjacent grooves, at three locations around the tire, or when cord or fabric is exposed, tire replacement due to tread wear is required.

TREAD WEAR INDICATOR



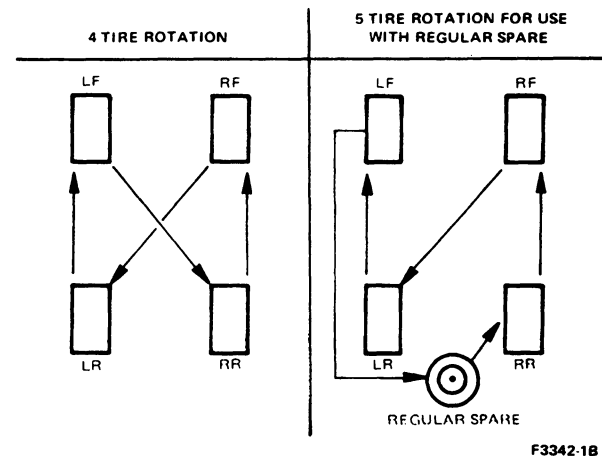
F3343-1B

Tire Rotation, Single Rear Wheels

To equalize tire wear, tires may be rotated, but not until the cause of unusual or uneven tire wear is determined and corrected. Rotation is recommended first at 8 000-12 000 km (5,000-7,500 miles) intervals or 24000 km (15,000 miles) thereafter.

CAUTION: Vehicles with A/S front and A/T rear tires can only be rotated side to side. Dual rear vehicles should have only the front tires rotated side to side.

NOTE: All-season and all terrain tires may show irregular tire wear if tires are not rotated regularly.



F3342-1B

Front Wheel Bearings

Wheel bearings are adjustable. Satisfactory operation and long life of bearings depend on proper adjustment and correct lubrication. **If bearings are adjusted too tightly, they will overheat and wear rapidly. An adjustment that is excessively loose can cause pounding and contribute to uneven tire wear, steering difficulties and inefficient brakes. The bearing adjustment should be checked at regular inspection intervals.**

Front hub assemblies and bearings should be cleaned, inspected and lubricated whenever the hub assemblies are removed or at the mileage / time periods indicated in the maintenance schedule.

New hub assembly grease seals should be installed when the hub is removed. A damaged or worn seal may permit bearing lubricant to reach the brake linings, resulting in ineffective brake operation and necessitating premature replacement of linings.

Bearing adjustment is described in Section 04-01A or the appropriate axle (semi-float or front wheel drive) or wheel hub and bearing (full float) section in Group 05.

ADJUSTMENTS (Continued)

Straightening Wheels

Do not heat wheels in an attempt to soften them for straightening to repair damage from striking curbs, etc. The special alloy used in these wheels is heat-treated, and uncontrolled heating from welding affects the properties of the material. Do not weld the wheels for any reason.

SPECIFICATIONS

NOTE: Torque specifications are for clean, dirt- and paint-free dry bolt and nut threads. Never use oil or grease on studs or nuts.

WHEEL TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
E-150, F-150, Bronco 5-Lug Wheel 1/2-20	135	100
E-250, E-350, F-250, F-350 8-Lug Wheel 9/16-18	190	140
F-Super Duty and F-Super Duty Stripped Chassis Vehicles 10-Lug Wheel 9/16-18	190	140

Vehicle	Wheelbase	Gross Vehicle Weight (GVW)	Wheel	Tire	Recommended Cold Inflation Pressure			
					PSI		Kilopascal (kPa)	
					Front	Rear	Front	Rear
F-150 (4x2) RC, SWB	2972 mm (117 inch)	5250/5000/5450	15 x 6.0J	P215/75R 15SL	35	35	241	241
			15 x 6.0J*	P235/75R 15XL	35	41	241	283
F-150 (4x2) RC, LWB	3378 mm (133 inch)	5450	15 x 6.0J	P215/75R 15SL	35	35	241	241
		6250	15 x 6.0J*	P235/75R 15XL	35	41	241	283
F-150 (4x2) SC, SWB	3526 mm (139 inch)	6050	15 x 6.0J*	P235/75R 15XL	35	41	241	283
F-150 (4x2) SC, LWB	3937 mm (155 inch)	6250	15 x 6.0J*	P235/75R 15XL	35	41	241	283
F-150 (4x2) PERF	2972 mm (117 inch)	5150	17 x 8.0J	P275/60HR17	30	30	207	207
F-150 (4x4) RC, SWB	2972 mm (117 inch)	6100	15 x 6.0J*	P235/75R 15XL	35	41	241	283
			15 x 7.5J	P265/75R 15SC	30	30	207	207
F-150 (4x4) RC, LWB	3378 mm (133 inch)	6250	15 x 6.0J*	P235/75R 15XL	35	41	241	283
			15 x 7.5J	P265/75R 15SC	30	30	207	207
			15 x 7.5J	P265/75R 15SC	30	30	207	207
F-150 (4x4) SC, SWB	3526 mm (139 inch)	6250	15 x 6.0J*	P235/75R 15XL	35	41	241	283
F-150 (4x4) SC, LWB	3937 mm (155 inch)	6250	15 x 6.0J*	P235/75R 15XL	35	41	241	283
Bronco	2660 mm (105 inch)	6050/6300	15 x 6.0J*	P235/75R 15XL	35	41	241	283
			15 x 7.5J	P265/75R 15SC	35	35	207	207
		6450*	15 x 6.0J*	P235/75R 15XL	38	41	262	283
			15 x 7.5J	P265/75R 15SC	30	30	207	207
F-250 (4x2) RC	3378 mm (133 inch)	6600	16 x 7K	LT215/85R 16D	51	58	352	352
			16 x 7K	LT235/85R 16E	44	51	303	303
			16 x 7K	7.50R-16D	40	50	276	345
		8600	16 x 7K	LT235/85R 16E	51	80	352	552
F-250 (4x2) SC	3937 mm (155 inch)	8800	16 x 7K	LT235/85R 16E	51	80	352	552

* Also available with 15 x 7.5J Wheel

NOTE: The size and the part number or two-character wheel code is stamped or cast on the wheel.

CF3944-J

SPECIFICATIONS (Continued)

Vehicle	Wheelbase	Gross Vehicle Weight (GVW)	Wheel	Tire	Recommended Cold Inflation Pressure			
					PSI		Kilopascal (kPa)	
					Front	Rear	Front	Rear
F-250 (4x4) RC	3378 mm (133 inch)	8600	16 x 7K*	LT 235/85R 16E	44	80	303	552
			16 x 7K ①	LT 235/85R 16E	58	80	400	552
F-250 (4x4) SC	3937 mm (155 inch)	8800	16 x 7K*	LT 235/85R 16E	51	80	352	552
F-350 (4x2) S/R, CHC	3378 mm (133 inch)	8800	16 x 7K*	LT 235/85R 16E	51	80	352	552
F-350 (4x4) RC	3378 mm (133 inch)	9000	16 x 7K	LT 235/85R 16E	51	80	352	552
			16 x 7K ①	LT 235/85R 16E	65	80	448	552
F-350 (4x2) Crew Cab	4278 mm (168 inch)	9200	16 x 7K*	LT 235/85R 16E	51	80	352	552
F-350 (4x4) CHC	3378 mm (133 inch)	8800	16 x 7K*	LT 235/85R 16E	51	80	352	552
			16 x 7K ①	LT 235/85R 16E	65	80	448	552
F-350 (4x4) Crew Cab	4278 mm (168 inch)	9200	16 x 7K*	LT 235/85R 16E	58	80	352	552
F-350 D/R, RC	3378 mm (133 inch)	10000	16 x 6K*	LT 215/85R 16D	58	65	400	448
F-350 D/R, SC	3937 mm (155 inch)	10000	16 x 6K	LT 215/85R 16D	58	65	400	448
F-350 D/R, SWB, CHC	3475 mm (137 inch)	10000	16 x 6K* ①	LT 215/85R 16D	58	58	400	400
		11000	16 x 6K* ①	LT 215/85R 16D	58	65	400	448
F-350 D/R, LWB, CHC	4089 mm (161 inch)	10000	16 x 6K* ①	LT 215/85R 16D	58	58	400	400
		11000	16 x 6K* ①	LT 215/85R 16D	58	65	400	448
F-350 D/R Crew Cab	4278 mm (168 inch)	10000	16 x 6K*	LT 215/85R 16D	58	58	400	448
F-350 D/R (4x4) CHC	3475 mm (137 inch)	11000	16 x 6K* ⑤	LT 235/85R 16E	65	65	448	448
			16 x 6K ① ⑤	LT 235/85R 16E	65	65	448	448
F-350 D/R (4x4) CHC	4089 mm (161 inch)	11000	16 x 6K ⑤ ①	LT 235/85R 16E	65	65	448	448
F-Super Duty D/R, SWB CHC	3480 mm (137 inch)	15000	16 x 6K ④	LT 235/85R 16E	65	80	448	504
F-Super Duty D/R, LWB CHC	4089 mm (161 inch)	15000	16 x 6K ④	LT 235/85R 16E	65	80	448	504
	4700 mm (185 inch)	15000	16 x 6K ④	LT 235/85R 16E	65	80	448	552
F-Super Duty Commercial Stripped Chassis D/R	4013 mm (158 inch)	16000	16 x 6K ⑦	LT 235/85R 16E	80	80	552	552
F-Super Duty Commercial Stripped Chassis D/R	4521 mm (178 inch)	16000	16 x 6K ⑦	LT 235/85R 16E	80	80	552	552
F-Super Duty Motor Home Chassis D/R	4521 mm (178 inch)	17000	16 x 6K ⑦	LT 235/85R 16E	80	80	552	552
F-Super Duty Motor Home Chassis D/R	5283 mm (208 inch)	17000	16 x 6K ⑦	LT 235/85R 16E	80	80	552	552
F-Super Duty Motor Home Chassis D/R	5791 mm (228 inch)	17000	16 x 6K ⑦	LT 235/85R 16E	80	80	552	552
F-Super Duty Motor Home Chassis D/R	4521 mm (178 inch)	15200	16 x 6K ⑦	LT 215/85R 16E	80	80	552	552

NOTES:

The size and part number or two-character wheel code is stamped or cast on the wheel.

*Minimum wheel/tire sizes recommended for gross vehicle weight rating (front and rear). All other combinations are optional.

① Vehicles for Heavy Duty Front End option.

⑤ Requires 2500 lb. Wheel.

⑥ Requires 2750 lb. Wheel.

⑦ Requires 3000 lb. Wheel.

For all tire installations on any vehicle:

• Do not mix tire brands.

• Do not mix radials, bias or bias-belted tires.

CF3945-J

SPECIFICATIONS (Continued)

Vehicle	Wheelbase	Gross Vehicle Weight (GVW)	Wheel	Tire	Recommended Cold Inflation Pressure			
					PSI		Kilopascal (kPa)	
					Front	Rear	Front	Rear
E-150 Cargo Van	3505 mm (138 inch)	5500	15 x 6.0J*⑦	P215/75R 15SL	35	35	241	241
			15 x 6.0J*	P225/75R 15SL	35	35	241	241
			15 x 6.0J*	P235/75R 15XL	41	41	283	283
		6500	15 x 6.0J*	P235/75R 15XL	41	41	283	283
E-150 RV	3505 mm (138 inch)	6700	15 x 6.0J*	P235/75R 15XL	41	41	283	283
E-150 Club Wagon 7/8 Passenger	3505 mm (138 inch)	6700	15 x 6.0J*	P235/75R 15XL	41	41	283	283
E-250 Cargo Van	3505 mm (138 inch)	7200	16 x 7K	LT 225/75R 16D	50	55	344	379
			16 x 7K	LT 225/75R 16E	50	80	344	379
		7200 ⑧	16 x 7K	LT 225/75R 16E	50	80	379	552
		8450 ⑧	16 x 7K	LT 225/75R 16E	55	75	379	517
		8550	16 x 7K	LT 225/75R 16E	55	75	379	517
E-250 Super Van	3505 mm (138 inch)	7300	16 x 7K*	LT 225/75R 16D	50	55	344	379
			16 x 7K	LT 225/75R 16E	50	60	344	413
		8450 ⑧	16 x 7K	LT 225/75R 16E	50	80	379	552
		8550	16 x 7K	LT 225/75R 16E	50	80	379	552
E-350 Cargo Van	3505 mm (138 inch)	9400	16 x 7K ⑨	LT 245/75R 16E	55	80	379	552
		9500	16 x 7K	LT 245/75R 16E	55	80	379	552
E-350 Super Van	3505 mm (138 inch)	9300/9400	16 x 7K	LT 245/75R 16E	55	80	379	552
E-350 Club Wagon 12 Passenger	3505 mm (138 inch)	8700	16 x 7K	LT 225/75R 16E	55	80	379	552
			16 x 7K	LT 245/75R 16E	55	80	379	482
E-350 Super Wagon	3505 mm (138 inch)	8800/9100/9300	16 x 7K	LT 245/75R 16E	55	80	379	552
E-350 Comm S/C S/R	3505 mm (138 inch)	9400	16 x 7K	LT 245/75R 16E	55	80	379	552
	4013 mm (158 inch)		16 x 7K	LT 245/75R 16E	55	80	379	552
E-350 C/A R/V & Comm S/R	3505 mm (138 inch)	9600	16 x 7K	LT 245/75R 16E	55	80	379	552

⑦ P215 Not available w/5.8L or 4.9L, 3.55 axle ratio

⑧ 4.9L Engine only

⑨ California only

* Also available with 15 x 7.0J Wheel

⑩ Available with Heavy Duty rear GAWR only

CF3947-H

SPECIFICATIONS (Continued)

Vehicle	Wheelbase	Gross Vehicle Weight (GVW)	Wheel	Tire	Recommended Cold Inflation Pressure			
					PSI		Kilopascal (kPa)	
					Front	Rear	Front	Rear
E-350 RV, C/A, D/R	3505 mm (138 inch)	10500	16 x 6K*	LT 225/75R 16D	65	55	448	379
			16 x 6K	LT 225/75R 16E	65	55	448	379
	4013 mm (158 inch)	11500	16 x 6K*	LT 225/75R 16D	65	60	448	414
			16 x 6K	LT 225/75R 16E	65	60	448	414
	4470 mm (176 inch)	11500	16 x 6K*	LT 225/75R 16D	65	60	448	414
			16 x 6K	LT 225/75R 16E	65	60	448	414
E-350 Comm C/A, D/R	3505 mm (138 inch)	10300	16 x 6K	LT 225/75R 16D	65	60	448	414
			16 x 6K	LT 225/75R 16E	65	60	448	414
		10000	16 x 6K*④	LT 225/75R 16D	65	55	448	379
			16 x 6K④	LT 225/75R 16E	65	55	448	379
	4013 mm (158 inch)	10700	16 x 6K*	LT 225/75R 16D	65	60	448	414
			16 x 6K	LT 225/75R 16E	65	60	448	414
E-350 S/C, D/R Comm	4013 mm (158 inch) 3505 mm (138 inch) 4470 mm (176 inch)	10000	16 x 6K*	LT 225/75R 16D	65	60	448	414
			16 x 6K	LT 215/85R 16E	65	60	448	414
E350 S/C R/V D/R	4013 mm (158 inch) 4470 mm (176 inch)	11500	16 x 6K	LT 225/75R 16D	65	60	448	414
			16 x 6K	LT 225/75R 16D	65	60	448	414

NOTES

* Minimum wheel/tire sizes recommended for gross vehicle weight rating (front and rear). All other combinations are optional.

① 50 states only. Vehicles over 6000 lb. GVW in Canada only.

② For customer selected front spring option.

③ Available with ambulance prep package.


④ School bus package only.

For all tire installation on any vehicle:

- Do not mix tire brands.
- Do not mix radials, bias or bias-belted tires.

CF3948-F

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number / Description	Illustration
T74P-3044-A1 C-Frame and Clamp Assembly	 T74P-3044-A1

ROTUNDA EQUIPMENT

Tool Number	Description
104-00110	Truck Tire Changer
104-00111	Tire Spreader
007-00014	Radial Runout Gauge
104-00104	Inflation Chamber

GROUP

06

(2000)

BRAKES

SECTION TITLE	PAGE	SECTION TITLE	PAGE
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BRAKE ACTUATION, HYDRAULIC.....	06-06-1	BRAKE, POWER, VACUUM, SINGLE AND TANDEM DIAPHRAGM.....	06-07A-1
BRAKE, FRONT DISC.....	06-03-1	BRAKE, REAR, ANTI-LOCK CONTROL.....	06-09A-1
BRAKE, GENERAL, HYDRAULIC.....	06-00-1	BRAKE, REAR DRUM.....	06-02-1
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SECTION 06-00 Brake, General, Hydraulic

SUBJECT	PAGE	SUBJECT	PAGE
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Bleed Procedure, ABS System.....	06-00-35	Brakes Pull or Drift.....	06-00-27
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Dump Valve Adjustment.....	06-00-34	OVERHAUL	
Front Disc Brakes.....	06-00-34	Brake Cylinder.....	06-00-32
Hydraulic System Bleeding.....	06-00-34	Brake Drum Refinishing.....	06-00-31
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Hydraulic Master Cylinder.....	06-00-35	Front Disc Brakes.....	06-00-31
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DIAGNOSIS AND TESTING			
Diagnosis Guides.....	06-00-6		
Master Cylinder Diagnosis.....	06-00-5		
Pull/Drift Diagnostic Procedure.....	06-00-22		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab, Commercial Chassis, Motorhome Chassis and Bronco Vehicles

DESCRIPTION AND OPERATION

Hydraulic brakes are standard equipment on all vehicles.

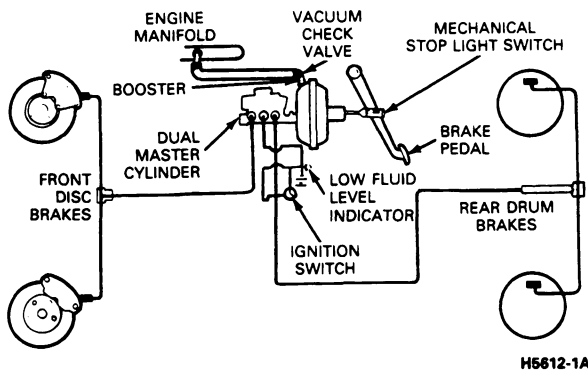
DESCRIPTION AND OPERATION (Continued)

Hydraulic rear drum brakes on all Bronco, F-150-250-350 and E-150-250-350 vehicles use automatic rear brake shoe adjusters. Hydraulic disc brakes are used on all front brake systems and for F-Super Duty vehicle rear brakes.

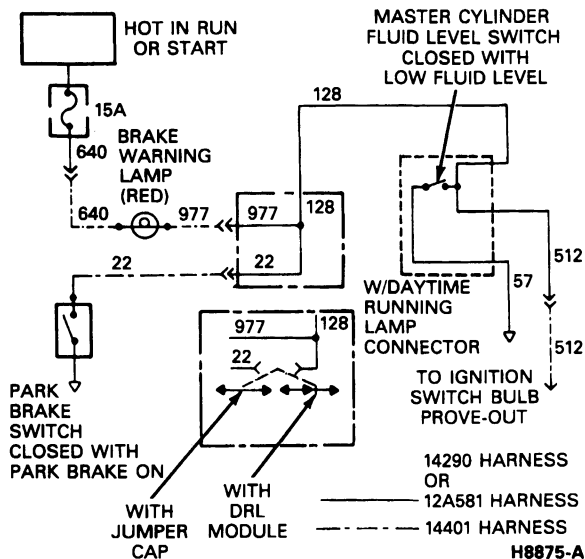
Dual Master Cylinder Brake System

The dual master cylinder contains a double hydraulic cylinder with a plastic see-through reservoir, FLI (Fluid Level Indicator), primary and secondary hydraulic pistons.

Hydraulic Brake System with Dash-Mounted Booster, Typical

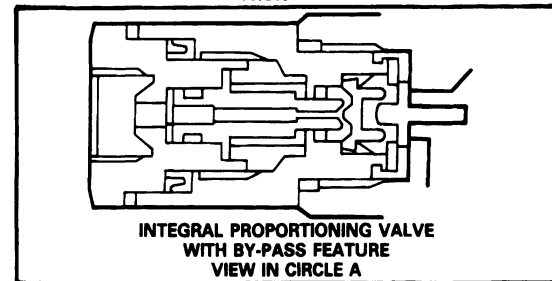
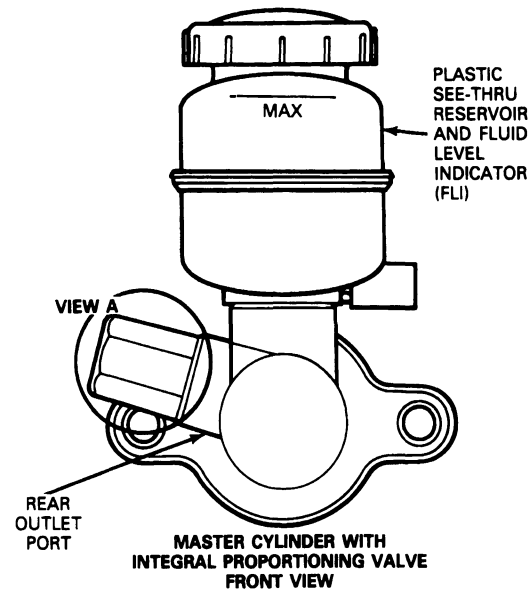


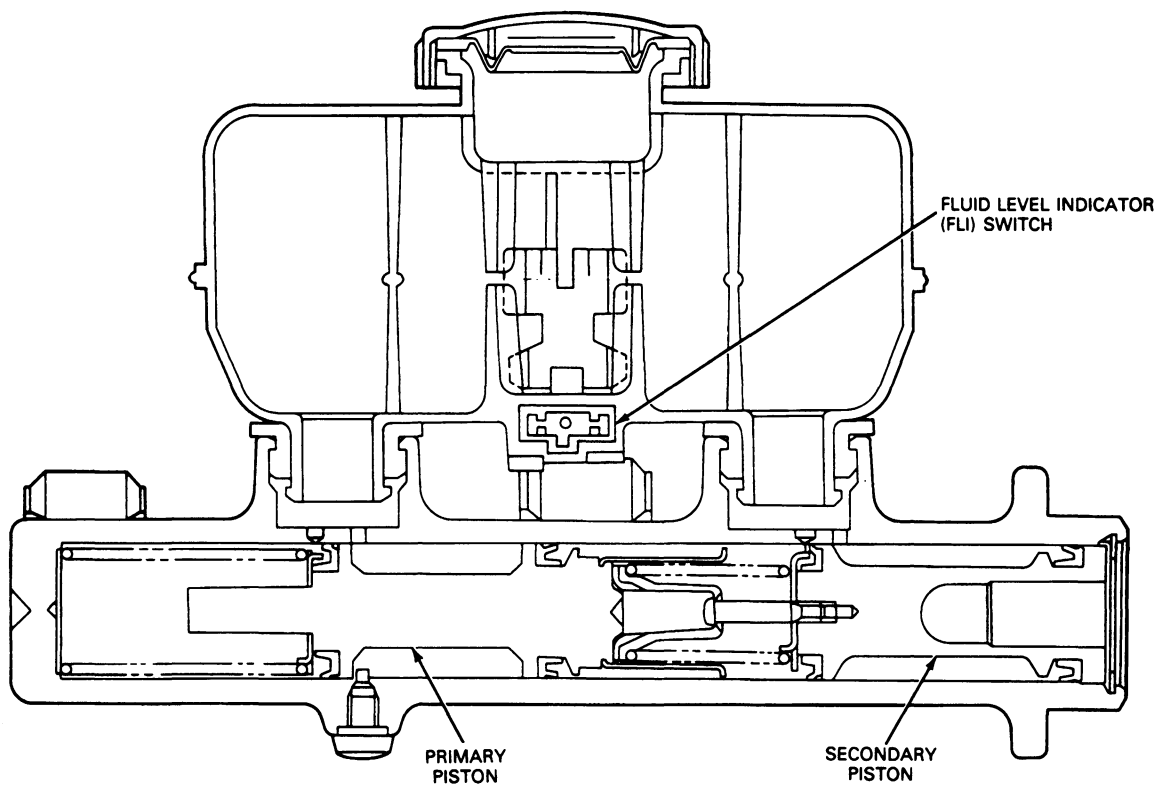
Base Brake Electrical Schematic, Bronco



The hydraulic brake system on all vehicles except F-Super Duty is assisted by a vacuum booster installed as standard equipment. Information about the vacuum booster is given in Section 06-07A. F-Super Duty vehicles use a Hydro-Boost hydraulic brake booster. Refer to Section 06-07C for information.

Master Cylinder Assembly with Integral Proportioning Valve



DESCRIPTION AND OPERATION (Continued)**Master Cylinder Assembly**

H5613-2A

A proportioning valve, where used, is integral to the master cylinder. It proportions pressure to the rear system.

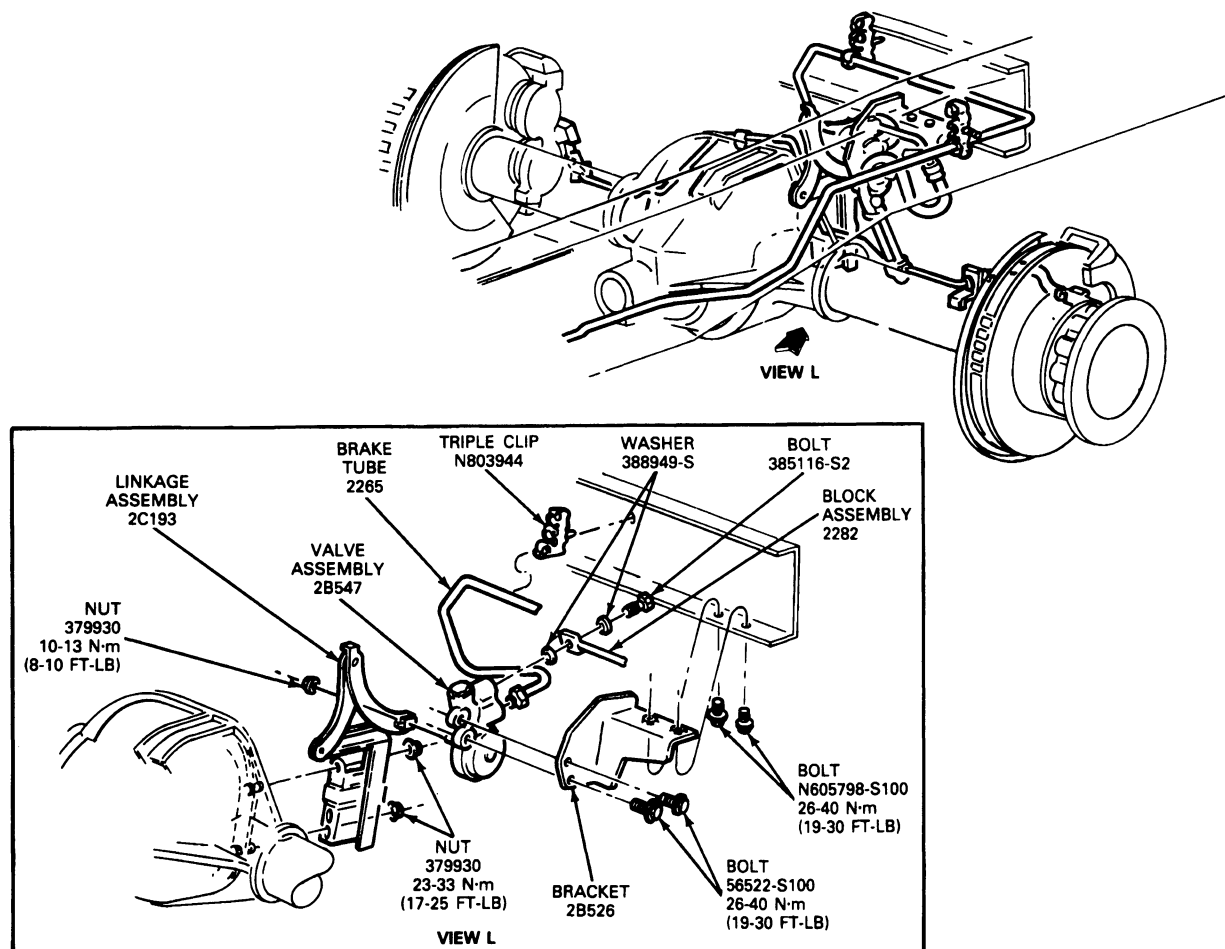
The height sensing brake proportioning valve is used on F-Super Duty vehicles.

The valve is located on the crossmember by the rear axle and is activated through a linkage system that is connected to the rear axle housing cover.

For more information on the Height Sensing Brake Proportioning Valve, refer to Section 06-06.

DESCRIPTION AND OPERATION (Continued)

Height Sensing Brake Proportioning Valve Installation, F-Super Duty



H7424-2A

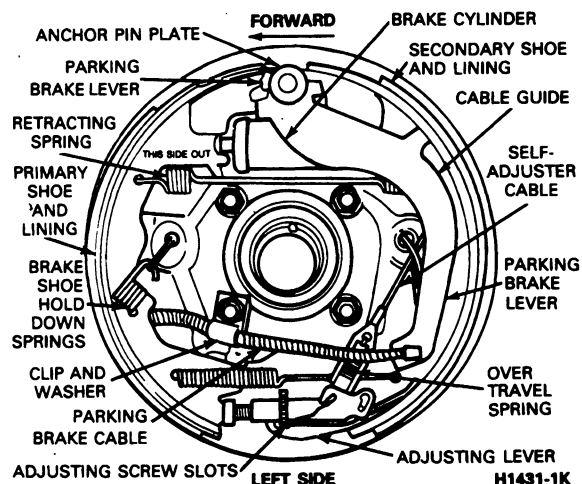
Disc Brakes

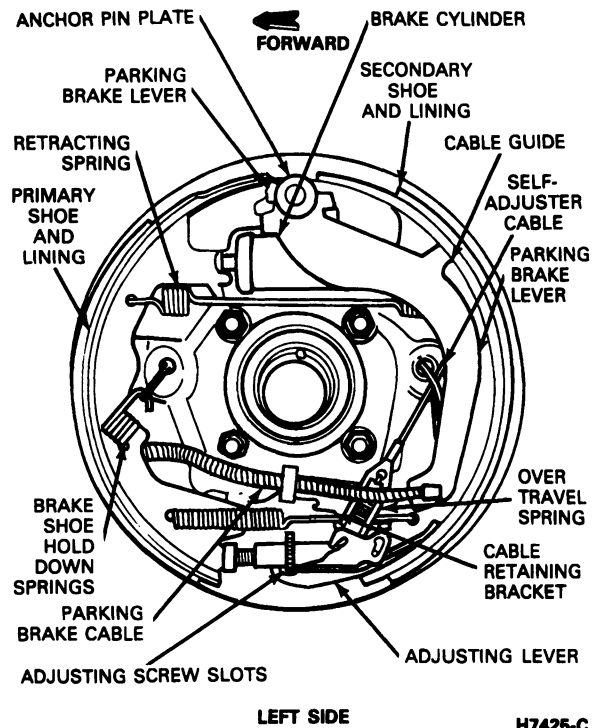
All F-150-250-350, E-150-250-350 and Bronco vehicles are equipped with front disc brakes. F-Super Duty vehicles are equipped with four-wheel disc brakes. Refer to Section 06-03.

Drum Brakes

The rear brakes are drum type with internal shoes that expand against the drum when the brakes are applied. The rear drum brakes are of the single anchor type, mounted to the same anchor, and actuated by one wheel cylinder. Refer to Section 06-02.

Self Adjusting Brake Assemblies, F-250-350 4x2 and 4x4 and E-250-350



DESCRIPTION AND OPERATION (Continued)**Self Adjusting Brake Assemblies, E-350 SRW and DRW and F-350 DRW Vehicles****DIAGNOSIS AND TESTING**

Occasional brake squeal can be caused by environmental conditions such as cold ambient temperatures, heat, rain, snow, salt, mud, hot ambient temperatures or high humidity. This occasional squeal is not a functional problem and does not indicate any loss in brake effectiveness.

Master Cylinder Diagnosis**Normal Conditions**

The following conditions are considered normal and are not indications that the master cylinder is in need of service.

Condition 1: During normal operation of the master cylinder, the fluid level in the reservoir will rise during brake application and fall during release. The net fluid level, i.e., after brake application and release, will remain unchanged.

Condition 2: A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

Condition 3: Fluid level will decrease with pad wear.

Abnormal Conditions

Changes in brake pedal feel or travel are indicators that something could be wrong in the brake system. Refer to Diagnosis Guides for abnormal condition diagnosis.

Rear Anti-lock Brakes

The Rear Anti-lock Brake System (RABS) is used on E-150-250-350, F-150-250-350 vehicles. The system consists of a computer module, RABS Valve speed sensor and an excitor ring. F-Super Duty vehicles are equipped with a speed sensor and excitor ring which is used for vehicle speed information. These vehicles will not be equipped with the complete RABS system. For system diagnostic and testing, refer to Section 06-09.

Four-Wheel Anti-Lock Bronco

The four-wheel anti-lock brake system (ABS) is used on the Bronco. This system consists of a Hydraulic Controlled Unit (HCU), Pump Motor Relay and System Relay. It also contains three speed sensors, speed sensor rings and an acceleration sensor. Data transmitted or stored by these electronically controlled units is monitored by the Electronic Control Unit (ECU). Microprocessors, within the module, process the data which is then translated into commands which activate the HCU when anti-lock function is necessary for optimum four-wheel braking performance. For Diagnosis and Testing refer to Section 06-09B.

DIAGNOSIS AND TESTING (Continued)**Diagnosis Guides**

CONDITION	POSSIBLE SOURCE	ACTION
Brake warning light on.	<ul style="list-style-type: none"> Low fluid level. Ignition wiring routed too closely to fluid level indicator assembly. Damaged float assembly. Low vacuum level (diesel only). Shorted light circuit. Worn or damaged brake fluid level indicator. Leak in brake system. Parking brake engaged. 	<ul style="list-style-type: none"> Add fluid, bleed system and check for leaks. Reroute wiring as required. Repair or replace as required. Refer to Section 06-07B, for diagnosis and testing procedures. Correct short in warning circuit. Replace switch. Repair leak. Release parking brake. Refer to Section 06-05.
Brakes not working, excessive pedal travel, brake pedal feels spongy when fully applied.	<ul style="list-style-type: none"> Rear brakes out of adjustment. Front wheel bearing out of adjustment. Master cylinder or booster dash unit mounting loose. Disc brake caliper attachment loose. Worn or damaged self-adjusters. Worn or damaged brake linings. Drum out-of-round or rotors with excessive runout. Worn or damaged four wheel ABS hydraulic control unit (Bronco only). Worn or damaged RABS valve accumulator (F-Series and Econoline only). Brake tubing improperly positioned. Low fluid level. Clogged reservoir vent cap hole. Air in system. 	<ul style="list-style-type: none"> Adjust rear brakes. Refer to Section 06-02. Adjust front wheel bearings. Refer to Section 04-01. Tighten nuts and bolts to specification. Refer to Section 06-06. Replace or tighten as required. Refer to Section 06-03. Remove drum and check lining for proper adjustment. Replace self-adjusters. Refer to Section 06-02. Replace brake shoes and linings in sets. Refer to Section 06-03. Refinish or replace if wear exceeds limits. Refer to Section 06-02. Refer to Section 06-09B. Refer to Section 06-09A. Check brake tubing for misposition near heat source. Hot fluid can boil and result in spongy pedal response. Fill as required. Repair or replace cap. Bleed system.
Excessive pedal travel or pedal goes to floor consistently.	<ul style="list-style-type: none"> Hydraulic system. Drum brakes out of adjustment, worn, bad wear pattern or cracked drums. Loose or improper attachment of pedal, pedal support booster and master cylinder. Misaligned anchor plate. External leak. Air in system. 	<ul style="list-style-type: none"> Perform master cylinder diagnosis test. Refer to master cylinder diagnosis chart. Repair as required. Refer to Section 06-06. Repair or replace as required. Refer to Section 06-02. Repair or replace as required. Refer to Section 06-06. Refer to misaligned disc brake anchor plate diagnosis. Repair as required. Refer to Section 06-03. Repair as required. Bleed system.
Empty reservoir.	<ul style="list-style-type: none"> Improperly positioned cap or gasket. Leaking reservoir mounting grommets. 	<ul style="list-style-type: none"> Reposition cap and gasket. Replace grommets and reservoir assembly as required.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Excessive pedal effort to fully apply brakes.	<ul style="list-style-type: none"> ● Overloaded vehicle. ● Insufficient vacuum to brake booster. ● Restricted air filter on power brake booster. ● Booster and brake pedal linkage binding caused by worn bushings or corrosion. ● Worn or damaged brake booster. ● Brake lining worn, glazed, contaminated or improper type. ● Brake shoe and lining improperly installed. ● Seized pistons in wheel cylinders or seized calipers. ● Restricted brake lines or hoses. ● Inoperative height sensing valve (F-Super Duty only). 	<ul style="list-style-type: none"> ● Lighten load and advise owner of correct load limits of vehicle. ● Replace damaged or leaking vacuum hoses. Refer to Section 06-06. ● Clean or replace filter. ● Replace worn bushings or clean and lubricate linkage. ● Replace booster. Refer to Section 06-06. ● Replace brake lining in axle sets. ● Reposition brake shoes properly and eliminate any binding. Refer to Section 06-03. ● Repair or replace as required. Refer to Section 06-03. ● Repair or replace as required. ● Check vehicle ride height and control linkage. Refer to Section 06-06.
Pedal eases down slowly.	<ul style="list-style-type: none"> ● External leak. ● Internal leak. 	<ul style="list-style-type: none"> ● Repair as required. ● Perform master cylinder diagnosis test. Refer to master cylinder diagnosis chart. Repair as required.
Intermittent loss of pedal.	<ul style="list-style-type: none"> ● Hydraulic system. ● Front wheel bearings out of adjustment. (On F-Super Duty vehicles, front or rear wheel bearings out of adjustment.) ● Drum brakes out of adjustment, worn, bad wear pattern or cracked drums. ● Loose or improper attachment of pedal, pedal support, booster and master cylinder. ● Misaligned anchor plate. 	<ul style="list-style-type: none"> ● Perform master cylinder diagnosis. Repair as required. Refer to Section 06-06. ● Adjust front wheel bearings. Refer to Section 04-01. ● Repair or replace as required. Refer to Section 06-02. ● Repair or replace as required. Refer to Section 06-06. ● Refer to misaligned disc brake anchor plate diagnosis. Repair as required. Refer to Section 06-03.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Brakes pull to one side.	<ul style="list-style-type: none"> • Unequal air pressure in tires. • Grease or fluid on linings. Contaminated linings. • Improper size or type of lining on one wheel. • Improper size wheel cylinder on one wheel. • Stuck or seized pistons in wheel cylinders or seized calipers. • Restricted brake lines or hoses. • Insufficient release of caliper due to lack of lubrication. • Insufficient clearance of inner brake shoe. • Front side-to-side torque variations. • Disfunctioning rear brake. • Incorrectly adjusted cage diameters. • Other brake components. <ul style="list-style-type: none"> — Improper adjustment of drum brakes. — Improper positioning of disc brake shoe and lining in the caliper. — Improperly adjusted, damaged or worn wheel bearings. — Distorted drum brake shoes. — Worn brake linings. — Missing, broken or stretched retracting or retaining springs and clips. • Other components. <ul style="list-style-type: none"> — Suspension. — Steering. — Tires. 	<ul style="list-style-type: none"> • Inflate tires to correct pressure. Refer to Section 04-04. • Clean, sand and/or replace linings. Refer to Section 04-04. • Replace with correct brake linings in sets. • Replace with correct wheel cylinder. • Raise vehicle on hoist. Check for movement of piston during application / release of brakes. Repair or replace as required. Refer to Section 06-03. • Repair or replace as required. • Lubricate the caliper rails and inner knuckle shoe groove. • Min. clearance with anti-rattle clip removed .25mm (0.01 in.) side-to-side, .71mm (0.028 in.) end-to-end. Repair or replace as required. Refer to Section 06-02. • Swap front rotors and linings from side-to-side. If pull direction changes replace pads and take light cut off rotors. Refer to Section 06-03. • Check for contaminates, broken components, frozen parking brake and improperly installed parts. Repair or replace as required. Refer to Section 06-02. • Set cage diameters to specifications. • Inspect, adjust, repair or replace as required. Refer to applicable Section in Group 06. • Refer to the appropriate section in this manual.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Brakes grab or lock up when applied.	<ul style="list-style-type: none"> ● Tires worn, flat spotted or incorrect pressure. ● Grease or fluid on linings — damaged linings. ● Improper size or type of linings. ● Over-reaction of brake booster. ● Rear brakes continually lock up at low pedal effort. ● Worn, damaged or dry wheel bearings. ● Parking brake cable binding or out of adjustment. ● Parking brake cable control assembly binding. 	<ul style="list-style-type: none"> ● Inflate tires to correct pressure. Replace tires with worn tread. ● Inspect, repair or replace linings in sets. ● Replace with correct brake linings in sets. ● Check brake booster for over-reaction by comparing with a known quality vehicle. Replace brake booster if required. ● Replace rear Anti-lock Brake (RAB) Valve on E-150-250-350, F-150-250-350 and / or all-wheel ABS valve-Bronco and perform diagnostic in Section 06-09B or Height Sensing Valve on F-Super Duty if lockup occurs at light load. Refer to Section 06-06. ● Inspect, repair or replace as required. ● Adjust cables. Repair, lubricate or replace if required. ● Repair, lubricate or replace if required.
Brakes drag, slow or incomplete release.	<ul style="list-style-type: none"> ● Parking brake control or cables binding. ● Brake pedal binding. ● Front wheel bearing out of adjustment. ● Worn or damaged master cylinder. ● Brakes out of adjustment. ● Restriction in hydraulic system. ● Seized wheel cylinders or caliper pistons. ● Stoplight switch out of adjustment. ● Lack of lubricant on disc brake caliper slides. ● Speed control dump valve inoperative. ● Hydraulic power Hydro-Boost (F-Super Duty Commercial Stripped Chassis and Motorhome Stripped Chassis) system restricted or routed incorrectly. ● Brake pedal to bell crank rod adjusted incorrectly (F-Super Duty Motorhome Chassis). 	<ul style="list-style-type: none"> ● Repair, lubricate or replace parts as required. Refer to Section 06-05. ● Repair, lubricate or replace parts as required. ● Check bearings for adjustment, wear, damage. Adjust bearings. Refer to Section 04-01. ● Check master cylinder for open compensator ports. Repair or replace. Refer to Section 06-06. ● Adjust brakes. ● Repair or replace as required. Refer to Section 06-07. ● Repair or replace as required. Refer to Section 06-03. ● Adjust switch. Refer to Section 17-01. ● Lubricate disc brake caliper slides. ● Repair or replace as required. ● Repair, replace or reroute as required. Refer to Section 06-07C. ● Adjust rod length. Refer to Section 06-06.
Noise at wheels when brakes are applied — snap or clicks.	<ul style="list-style-type: none"> ● Cracked welds at rear brake shoe web. ● Brake shoes binding at backing plate ledges. ● Machining marks on brake drums. ● Backing plate ledges worn. ● On disc brakes — loose or missing anti-rattle clips. ● Improper finish on brake rotor. ● Loose outer shoe crimping. 	<ul style="list-style-type: none"> ● Replace brake shoe and lining assemblies in axle sets. Refer to Section 06-02. ● Clean and lubricate ledges. ● Refinish or replace brake drums. ● Replace backing plate and lubricate ledges. ● Replace. Refer to Section 06-03. ● Refinish rotor. ● Inspect, repair or replace. Refer to applicable Section in Group 06.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Noise at wheels — brakes applied — squeak or squeal.	<ul style="list-style-type: none"> ● Brake lining and / or rotor surface contamination. ● Disc brakes — missing or damaged brake pad insulators. ● Improper lining parts. ● Drum brakes — loose lining rivets, weak, damaged or incorrect shoe retracting springs, loose or damaged shoe retainer pins, springs and clips, and grooved backing plate ledges. 	<ul style="list-style-type: none"> ● Remove caliper assembly from spindle and remove inner and outer linings. Hand sand the linings and both braking surfaces of rotor. Use Garnett Paper 100A (medium grit) or equivalent or aluminum oxide 150J (medium) or equivalent. Refer to Section 06-03. ● Replace insulators or replace shoe and lining assembly if pads are worn. Refer to Section 06-03. ● Inspect for correct usage. Replace as required. Refer to Section 06-03. ● Inspect, repair or replace as required. Refer to Section 06-02.
Noise at wheels — brakes not applied — squeak or squeal.	<ul style="list-style-type: none"> ● Wheel covers improperly attached. ● Loose wheel lugnuts. ● Worn, dry or improperly adjusted wheel bearings. ● Bent or warped backing plate causing interference with drum or rotor. ● Contaminated linings — adjustment too tight (rear brakes). ● Improper machining of drum, causing interference with backing plate or shoe. ● Other brake system components: <ul style="list-style-type: none"> — Loose or extra parts in brakes. — Drum brakes — weak, damaged or incorrect retracting springs. — Drum brakes — grooved backing plate ledges. — Improper positioning of shoe in caliper. — Outside diameter of rotor rubbing caliper housing. — Lack of correct lubricant on disc brake caliper slides and pins. — Improper installation of disc brake anti-rattle clips. — Excessive runout of disc brake rotor. 	<ul style="list-style-type: none"> ● Seat the wheel covers with a rubber mallet. Repair flanges or repair cover. Refer to Section 04-04. ● Tighten to specified torque. Replace wheel if stud holes are elongated. ● Replace worn or damaged wheel bearings. Lubricate and adjust. Refer to Section 04-01. ● Repair or replace as required. Refer to Section 06-02. ● Remove contamination from linings. Adjust brakes properly. ● Refinish drum or file off material contacting backing plate as needed. Refer to Section 06-02. ● Inspect, repair or replace as required. Refer to Applicable section in Group 06.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Noise at wheels when brakes are applied — scrape or grind (loud, harsh rubbing noise).	<ul style="list-style-type: none"> Contaminated linings — if caliper is not bound, brake linings are not worn to rivets, and rotor is scored at least 13mm (0.5-inch) wide by 1.5mm (1/16-inch) deep. Wheel bearings not lubricated. Verify noise is coming from bearings. Worn brake linings, loose rivets or foreign material between lining and drum or rotor. Brake shoe interference with back of drum, or shield-to-rotor clearance also binding at backing plate guide ledges. Caliper to wheel or rotor interference. Other brake system components: <ul style="list-style-type: none"> Warped or bent backing plate or splash shield causing interference with brake drum. Cracked drums or rotors. Tires rubbing against chassis or body. Rotor to spindle interference. 	<ul style="list-style-type: none"> Replace or turn rotor. Remove and replace contaminated lining as required. Refer to Section 06-03. Lubricate and replace bearings and seals as required. Refer to Section 04-01. Replace shoes and linings in sets. Refer to Section 06-02. Refinish brake drums or rotors if excessively scored. Refer to Section 06-03. Inspect. Replace as required. Lubricate guide ledges. Replace as required. Inspect and repair as required. Refer to applicable section in Group 06. Inspect and service as required. Refer to Section 04-04. Replace as required. Refer to Section 06-03.
Noise at wheels — brakes applied — groan, roughness or chatter at wheel. A harsh feeling while braking in neutral evidenced by a pulsating brake pedal feel.	<ul style="list-style-type: none"> Loose wheel lugnuts. Corrosion build-up on rotor surfaces. Worn, damaged, dry or improperly adjusted wheel bearings. Loose or worn front suspension components. Rotor thickness variation. Disc brake caliper backing plate and anchor plate loose or missing parts. Also, loose or bent dust shield. Rear brake roughness. Brake drum cracked or out-of-round. Wheel/tire imbalance. Drivetrain imbalance. 	<ul style="list-style-type: none"> Tighten to specified torque. Replace wheel if stud holes are elongated. Refer to Section 04-04. Hand sand corrosion from rotor braking surfaces and contamination from linings. Refer to Section 06-03. Inspect, lubricate or replace as required. Refer to Section 04-01. Inspect, repair or replace as required. Replace or turn rotor. Refer to Section 06-03. Replace or repair as required. Refer to Section 06-03. Attempt stopping the vehicle using the parking brake. If roughness is present, check drums for excessive wear or runout. Refinish or replace as required. Refer to Section 06-02. Refinish or replace drum as required. Refer to Section 06-02. Verify and repair as required. Refer to Section 04-04. Attempt stopping the vehicle in the neutral transmission position. If roughness is gone, drivetrain should be inspected.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Noise at wheels — brakes not applied — growling, click, rattle, clunk or knock. Defined by a series of sharp, short sounds in quick succession.	<ul style="list-style-type: none"> Stones or foreign material trapped inside. Loose wheel lugnuts. Worn, damaged or dry wheel bearings. Disc brake caliper assembly — Loose or missing anti-rattle clips or poor crimping on outer shoe. Drum brakes loose or extra parts. Dust shield bent, loose or missing. Loose grease cap. Drum brakes — brake shoes binding at backing plate ledges in three places. Drum brakes — backing plate ledges worn in three places. 	<ul style="list-style-type: none"> Remove stones or foreign material as required. Tighten to specified torque. Replace wheel if stud holes are elongated. Refer to Section 04-04. Inspect, lubricate or replace. Adjust bearings properly. Refer to Section 04-01. Inspect, repair or replace as required. Refer to Section 06-03. Inspect, remove or repair as required. Refer to Section 06-02. Repair as required. Repair or replace as required. Lubricate ledges. Replace plate and lubricate ledges.
Vibration when brakes are applied — front brakes.	<ul style="list-style-type: none"> Loose lugnuts. Cracked rotors. Rotors out-of-round or improper machining. Excessive rotor runout. Worn or improperly adjusted wheel bearings. Loose or worn front suspension components. Excessive radial or lateral runout on wheel and tire. 	<ul style="list-style-type: none"> Tighten lugnuts to specification. Replace rim if stud holes are elongated. Refer to Section 04-04. Replace rotor. Refer to Section 06-03. Machine rotors or replace as required. Replace rotor. Adjust or replace wheel bearings as required. Refer to Section 04-01. Tighten loose components to specifications. Replace worn or damaged components. Refer to Group 04. Adjust tire and wheel to eliminate excessive runout or replace tire and / or wheel as required. Refer to Section 04-04.
Vibration when brakes are applied — rear brakes.	<ul style="list-style-type: none"> Loose lugnuts. Cracked drums. Drums out-of-round or improperly machined. Excessive radial and lateral runout on wheel and tire. 	<ul style="list-style-type: none"> Tighten lugnuts to specification. Replace rim if stud holes are elongated. Refer to Section 04-04. Replace drums. Refer to Section 06-02. Machined drums or replace as required. Adjust tires and wheels to eliminate runout or replace wheel and / or tire as required.
Parking brake will not hold.	<ul style="list-style-type: none"> Parking brake cable out of adjustment. Rear brakes out of adjustment. Parking brake linkage, cable release lever, clevis and ratchet binding, worn or damaged. 	<ul style="list-style-type: none"> Adjust parking brake cable(s). Refer to Section 06-05. Adjust rear brakes. Refer to Section 06-02. Repair or replace linkage or cables as required. Refer to Section 06-05.
Parking brake will not release or fully return.	<ul style="list-style-type: none"> Manual release brake control components binding or damaged. Parking brake linkage and cables binding. Worn or damaged rear brake components. 	<ul style="list-style-type: none"> Repair or replace manual parking brake control. Repair or replace as required. Check rear brake shoe retracting springs and parking brake levers. Repair as required. Refer to Section 06-02.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Rough engine idle or stall — power brake only.	<ul style="list-style-type: none"> Vacuum leak. Worn or damaged vacuum booster. 	<ul style="list-style-type: none"> Check vacuum hoses and connections for leaks. Repair or replace as required. Check vacuum booster for internal leaks. Replace if required. Refer to Section 06-06.

TH3908A

DIAGNOSTIC PIN POINT TEST INDEX

Description	Test
Brake System Preliminary Checks	Test A
Dual Brake Warning Lamp System Test	Test B
Hydraulic Leak Test	Test C
Power Brake Function Test	Test D
Dash Mounted Vacuum Booster Test (Power Brakes)	Test E
Master Cylinder Diagnosis	Test F
Master Cylinder Diagnosis, Pedal Goes Down Fast	Test G
Master Cylinder Diagnosis, Pedal Eases Down Slowly	Test H
Master Cylinder Diagnosis, Pedal Is Low or Feels Spongy	Test J
Master Cylinder Diagnosis, Pedal Effort Excessive	Test K

(Continued)

DIAGNOSTIC PIN POINT TEST INDEX (Cont'd)

Description	Test
Front Disc Brake Vibration / Shudder, E-250-350, F-250-350 with Dana Axle	Test L
Master Cylinder Diagnosis Guide, Red Brake Warning Light Staying On	Test M
Master Cylinder Bypass Condition Check	Test N
Brake Pull Service Procedure	Test P
Brake Pull and Drift Diagnosis Procedure	Test Q
Tire Mismatch Check	Test R
Alignment Test	Test S
Steering Gear Valve Off-Center	Test T
Brake Imbalance	Test U

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BRAKE SYSTEM PRELIMINARY CHECKS — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	FLUID LEVEL CHECK		
	<ul style="list-style-type: none"> Check fluid level in brake master cylinder reservoir. Is level within 3.17mm (1/8 in)? 	Yes No	GO to A2. ADD Ford Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent as required. CAUTION: Do not mix low temperature brake fluid with the specified brake fluid.
A2	REAR BRAKE ADJUSTMENT CHECK		
	<ul style="list-style-type: none"> Key OFF. Push the brake pedal down as far as it will go. Does the pedal travel more than halfway to the floor? 	Yes No	ADJUST the rear brakes as required. ADJUST brakes by driving the vehicle forward and backward and applying the brakes sharply several times. GO to A3.

DIAGNOSIS AND TESTING (Continued)

BRAKE SYSTEM PRELIMINARY CHECKS — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A3	ROAD TEST VEHICLE		
	<ul style="list-style-type: none"> ● If brakes are functional, road test vehicle. ● Drive vehicle about 32 km/h (20 mph). ● Apply the brakes. ● Does the vehicle stop evenly? 	Yes No	Brakes are OK. Manually ADJUST brakes. REFER to Section 06-02.

TH8661A

DUAL BRAKE WARNING LAMP SYSTEM TEST, RANGER/EXPLORER — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	BRAKE WARNING LAMP TEST		
	NOTE: The brake warning lamp should only light when the ignition switch is in the START position or when the ignition switch is ON and the parking brake is applied (gasoline), or when the vacuum is low (diesel). <ul style="list-style-type: none"> ● Release parking brake. ● Check fluid level in reservoir. Fill as required. ● Key in ACC or ON. ● Does brake lamp turn on? 	Yes No	CHECK switch wiring for possible short to ground. REPAIR or REPLACE as required. GO to B2. GO to B3.
B2	MASTER CYLINDER FLUID LEVEL SWITCH WIRING CHECK		
	<ul style="list-style-type: none"> ● Partially drain the master cylinder. ● Key in RUN and observe brake lamp. ● Does the brake lamp illuminate? 	Yes No	FILL reservoir, switch OK. CHECK for open in fluid level switch to brake lamp wiring. SERVICE as required. If no open found, GO to B3.
B3	MASTER CYLINDER LEVEL SWITCH CHECK		
	<ul style="list-style-type: none"> ● Manually push the float in the reservoir to the bottom. ● Key in RUN and observe the brake lamp. ● Does the brake lamp illuminate? 	Yes No	REFILL reservoir, switch OK. REPLACE master cylinder.

TH8662A

HYDRAULIC LEAK TEST — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	VISUAL INSPECTION		
	<ul style="list-style-type: none"> ● Apply the brakes and check for leaks. ● Are any leaks found? 	Yes No	REPLACE leaking parts as required. GO to C2.
C2	REAR BRAKE LEAK CHECK		
	<ul style="list-style-type: none"> ● Remove rear brake drum. ● Inspect all wheel cylinders for leaks. ● Do wheel cylinders check OK? 	Yes No	GO to C3. REPLACE or REBUILD wheel cylinders as required.
C3	FRONT BRAKE LEAK CHECK		
	<ul style="list-style-type: none"> ● Inspect calipers for leaks. ● Do calipers check OK? 	Yes No	GO to C4. REPLACE or REBUILD calipers as required.

DIAGNOSIS AND TESTING (Continued)**HYDRAULIC LEAK TEST — TEST C (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
C4	MASTER CYLINDER LEAK CHECK		
	<ul style="list-style-type: none"> Disconnect the hydraulic tubes from the master cylinder. Plug the output ports using the appropriate size flared tube type plugs. Push down hard on the brake pedal. Does the pedal slowly move downward? 	Yes No	REPLACE or REBUILD the master cylinder as required. Hydraulic system checks OK.

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POWER BRAKE FUNCTION TEST — TEST D

TEST STEP		RESULT	ACTION TO TAKE
D1	BRAKE PEDAL CHECK		
	<ul style="list-style-type: none"> Key OFF. Pump the brake several times to eliminate any vacuum from the system. Push the pedal down as far as it will go. Note the effort required to hold the pedal in this position. Does the pedal gradually move downward? 	Yes No	GO to C1. GO to E2.
D2	VACUUM CHECK		
	<ul style="list-style-type: none"> Push brake pedal all the way down. Key ON, engine running. Does pedal move downward when the engine is started? 	Yes No	BRAKES are functioning properly. GO to F1.

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DASH-MOUNTED VACUUM BOOSTER TEST (POWER BRAKES) — TEST E

TEST STEP		RESULT	ACTION TO TAKE
E1	VACUUM CHECK		
	<ul style="list-style-type: none"> Disconnect engine vacuum line from booster. Connect vacuum gauge Rotunda model 059-00008 or equivalent to the vacuum line with a T-fitting. Key ON, engine running. Allow engine to reach normal operating temperature. Record the vacuum pressure. Is the vacuum reading 457-533 mm-Hg (18-21 in-Hg)? 	Yes No	GO to E2. TUNE-UP or REPAIR engine as required.
E2	SYSTEM INSPECTION		
	<ul style="list-style-type: none"> Key OFF. Reconnect the vacuum line. Inspect plastic check valve, rubber grommet and all vacuum plumbing for cracks, holes, bad connections or missing clamps. Push down on brake pedal. Key ON, engine running. Does the pedal move downward when the engine is started? 	Yes No	Vacuum system is OK. GO to E3.
E3	VACUUM DROP CHECK, DIESEL ONLY		
	<ul style="list-style-type: none"> Key OFF. Disconnect the vacuum line and connect a vacuum gauge with a T-fitting to the lower part of dash-mounted plastic check valve. Key ON, engine running at idle until vacuum reaches 437-533 mm-Hg (18-21 in-Hg). Key OFF. Observe vacuum gauge for 1 minute. Does vacuum pressure drop more than 1 in-Hg? 	Yes No	REPLACE check valve. GO to E4.

DIAGNOSIS AND TESTING (Continued)**DASH-MOUNTED VACUUM BOOSTER TEST (POWER BRAKES) — TEST E (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
E4	COMPONENT ISOLATION CHECK		
	<ul style="list-style-type: none"> ● Key OFF. ● Reconnect the vacuum gauge to the same point as in Step E1, but leave the rest of the system connected. ● Key ON, engine running at idle until vacuum reaches 437-533 mm-Hg (18-21 in-Hg). ● Key OFF. ● Observe vacuum gauge for 1 minute. ● Does vacuum pressure drop more than 1 in-Hg? 	<p>Yes</p> <p>No</p>	<p>DISCONNECT each component one at a time and repeat the test procedures in Step E4 until the leaking component is found. Plug the disconnected vacuum line while performing the test procedures. REPAIR or REPLACE as required. On diesel engines with dash-mounted booster, REPLACE check valve also.</p> <p>GO to E5.</p>
E5	BOOSTER LEAK CHECK		
	<ul style="list-style-type: none"> ● Key ON. ● Run engine until vacuum pressure reaches 437-533 mm-Hg (18-21 in-Hg). ● Key OFF. ● Push down on the brake pedal and hold for a few seconds and release. ● Does the vacuum drop to 0 kPa (0 in-Hg)? 	<p>Yes</p> <p>No</p>	<p>REPLACE or REBUILD booster as required.</p> <p>System checks OK. REMOVE vacuum gauge and RECONNECT all vacuum lines.</p>

TH8665A

MASTER CYLINDER DIAGNOSIS — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	FLUID LEVEL CHECK		
	<ul style="list-style-type: none"> ● Check fluid level in master cylinder reservoir. 	<p>Full reservoir</p> <p>Low or empty reservoir with no brakelamp</p>	<p>GO to F2.</p> <p>REPLACE reservoir.</p>
F2	FLUID LEVEL CONDITION		
	<ul style="list-style-type: none"> ● Apply and release brake pedal one full stroke. Observe reservoir fluid level of both chambers as pedal is released. 	<p>Level remains constant</p> <p>Fluid level drops</p>	<p>GO to F3.</p> <p>External leak in brake system cylinder. REPAIR leak.</p>
F3	MASTER CYLINDER CONDITION		
	<ul style="list-style-type: none"> ● Wipe off exterior of master cylinder, cover and gasket with clean cloth. ● Road test vehicle and pump brakes. ● Check if master cylinder exterior is dry or wet. ● Check for fluid from bore end of booster or dash. 	<p>Dry master cylinder exterior</p> <p>Wet master cylinder exterior or dripping fluid from booster or dash</p>	<p>GO to F4.</p> <p>External leak in master cylinder. REPAIR master cylinder.</p>
F4	MASTER CYLINDER CONDITION		
	<ul style="list-style-type: none"> ● Hold pressure on pedal until pedal goes down. 	<p>Pedal goes down 3.175mm (1/8-inch) each time pedal is released</p>	<p>CHECK entire brake system for major leak. REPAIR as required.</p> <p>REFER to Brakes Not Working, Excessive Pedal Travel, Brake Pedal Feels Spongy When Fully Applied in diagnosis guide.</p>

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DIAGNOSIS AND TESTING (Continued)

MASTER CYLINDER DIAGNOSIS GUIDE, PEDAL GOES DOWN FAST — TEST G

TEST STEP		RESULT	ACTION TO TAKE
G1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Road test vehicle only if condition cannot be verified in shop. Statically depress brake pedal. Does brake pedal operate properly? 	Yes No	Vehicle OK. GO to G2.
G2	BRAKE FLUID LEVEL		
	<ul style="list-style-type: none"> Check master cylinder brake fluid reservoir level. Is fluid level within specifications? 	Yes No	GO to G3. CHECK reservoir sealing points. ADD fluid and BLEED system. REPEAT Test G1.
G3	PRESSURIZE SYSTEM		
	<ul style="list-style-type: none"> Pump brake pedal rapidly (five times). 	Pedal height builds up, then sinks Pedal height builds up and holds.	GO to G4. CHECK rear brake adjustment and ADJUST if necessary. If condition still exists, BLEED system. REPEAT Test G1.
G4	BRAKE SYSTEM LEAKS		
	<ul style="list-style-type: none"> Perform Hydraulic Leak Test — Test D in this section. Does system leak? 	No Yes	GO to G5. SERVICE as necessary. ADD fluid and BLEED system. REPEAT Test G1.
G5	MASTER CYLINDER BY-PASS TEST		
	<ul style="list-style-type: none"> Perform Master Cylinder Bypass Condition. Check — Test N in this section. Is test OK? 	Yes No	System OK. REPLACE damaged parts. ADD fluid and BLEED system. REPEAT Test G1.

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MASTER CYLINDER DIAGNOSIS GUIDE, PEDAL EASES DOWN SLOWLY — TEST H

TEST STEP		RESULT	ACTION TO TAKE
H1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Check if condition occurs during actual stopping application by depressing the brake pedal while the vehicle is moving. 	Condition occurs only when vehicle is stationary Condition occurs while vehicle is moving and braking; performance is affected	No action required. (SEE Normal Condition # 1.) GO to H2.
H2	BRAKE SYSTEM LEAKS		
	<ul style="list-style-type: none"> Perform Hydraulic Leak Test — Test D in this section. Does system leak? 	No Yes	GO to H3. SERVICE as necessary. ADD fluid and BLEED system. REPEAT Test H1.
H3	MASTER CYLINDER BY-PASS TEST		
	<ul style="list-style-type: none"> Perform Master Cylinder Bypass Condition Check — Test N in this section. Is test OK? 	Yes No	System OK. REPLACE damaged parts. ADD fluid and BLEED system. REPEAT Test H1.

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DIAGNOSIS AND TESTING (Continued)**MASTER CYLINDER DIAGNOSIS GUIDE, PEDAL IS LOW OR FEELS SPONGY — TEST J**

TEST STEP		RESULT	ACTION TO TAKE
J1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Statically apply brake pedal. Road test vehicle only if condition cannot be verified in shop. Does brake pedal operate properly? 	Yes No	Vehicle OK. GO to J2.
J2	BRAKE PEDAL RESERVE CHECK		
	<ul style="list-style-type: none"> Key ON, engine running at idle with transmission in PARK or NEUTRAL. Depress brake pedal lightly three or four times. Wait 15 seconds to allow the vacuum to replenish. Push down on brake pedal until it stops moving downward or an increased resistance to the pedal travel occurs. <p>NOTE: This increased resistance may feel like the pedal has bottomed out.</p> <ul style="list-style-type: none"> Hold the pedal in the applied position while increasing the engine speed to 2000 rpm. Release the accelerator pedal. Does the brake pedal move downward as engine speed returns to normal? 	Yes No	GO to J3. CHECK vacuum to booster.
J3	BRAKE FLUID LEVEL CHECK		
	<ul style="list-style-type: none"> Check master cylinder brake fluid reservoir level. Is fluid level within specifications? 	Yes No	GO to J4. CHECK reservoir sealing points. ADD fluid and BLEED system.
J4	FILLER CAP VENT CHECK		
	<ul style="list-style-type: none"> Check if filler cap vent holes are clogged or dirty. Are holes clogged or dirty? 	No Yes	GO to J5. CLEAN as necessary. REPEAT Test J1.
J5	BLEED BRAKE SYSTEM		
	<ul style="list-style-type: none"> Bleed brake system as described in this section. 	Condition corrected Condition persists	Vehicle OK. GO to J6.
J6	FRONT WHEEL BEARING ADJUSTMENT		
	<ul style="list-style-type: none"> Check front wheel bearings for proper adjustment. Are bearings properly adjusted? 	Yes No	CHECK rear brake adjustment and ADJUST if necessary. REPEAT Test J1. ADJUST front wheel bearings. REPEAT Test J1.

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MASTER CYLINDER DIAGNOSIS GUIDE, PEDAL EFFORT EXCESSIVE — TEST K

TEST STEP		RESULT	ACTION TO TAKE
K1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Depress brake pedal fully several times. 	Pedal has short stroke and requires excessive effort Pedal has long stroke and requires excessive effort	GO to K2. GO to K2.

DIAGNOSIS AND TESTING (Continued)**MASTER CYLINDER DIAGNOSIS GUIDE, PEDAL EFFORT EXCESSIVE — TEST K (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
K2	BRAKE PEDAL LINKAGE TEST		
	<ul style="list-style-type: none"> Detach booster pushrod from pedal pin and depress brake pedal fully. 	Pedal moves freely Condition persists	CHECK booster vacuum availability as described under Vacuum Booster Diagnosis in this section. SERVICE or REPLACE brake pedal linkage. REPEAT Test K1.

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FRONT DISC BRAKE VIBRATION/SHUDDER, E-250-350 AND F-250-350 WITH DANA AXLE — TEST L

TEST STEP		RESULT	ACTION TO TAKE
L1	ROAD TEST		
	<ul style="list-style-type: none"> With standard wheels and tires installed, road test the vehicle and verify the condition. 	Front brake chirp No shudder / vibration Shudder / vibration	Normal condition. No repair required. Brake system not responsible. REFER to Section 00-04. GO to L2.
L2	APPLY PARKING BRAKE		
	<ul style="list-style-type: none"> Lightly apply the parking brake and road test the vehicle. 	No shudder / vibration Shudder / vibration	CHECK the front brakes. GO to L3. CHECK the rear brakes. GO to L4.
L3	DISC BRAKES		
	<ul style="list-style-type: none"> Resurface rotors and road test vehicle. 	No shudder / vibration Shudder / vibration	Brakes check OK. REPLACE rotors.
L4	DRUM BRAKES		
	<ul style="list-style-type: none"> Refinish brake drums and road test vehicle. 	No shudder / vibration Shudder / vibration	Brakes check OK. REPLACE drums.

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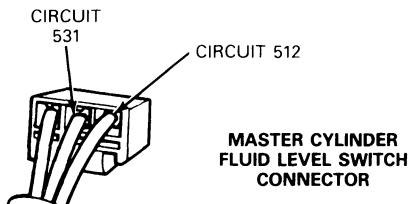
MASTER CYLINDER DIAGNOSIS GUIDE, RED BRAKE WARNING LIGHT STAYING ON — TEST M

TEST STEP		RESULT	ACTION TO TAKE
M1	CHECK PROPER FUNCTION OF BRAKE LAMP		
	<ul style="list-style-type: none"> Key ON or ACC. Verify parking brake is fully released. Is the red brake warning lamp on? 	Yes No	GO to M3. GO to M2.
M2	CHECK PROPER FUNCTION OF BRAKE LAMP		
	<ul style="list-style-type: none"> Set parking brake. Does the red brake warning lamp come on? 	Yes No	Red brake lamp bulb and circuits are functioning properly. GO to B1.
M3	CHECK BRAKE FLUID LEVEL IN MASTER CYLINDER		
	<ul style="list-style-type: none"> Check the brake fluid level at the master cylinder reservoir. Is the fluid level within specification? 	Yes No	GO to M4. CHECK for leaks in the vehicle brake system and REPAIR as required. FILL the master cylinder reservoir to the required level. REPEAT M1.

DIAGNOSIS AND TESTING (Continued)

MASTER CYLINDER DIAGNOSIS GUIDE, RED BRAKE WARNING LIGHT STAYING ON — TEST M (Continued)

TEST STEP		RESULT	ACTION TO TAKE
M4	VERIFY FLOAT BUOYANCY		
	<ul style="list-style-type: none"> Remove the cap from the master cylinder reservoir. Using a clean steel implement, attempt to push the float down. Does the float move down? 	Yes No, the float sits on the bottom	GO to M5. REPLACE the master cylinder reservoir. BLEED the brake system. REPEAT M1.
M5	CHECK RABS MODULE		
	<ul style="list-style-type: none"> Key OFF. Disconnect RABS module harness connector. Key ON. Does the brake lamp turn on? 	Yes No	RECONNECT RABS module connector. GO to M6. REPLACE RABS module. RECONNECT RABS module connector. REPEAT M1.
M6	LOCATE CAUSE OF RED BRAKE LIGHT ON		
	<ul style="list-style-type: none"> Key OFF. Disconnect the fluid level switch harness connector from the master cylinder. Key ON. Does the brake lamp turn on? 	Yes No	Diesel Only: GO to M7. All others: GO to M8. GO to M9.
M7	LOW VACUUM SWITCH CHECK (DIESEL ONLY)		
	<ul style="list-style-type: none"> Key OFF. Disconnect low vacuum switch harness connector. Key ON. Does the brake lamp turn on? 	Yes No	GO to M8. RECONNECT all loose connections. REFER to Section 06-07B to diagnose reason for low vacuum switch actuating the brake lamp.
M8	PARKING BRAKE SWITCH		
	<ul style="list-style-type: none"> Key OFF. Disconnect parking brake switch harness connector. Key ON. Does the brake lamp turn on? 	Yes No	Key OFF. LOCATE and SERVICE short to ground in Circuit 977 (P/W), 640 (R/Y), 531 (DG/Y), or 162. RECONNECT all loose connections. REPEAT M1. Key OFF. REPLACE parking brake switch. RECONNECT all loose connections. REPEAT M1.
M9	CHECK FLUID LEVEL SWITCH		
	<ul style="list-style-type: none"> Key OFF. With the fluid level switch harness connector disconnected, jumper between Circuits 512 (T/LG) and 531 (DG/Y). Key ON. Does the brake lamp turn on? 	Yes No	LOCATE and SERVICE short to ground in Circuit 512 (T/LG). RECONNECT all loose connections. REPEAT M1. REPLACE master cylinder reservoir. BLEED brake system. RECONNECT all loose connections. REPEAT M1.



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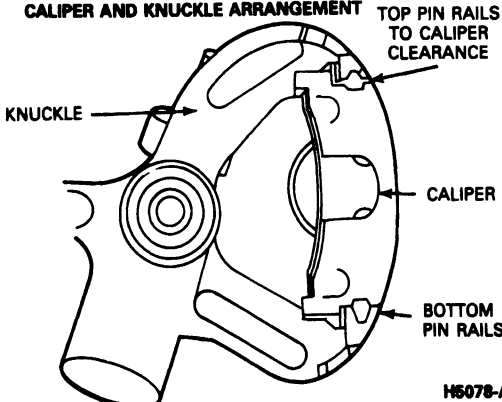
DIAGNOSIS AND TESTING (Continued)

MASTER CYLINDER BYPASS CONDITION CHECK — TEST N

TEST STEP		RESULT	ACTION TO TAKE
N1	FLUID LEVEL CHECK		
	<ul style="list-style-type: none"> Check the fluid level in the master cylinder reservoir. Is the reservoir low or empty? 	Yes	► FILL the reservoir to the correct level. GO to N2.
		No	► GO to N2.
N2	FLUID LEVEL CHECK, BRAKES APPLIED		
	<ul style="list-style-type: none"> Apply brakes several times while observing the fluid level in the master cylinder reservoir. Does the level remain the same? 	Yes	► GO to N3.
		No	► Master cylinder checks OK.
N3	WHEEL TURNING TORQUE CHECK, FRONT WHEELS		
	<ul style="list-style-type: none"> Place transmission in NEUTRAL. Raise front wheels off of ground. Apply 445 N (100 lbs) to the brakes and hold for approximately 15 seconds. While holding brakes, exert 101 N-m (75 ft-lb) to front wheels. Does either wheel rotate? 	Yes	► SERVICE master cylinder as required.
		No	► Front chamber of master cylinder checks OK. GO to N4.
N4	WHEEL TURNING TORQUE CHECK, REAR WHEELS		
	<ul style="list-style-type: none"> Place transmission in NEUTRAL. Raise rear wheels off of ground. Apply 445 N (100 lbs) to the brakes and hold for approximately 15 seconds. While holding brakes, exert 101 N-m (75 ft-lb) to front wheels. Does either wheel rotate? 	Yes	► SERVICE master cylinder as required.
		No	► Rear chamber of master cylinder checks OK.

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BRAKE PULL SERVICE PROCEDURE — TEST P

TEST STEP		RESULT	ACTION TO TAKE
P1	CALIPER MINIMUM CLEARANCE CHECK		
	<ul style="list-style-type: none"> Remove the pins from the caliper. Clean any rust from the caliper. Hold the caliper in place and measure the clearance between the caliper and the top pin rails. Is the clearance at least 0.38mm (0.15 in)? 	Yes	► GO to P3.
		No	► GO to P2.
<p>CALIPER AND KNUCKLE ARRANGEMENT</p>  <p>KNUCKLE</p> <p>TOP PIN RAILS TO CALIPER CLEARANCE</p> <p>CALIPER</p> <p>BOTTOM PIN RAILS</p> <p>H6078-A</p>			

DIAGNOSIS AND TESTING (Continued)**BRAKE PULL SERVICE PROCEDURE — TEST P (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
P2	CALIPER MINIMUM CLEARANCE CHECK, NEW CALIPER INSTALLED		
	<ul style="list-style-type: none"> ● Replace the caliper. ● Hold the caliper in place and measure the clearance between the caliper and the top pin rails. ● Is the clearance at least 0.38mm (0.15 in)? 	Yes No	GO to P3 . REPLACE the steering knuckle. NOTE: Check the clearance on the new knuckle before installation.
P3	PAD AND SIDE AND END CLEARANCE CHECK		
	<ul style="list-style-type: none"> ● Remove both calipers and inner pad assemblies. ● Remove the anti-rattle clip from the inner pad. ● Re-install pad and check the side and end clearance with a feeler gauge. ● Are the pad clearance within specification? 	Yes No	APPLY a light coating of Disc Brake Caliper Slide Grease D7AZ-19590-A or equivalent to the knuckle top and bottom inner pad groove and caliper rails. CAUTION: Make sure that the lubricant does not get on the rotors, linings or on the caliper piston boots. INSTALL all components that were removed. FILE the steel backing plate. REFER to Inner Shoe Backing Plate Filing Procedure in this section.

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Pull/Drift Diagnostic Procedure

This procedure should be used if the pull or drift is not significantly reduced with the service procedure or in cases of a steady state-of-drift (no braking).

Pull or drifts come from various sources, each with a particular set of symptoms. Careful road test evaluation with customer, usually will pinpoint which cause (or causes) are present.

BRAKE PULL AND DRIFT DIAGNOSIS PROCEDURE - TEST Q

TEST STEP		RESULT	ACTION TO TAKE
Q1	STEADY STATE PULL CHECK		
	<ul style="list-style-type: none"> ● Maintain a steady speed of 80-89 km/h (50-55 mph). ● Do not brake. ● Is there a steady state pull? 	Yes No	GO to R1 . For Regular Cab: GO to Q2 . For all other vehicles GO to Q3 .
Q2	STEADY STATE PULL CHECK, NO PASSENGER		
	<ul style="list-style-type: none"> ● Have passenger exit vehicle. ● Maintain a steady speed of 80-89 km/h (50-55 mph). ● Do not brake. ● Is there a steady state pull? 	Yes No	GO to S1 . GO to Q4 .
Q3	STEADY STATE PULL CHECK, PASSENGER IN REAR SEAT		
	<ul style="list-style-type: none"> ● Have passenger move to the rear passenger seat. ● Maintain a steady speed of 80-89 km/h (50-55 mph). ● Do not brake. ● Is there a steady state pull? 	Yes No	GO to S1 . GO to Q4 .

DIAGNOSIS AND TESTING (Continued)

BRAKE PULL AND DRIFT DIAGNOSIS PROCEDURE - TEST Q (Continued)

TEST STEP		RESULT	ACTION TO TAKE
Q4	ACCELERATION PULL CHECK		
	<ul style="list-style-type: none"> ● Unlock front hubs (if so equipped). ● Accelerate vehicle. ● Decelerate vehicle with engine brake only. ● Does it pull one way on acceleration and another way on deceleration? 	<p>Yes</p> <p>No</p>	<p>MEASURE circumference of all tires. Place the two tires with the closest circumferences on the rear axle. Make sure all tires have the same pressure.</p> <p>GO to Q5.</p>
Q5	ENGINE OFF PULL CHECK		
	<ul style="list-style-type: none"> ● Maintain a steady speed of 80-89 km / h (50-55 mph). ● Place transmission in NEUTRAL. ● Key OFF. ● Does the pull go away? 	<p>Yes</p> <p>No</p>	<p>GO to T1.</p> <p>GO to Q6.</p>
Q6	RUBBER BALL SOCKET (RBS) MEMORY STEER CHECK		
	<ul style="list-style-type: none"> ● Stop vehicle along highway. ● Rotate steering wheel full left. ● Road test vehicle. ● Stop vehicle along highway. ● Rotate steering wheel full right. ● Road test vehicle. ● Does the pull condition change? 	<p>Yes</p> <p>No</p>	<p>RBS has memory steer condition. REPLACE RBS with greaseable steel linkage.</p> <p>NOTE: All service part steering linkage is greaseable steel socket type.</p> <p>GO to Q7.</p>
Q7	HARD BRAKE PULL CHECK		
	<ul style="list-style-type: none"> ● While holding the steering wheel firmly, apply the brakes moderately hard (not hard enough to engage the RABS) from 80 km / h (50 mph). <p>NOTE: Be sure to be in a safe clear area.</p> <ul style="list-style-type: none"> ● Does the vehicles heading change during braking? 	<p>Yes</p> <p>No</p>	<p>GO to U1.</p> <p>GO to Q8.</p>
Q8	PULL CHECK, RABS DISCONNECTED		
	<ul style="list-style-type: none"> ● Disconnect the fluid level sensor to disable the RABS. ● Apply the brakes from 80 km / h (50 mph). ● Does the vehicle pull with the RABS disabled? 	<p>Yes</p> <p>No</p>	<p>GO to U1</p> <p>GO to Q9.</p>
Q9	PULL CHECK, BRAKES LOCKED-UP		
	<ul style="list-style-type: none"> ● Brake the vehicle hard from 80 km / h (50 mph) to the point of lock-up. ● Do both rear wheels lock-up, and do both rear wheels lock-up at the same time? 	<p>Yes</p> <p>No</p>	<p>Reconnect fluid level sensor. Brakes check OK.</p> <p>GO to U1.</p>

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DIAGNOSIS AND TESTING (Continued)**TIRE MISMATCH CHECK — TEST R**

TEST STEP		RESULT	ACTION TO TAKE
R1	TIRE MISMATCH CHECK		
	<ul style="list-style-type: none"> Compare the installed tires and wheels with the equipment listed on the certification label. <p>NOTE: On rear limited-slip axle vehicle drift concerns, it may be necessary to measure tire circumference and place a matched set of tires on the rear axle.</p>	<p>Tires and wheels do not match certification label.</p> <p>Tires and wheels do not match certification label or RPO list.</p> <p>Tires and wheels match.</p>	<p>COMPARE tires and wheels to RPO list and inflate tires to the correct pressure.</p> <p>SWAP know good tires and wheels as specified by certification label or RPO list for evaluation only. INFLATE tires to the correct pressure. GO to R2</p> <p>GO to R2.</p>
R2	SWAP FRONT TIRES SIDE TO SIDE		
	<ul style="list-style-type: none"> Unlock front hubs. Spin front tires. If hubs are unlocked, the axle shaft will not rotate with the wheels. Swap the front tires from side to side. Road test the vehicle. Is the concern corrected? 	<p>Yes</p> <p>No</p>	<p>Tires or wheels should be replaced with equipment specified on certification label or RPO list.</p> <p>GO to R3.</p>
R3	SWAP REAR TIRES SIDE TO SIDE		
	<ul style="list-style-type: none"> Swap the rear tires from side to side. Road test the vehicle. Is the concern corrected? 	<p>Yes</p> <p>No</p>	<p>Tires or wheels should be replaced with equipment specified on certification label or RPO list.</p> <p>GO to R4.</p>
R4	SWAP FRONT AND REAR TIRES		
	<ul style="list-style-type: none"> Swap the front tires with the rear tires. Check tire pressure and adjust as required. Road test the vehicle. Is the concern corrected? 	<p>Yes</p> <p>No</p>	<p>Tires or wheels should be replaced with equipment specified on certification label or RPO list.</p> <p>GO to S1.</p>

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ALIGNMENT TEST — TEST S

TEST STEP		RESULT	ACTION TO TAKE
S1	FRONT WHEEL ALIGNMENT CHECK		
	<ul style="list-style-type: none"> Unlock front hubs. Set tire pressure to specification on certification label. <p>NOTE: Do not adjust wheel alignment to correct brake pull if vehicle only pulls during brake application.</p> <ul style="list-style-type: none"> Measure the front wheel alignment. Are the front wheels within alignment specifications? 	<p>Yes</p> <p>No</p>	<p>GO to S2.</p> <p>ALIGN to the Preferred Alignment Specifications.</p>

DIAGNOSIS AND TESTING (Continued)

ALIGNMENT TEST — TEST S (Continued)

TEST STEP		RESULT	ACTION TO TAKE
S2	TIRE MISMATCH CHECK		
<ul style="list-style-type: none"> Compare the installed tires and wheels with the equipment listed on the certification label. 		Tires and wheels do not match certification label	▶ COMPARE tires and wheels to RPO list and inflate tires to the correct pressure.
		Tires and wheels do not match certification label or RPO list	▶ SWAP known good tires and wheels as specified by certification label or RPO list for evaluation only. INFLATE tires to the correct pressure. GO to S3.
		Tires and wheels match	▶ GO to S3.
S3	ROAD TEST VEHICLE		
<ul style="list-style-type: none"> Road test the vehicle after performing front end alignment. 		Vehicle exhibits shimmy concern	▶ Vehicle exceeds maximum average caster value. SET average caster value in accordance with the ride height / caster chart in Section 04-00.
		Vehicle exhibits wander and poor steering returnability concerns	▶ Vehicle is below maximum caster value. SET average caster value in accordance with the ride height / caster chart in Section 04-00.

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STEERING GEAR VALVE OFF-CENTER — TEST T

TEST STEP		RESULT	ACTION TO TAKE
T1	STEERING SYSTEM LEAK CHECK		
<ul style="list-style-type: none"> Raise front end of vehicle. Be sure that there is no interference with steering linkage and that the front wheels spin freely. Check steering system for any external leaking. Are any leaks in the steering system found? 		Yes	▶ SERVICE steering system as required. REFER to Section 11-00.
		No	▶ GO to T2.
T2	LINKAGE MOVEMENT CHECK		
<ul style="list-style-type: none"> Place wheels in straight ahead position. Start the engine and observe the steering wheel or linkage for movement when the engine is started. Is any movement observed? 		Yes	▶ GO to T3.
		No	▶ Valve is OK.
T3	RESERVOIR FLUID LEVEL CHECK		
<ul style="list-style-type: none"> Unlock the front hubs. Install power steering analyzer D79L-33610-A or equivalent in the pressure line between the power steering outlet port 1 and the integral steering gear inlet port. Fully open the gauge valve. Check the fluid level in the reservoir. Add Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent as required. Key ON, engine running. Turn steering wheel from stop to stop to bring the steering lubricant to normal operating temperature. Key OFF. Check fluid level in reservoir. Is the level OK? 		Yes	▶ GO to T4.
		No	▶ REFILL the reservoir to specification. GO to T4.

DIAGNOSIS AND TESTING (Continued)

STEERING GEAR VALVE OFF-CENTER — TEST T (Continued)

TEST STEP		RESULT	ACTION TO TAKE
T4	STEERING WHEEL TORQUE CHECK		
	<ul style="list-style-type: none"> ● Key ON, engine running at approximately 1000 rpm. ● Center the steering wheel. ● Attach an inch-pound torque wrench to the steering wheel nut. ● Record the torque required to get a reading of 1723 kPa (250 psi) on the gauge in each direction. ● Are the torque readings within 0.68 N·m (6 in-lb) of each other? 	<p>Yes</p> <p>No</p>	<p>Valve checks OK. REMOVE gauge and RECONNECT all lines.</p> <p>REMOVE the steering gear and REPLACE the shaft and control assembly.</p>

TH8781A

BRAKE IMBALANCE — TEST U

TEST STEP		RESULT	ACTION TO TAKE
U1	ROTATIONAL DRAG CHECK		
	<ul style="list-style-type: none"> ● Unlock the front hubs. ● Make a series of 10 stops from speeds of 48 km / h (30 mph). Do not allow more than 30 second intervals between stops. ● Raise both front tires off of the ground. ● Rotate the front and rear wheels by hand. ● Is there excess drag in the front wheels? <p>NOTE: Reconnect fluid level sensor.</p>	Yes No	► GO to U2 . ► GO to U5 .
U2	FRONT BRAKE CHECK		
	<ul style="list-style-type: none"> ● Open the bleed screw on the wheel that exhibits excess drag. ● Does brake fluid squirt out? 	Yes No	► CHECK master cylinder push rod adjustment. REFER to Section 06-06. ► CHECK if brake pedal is fully returning. GO to U3 .
U3	CALIPER PISTON CHECK		
	<ul style="list-style-type: none"> ● Remove both calipers and check piston retraction using a C-clamp and a wooden block. ● Does piston easily retract into bore under clamp pressure? 	Yes No	► GO to U4 . ► REBUILD or REPLACE calipers as required.
U4	ROAD TEST, COMPONENTS SWAPPED		
	<ul style="list-style-type: none"> ● Swap rotors and linings from side to side. <p>NOTE: Shoe tab clearance should be checked and modified as required.</p> <ul style="list-style-type: none"> ● Perform 10 or more stops from 40 mph. ● Any change in drift condition? 	Yes No	► SERVICE front brakes. REPAIR or REPLACE as required. ► GO to U5 .
U5	REAR BRAKE DRUM AND LINING CHECK		
	<ul style="list-style-type: none"> ● Remove rear wheels and brake drum. ● Check linings and drum for grease, axle lube, leaking brake fluid or other contaminants. ● Are components clean? 	Yes No	► GO to U6 . ► CLEAN or REPLACE components as required.
U6	WORN OR DAMAGED BRAKE COMPONENT CHECK		
	<ul style="list-style-type: none"> ● Check for worn or damaged components. ● Check for frozen parking brake cables or improperly installed parts. ● Do components check OK? 	Yes No	► GO to U7 . ► REPAIR, REPLACE or REINSTALL as required.
U7	CAGE DIAMETER CHECK		
	<ul style="list-style-type: none"> ● Check cage diameter with Brake Shoe Adjustment Gauge D81L-1103-A or equivalent. ● Is either side out of specification? 	Yes Yes	► REPAIR or REPLACE the adjusting mechanism as required. ► GO to U8 .

DIAGNOSIS AND TESTING (Continued)

BRAKE IMBALANCE — TEST U (Continued)			
TEST STEP		RESULT	ACTION TO TAKE
U8	WHEEL CYLINDER CHECK, LEFT SIDE		
	<ul style="list-style-type: none"> Replace the right side brake drum. Have an assistant apply the brakes while observing the movement of one of the brake shoes. Hold the brake shoe that moved in place while the assistant applies the brakes again. Does the opposite shoe move? 	Yes No	<ul style="list-style-type: none"> GO to U9. REPAIR or REPLACE the wheel cylinder as required.
U9	WHEEL CYLINDER CHECK, RIGHT SIDE		
	<ul style="list-style-type: none"> Install the left side brake drum and remove the right side brake drum. Have an assistant apply the brakes while observing the movement of one of the brake shoes. Hold the brake shoe that moved in place while the assistant applies the brake again. Does the opposite shoe move? 	Yes Yes	<ul style="list-style-type: none"> GO to U10. REPAIR or REPLACE the wheel cylinder as required.
U10	ROAD TEST		
	<ul style="list-style-type: none"> Swap the rear shoes from side to side. Road test the vehicle. Is drift concern significantly reduced? 	Yes No	<ul style="list-style-type: none"> REPLACE the rear linings. CHECK the front suspension for worn or damaged ball joints, radius arm bushings, radius arm attachments at the axle and frame, alignment adjusters, steering linkage or other components. REPAIR or REPLACE as required.

TH8782A

DIAGNOSTIC AND SERVICE PROCEDURE

Brakes Pull or Drift

A comprehensive pull and drift diagnostic procedure has been developed to assist technicians with truck service.

Proceed with the pull and drift diagnostic procedure if the pull or drift is not significantly reduced or where there is a case of steady state drift (no braking).

A Diagnostic Check List is provided at the end of this procedure to record information.

Refer to Diagnosis Guides for service procedures.

Inner Shoe Backing Plate Filing Procedure

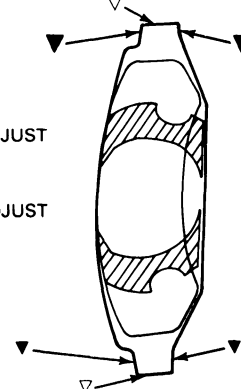
WARNING: USE SAFETY GLASSES WHEN FILING STEEL BACKING PLATES.

- File material, removing equal amounts from both sides or ends.

CAUTION: Do not grind. It is possible to remove too much material when grinding.

INNER SHOE AND LINING

- ▽ SHOE TAB AREAS TO BE FILED TO ADJUST END CLEARANCE
- ▽ SHOE TAB AREAS TO BE FILED TO ADJUST SIDE CLEARANCE



H5080-B

- Check the tab clearance and install anti-rattle clip on the lower pad tab.
- Apply a light coat of Disc Brake Caliper Slide Grease (D7AZ-19590-A or equivalent) to the knuckle top and bottom inner pad grooves and caliper rails.

CAUTION: Make sure the lubricant does not get on the rotors, linings, or on the caliper piston boots.

DIAGNOSTIC AND SERVICE PROCEDURE (Continued)

4. Replace the right side radius arm bracket fasteners.

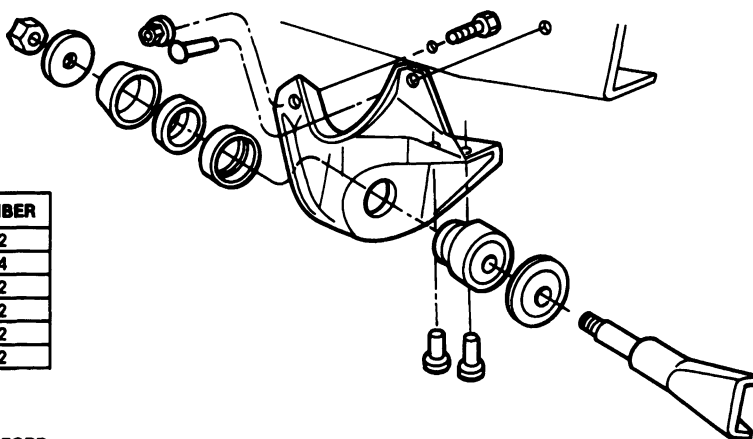
NOTE: The specified fasteners and torque requirements must be used. See illustration for a description of parts contained in the right side radius arm bracket kit (E8TZ-3L095-A). Replace one rivet at a time to maintain bracket location.

- a. Start with rivet number one. Drill a 1/8-inch hole through the middle of the rivet.
- b. Drill the same hole with an 11/32-inch drill.
- c. Use an air chisel to remove the rivet head.
- d. Drive the rivet out with a punch.
- e. Drill the rivet hole in the frame web to a 1/2-inch diameter. See illustration, reference rivet No. 1.

- f. Install a 1/2-inch Grade 8 bolt. The bolt head must be on the inboard side of the frame. Install a 1/2-inch hardened washer on the outside of the bracket. Install the nut and tighten to 142 N·m (105 ft-lb).
- g. Remove the No. 2 rivet using Steps a through d.
- h. Drill the No. 2 rivet hole on the frame flange to a 9/16-inch diameter.
- i. Install a 9/16-inch Grade 8 bolt. The bolt head must be on the inboard side of the frame flange. Install a 9/16-inch hardened washer on the outboard side of the bracket. Install the nut and tighten to 190 N·m (140 ft-lb).
- j. Repeat Steps h and i for the No. 3 rivet.

NOTE: Make sure the torque specifications are followed.

RIGHT SIDE RADIUS ARM BRACKET



PART	PART NUMBER
1/2" TORQUE PREVAILING NUT	34989-S2
9/16" TORQUE PREVAILING NUT	34990-S4
1/2"-13 X 1.75 BOLT	58676-S2
9/16"-12 X 1.75 BOLT	58698-S2
1/2" HARDENED WASHER	44879-S2
9/16" HARDENED WASHER	44880-S2

TORQUE 1/2" BOLT TO 105 FT-LBS
TORQUE 9/16" BOLT TO 140 FT-LBS

**CAUTION: DO NOT SUBSTITUTE — USE ONLY FORD
SUPPLIED HARDWARE KIT IN MAKING
THIS REPAIR**

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DIAGNOSTIC AND SERVICE PROCEDURE (Continued)

DIAGNOSTIC CHECK LIST

NOTE: The following checklist should be completed after each step of the diagnostic where applicable.

SERVICE PROCEDURE

1. Check clearances.
 - ___ Caliper to knuckle clearance.
 - ___ Inner shoe side and end clearance.
2. Lubrication of components.
 - ___ Lubrication of the caliper rails and inner knuckle pad grooves.
3. Radius arm bushings.
 - ___ Replacement of right and left side radius arm bushings.

DIAGNOSTIC PROCEDURE:

1. Tire mismatch.
 - ___ Unlocked hubs check.
 - ___ Front tires swapped side to side.
 - ___ Rear tires swapped side to side.
 - ___ Front to rear tire swap.
2. Alignment.
 - ___ Unlocked hubs check.
 - ___ Toe changed to ___.
 - ___ Caster changed and split is ___.
 - ___ Camber changed and split is ___.
3. Tire circumference.
 - ___ Unlocked hubs check.
 - ___ Tire circumference checked and two closest circumference tires swapped to rear axle.

4. Steering gear valve.
 - ___ Unlocked hubs check.
 - ___ Install pressure gauge.
 - ___ Check fluid level with engine off and on.
 - ___ Apply torque to the steering wheel nut and check gauge readings.
 - ___ Replaced the shaft and control assembly.
 - ___ Removed the pressure gauge.
5. RABS linkage.
 - ___ Replaced the RABS linkage.
6. Brake imbalance.
 - ___ Unlocked hubs check.
 - ___ Front wheel rotational drag check.
 - ___ Master cylinder check.
 - ___ Piston retraction check.
 - ___ Rotors and linings swapped from side to side.
 - ___ Rear brakes checked.
 - ___ Rear drums and shoes swapped from side to side.
7. Miscellaneous.
 - ___ Check for loose, damaged or worn parts.

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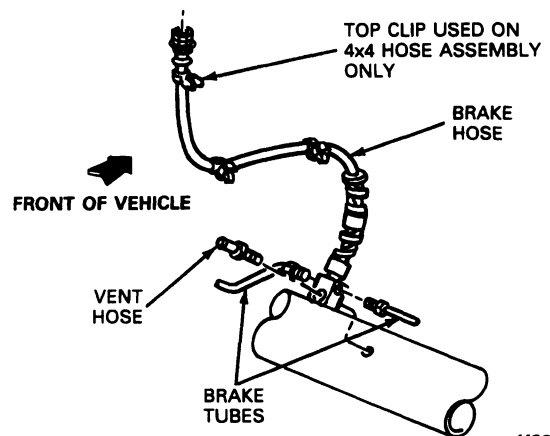
REMOVAL AND INSTALLATION

Hydraulic Line Repair

Steel tubing is used in the hydraulic lines between the master cylinder and the front brake tube connector and between the rear brake tube connector and the rear brake cylinders. Steel tubing is also used to connect the master cylinder to the flexible brake hose at the rear axle. Flexible hoses connect the brake tube to the front brake cylinders rear brake tube connector.

When replacing hydraulic brake tubing, hoses, or connectors, tighten all connections securely. After replacement, bleed the brake system at the wheel cylinders and at the master cylinder. Refer to procedure in this section.

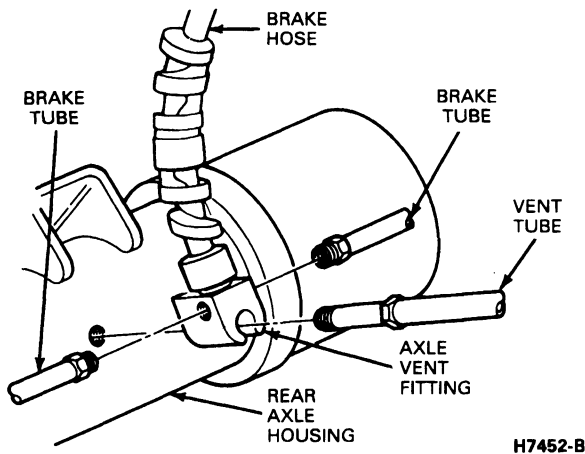
Rear Brake Tube Connector, F-150-250-350, Typical



H8874-A

REMOVAL AND INSTALLATION (Continued)

Combined Brake/Vent Hose Assembly, Econoline and F-Super Duty



Brake Tube

WARNING: COPPER TUBING SHOULD NOT BE USED IN THE HYDRAULIC SYSTEM. USE ONLY SAE J526 OR J527 STEEL TUBING, OR EQUIVALENT.

NOTE: If a section of the brake tube is damaged, replace the entire section with tubing of the same type, size, shape, and length. Be careful not to kink or crack the tubing when bending it to fit the frame or rear-axle forms.

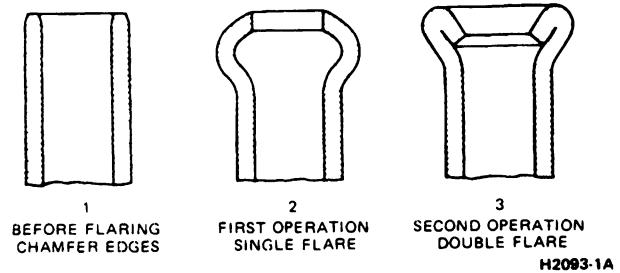
Double flare brake tubing as described below should provide good leak-proof connections.

NOTE: Always clean the inside of a new brake tube with clean isopropyl alcohol.

Flaring A Line (Split-Die Type)

1. Cut off and straighten the required length of line (a tubing cutter tool will simplify making a clean and square cut).
2. Square off the ends of the line with a file, and chamfer the end of the line to be flared.
3. Select the split die for the line to be used, clean out all filings, and insert the die into the tapered hole in the body.
4. Push the tube through the die until the line is even with the face of the die. Lock the line in this position by tightening the wing nut securely.
5. The punches are marked Op. 1 and Op. 2. Slide the first operation punch into the hole in the center of the body and tighten the screw securely to form the single flare.

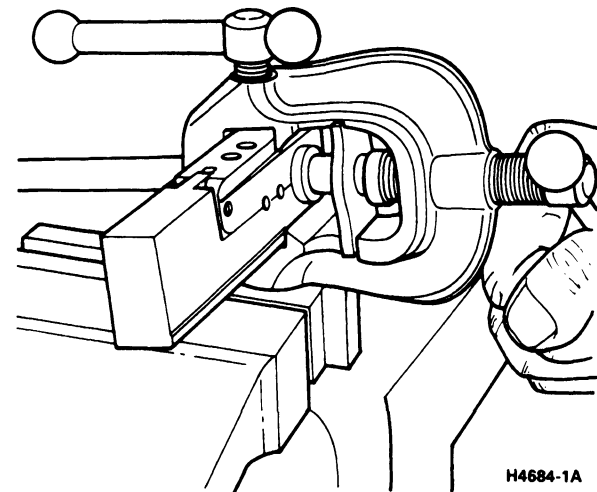
Line Flaring Sequence



6. Release the screw and replace the first operation punch with the second punch and tighten the screw to form the double flare.
7. Release the screw, wing nut, punch, and dies.
8. Remove the line and inspect the flare for cracks or poor flare form. If the flare is not correct, cut it off and repeat the process.

NOTE: The finished flare must be square with the line, free of cracks and have a smooth mating surface to ensure a leakproof connection.

Line Flaring (Split-Die Type)



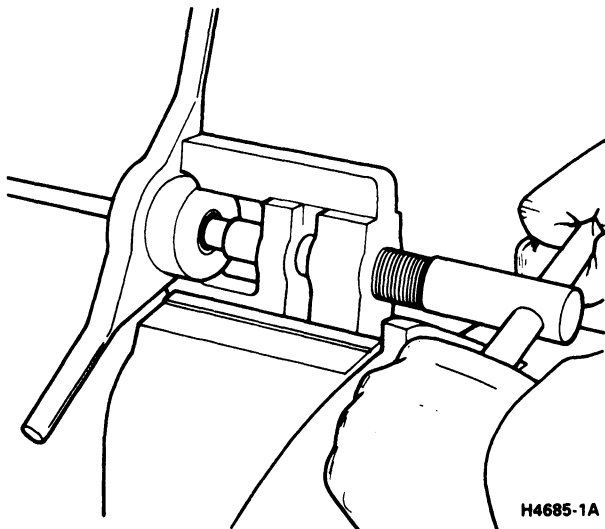
Flaring A Line (Flaring-Bar Type)

1. Cut off and straighten the required length of line. (A tubing cutter tool will simplify making a clean and square cut.)
2. Square off the ends of the line with a file, and chamfer the end of the line to be flared. Make sure to clean out all filings.
3. Insert the line through its appropriate ribbed hole in the bar assembly until the end of the line sticks out about as far as the thickness of the adapter above the bar, or even with the bar, depending on the tool used.
4. Fit the adapter onto the line and slide the bar into the yoke. Lock the bar in position with the line beneath the yoke screw.
5. Form the single flare by tightening the yoke screw securely.
6. Release the screw and remove the adaptor.

REMOVAL AND INSTALLATION (Continued)

7. Form the double flare by tightening the yoke screw again, with second adaptor fitted, depending on the tool used.
8. Release the screw bar, and flared line.
9. Inspect the flare for cracks or poor flare form, and repeat the process if the flare is not correct.

Line Flaring (Flaring-Bar Type)



Brake Hose

Replace a flexible brake hose if it shows signs of softening, cracking or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle parts.

NOTE: The wet appearance of the outer cover of rubber brake hoses is called "sweating". This is a normal condition for neoprene rayon braid hose. The "sweating" condition is not evidence of a brake fluid leak and will not result in a loss of pressure in the system.

OVERHAUL

Removal of dust and dirt from brake assemblies should be done by using the Rotunda Brake and Clutch Service Vacuum model 091-00001 or Rotunda Brake Parts Washer model 065-00016 or an equivalent.

WARNING: BRAKE ASSEMBLY DUST AND DIRT SHOULD NOT BE REMOVED BY EITHER BLOWING OFF WITH AN AIR GUN OR VACUUMING WITH A STANDARD INDUSTRIAL VACUUM CLEANER BECAUSE A HEALTH HAZARD FROM BREATHING IN ASBESTOS DUST MAY DEVELOP. ALSO, ANY MACHINING DONE ON BRAKE LININGS OR PADS SHOULD BE DONE USING PROPERLY EXHAUST-VENTILATED EQUIPMENT.

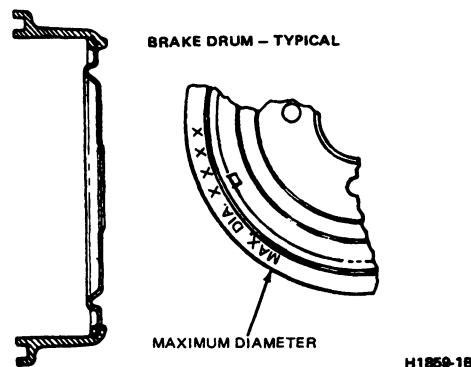
Brake Drum Refinishing

Refer to Section 06-02 for additional information.

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

A badly scored, rough or out-of-round drum should be ground or turned on a drum lathe. Refer to the lathe manufacturer's instructions. Do not remove any more material from the drum than is necessary to provide a smooth surface for the brake shoe contact. Brake drum maximum braking surface diameter is shown on each brake drum. Brake drums which exceed the maximum braking surface diameter shown on the brake drum, either through wear or refinishing, must be replaced. The maximum braking surface diameter specification, which is shown on each brake drum, allows for a 1.52mm (0.060 inch) machining cut over the original drum diameter plus 0.762mm (0.030 inch) additional wear before reaching the drum-discard diameter.

Braking Surface Diameter Marking Location, E-150-250-350, Bronco and F-150-250-350.



Front Disc Brakes

1. Remove the shoe and linings as described in Section 06-03.
2. Measure the thickness of the brake lining. If the lining thickness at any point on the assembly is less than 1.5mm (1 / 16 inch) above the backing plate or 0.794mm (1 / 32 inch) above the rivets, or if the lining shows evidence of brake fluid or oil contamination that is causing a brake pull, replace all four shoe and lining assemblies.
3. To check rotor runout, first eliminate the wheel bearing end play by tightening the adjusting nut. Then check to be sure the rotor can still be rotated.

OVERHAUL (Continued)

4. Clamp a Dial Indicator TOOL-4201-C to the spindle so the stylus contacts the rotor approximately 25.4mm (1 inch) from the outer edge. Rotate the rotor and take an indicator reading. If the reading exceeds allowable total lateral runout (refer to Section 06-03) replace or re-surface the disc brake rotor. **The following requirements must be met when re-surfacing disc brake rotors.**

NOTE: Use a disc brake lathe to re-finish the disc brake rotors. Follow the manufacturer's instructions.

Replace the rotor when the overall thickness is at or below the specified minimum thickness shown on the rotor. Refer to the specifications at the end of Section 06-03 for minimum (discard) rotor thickness, maximum rotor brake surface lateral runout, thickness variation, and surface finish.

When the runout check is finished, adjust the bearings as described in Section 04-01A or the appropriate 4x4 hub and bearing section in Group 05.

5. Check the rotor for scoring. Remove minor scores with a fine emery cloth. If the rotor is excessively scored, re-finish or replace the rotor if necessary.
6. Check the caliper. If it is cracked or shows any signs of leakage, replace.
7. If the caliper is leaking around the dust boot, remove and repair it.
8. Check brake hoses for signs of cracking, leaks or abrasion. Replace if necessary.

- Use a disc brake lathe to re-finish the disc brake rotors. Follow the manufacturer's instructions.
- No more than 0.508mm (0.020 inch) of material may be machined equally off each surface. If rotor thickness falls below the minimum shown on each rotor, it must be replaced.
- Refer to the specifications at the end of Section 06-03, for maximum rotor brake surface lateral runout, thickness variation, and surface finish.

CAUTION: When the runout check is finished, adjust the bearings as described in Section 04-01A or Section 04-01B to prevent bearing failure.

7. Check the rotor for scoring. Remove minor scores with a fine emery cloth. If the rotor is excessively scored, re-finish or replace the rotor if necessary. If either the rotor or the hub assembly needs replacing, refer to Section 06-03 for proper procedure.
8. Check the caliper. If it is cracked or shows any signs of leakage, replace.
9. If the caliper is leaking around the dust boot, remove and repair.
10. Check brake hoses for signs of cracking, leaks or abrasion. Replace if necessary.

Rear Disc Brakes

1. Remove the shoe and linings as described in Section 06-03.
 2. Measure the thickness of the brake lining. If the lining thickness at any point on the assembly is less than 1.5mm (1 / 16 inch) above the backing plate or 0.795mm (1 / 32 inch) above the rivets.
 3. If the lining shows evidence of brake fluid or oil contamination that is causing a brake pull, replace all four shoe and lining assemblies.
 4. When checking rotor runout on rear disc brakes, make sure that the rear axle bearings are not loose and that they are set properly.
- NOTE: Do not disturb the axle bearing setting.
5. Clamp a Dial Indicator TOOL-4201-C to the spindle so the stylus contacts the rotor approximately 25.4mm (1 inch) from the outer edge.
 6. Rotate the rotor and take an indicator reading. If the reading exceeds 0.254mm (0.010 inch) total lateral runout replace or re-surface the disc brake rotor.

The following requirements must be met when re-surfacing disc brake rotors.

Brake Cylinder

1. Clean all brake cylinder parts in clean isopropyl alcohol or use the Rotunda Brake Parts Washer model 065-00016 or equivalent.
2. Inspect all parts for wear or damage. Check the cylinder bore for rust, scores or other damage.
3. Be sure the bleeder screw passage is clean and open.
4. Replace all parts that are worn or damaged.

NOTE: If dirt is found in any part of the hydraulic system, flush the entire system with clean isopropyl alcohol.

Master Cylinder

1. Clean all master cylinder parts in clean isopropyl alcohol, or use the Rotunda Brake Parts Washer model 065-00016 or equivalent and inspect the parts for wear or damage. Replace if required. **When a master cylinder repair kit is used, follow the instructions in the kit and install all of the parts provided.**
2. Make sure that all ports and vents in the master cylinder are open and free of foreign matter.

OVERHAUL (Continued)**Brake Drums and Linings, Service Brakes (All Vehicles) and Transmission Mounted Parking Brake (F-Super Duty)**

1. Remove one wheel from front axle and one wheel and drum (if applicable) from the rear axle, and inspect the drums and brake shoe linings for wear or damage that would affect brake operation.

NOTE: Do not let brake fluid, oil or grease touch the drum or linings.

2. If the drum and linings are in good condition, install the wheel and drum. **The condition of the drums and linings of the opposite wheel will usually be about the same as the wheel removed.**
3. Fill the master cylinder reservoir with the specified brake fluid to within 3.17mm (1/8 inch) of the top of the reservoir.
4. Be sure that the parking brake is fully released before making any brake adjustment.
5. On brake assemblies with an adjustable anchor pin, check the front brake anchor pin nut with a wrench. If the nut is loose, tighten it to 109-135 N·m (80-100 ft-lb).

ADJUSTMENTS**Brake Pedal Adjustment**

On dual-brake master cylinder or dash-mounted vacuum booster equipped vehicles, the brake systems are designed to permit a full stroke of the master cylinder when the brake pedal is fully depressed. A brake pedal clearance adjustment is not required.

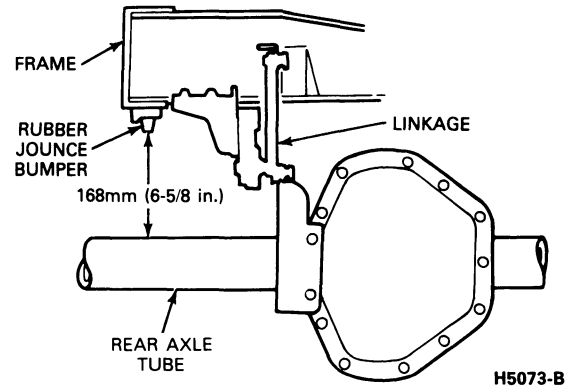
For proper brake pedal adjustment on F-Super Duty Motorhome vehicles, refer to Section 06-06.

To release the brakes, fluid must flow back to the master cylinder through a return port when pedal pressure is released. To be sure the piston moves back far enough to expose the return port, free-travel is built into the pedal linkage on standard booster systems. This prevents the piston from becoming trapped in a partially released position. Pedal-free travel is not always perceptible in dash-mounted booster systems, because the operating clearance for the piston is adjusted at the booster push rod, rather than the pedal linkage. Refer to Section 06-07A for instructions on a dash-mounted booster push rod adjustment.

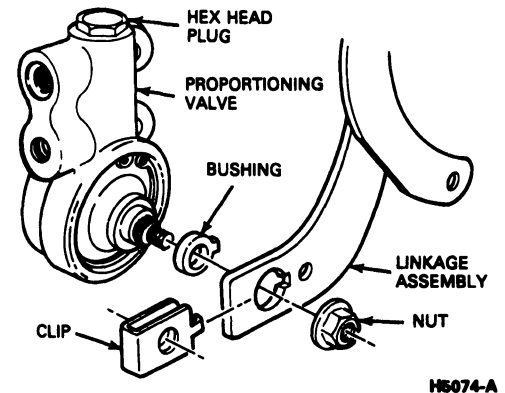
Rear Height Sensing Proportioning Valve Adjustment, F-Super Duty Vehicles

NOTE: Refer to Section 06-06 for height sensing proportioning valve removal and installation procedures.

1. Raise the rear of the truck with body jacks to attain a clearance of 168mm (6-5/8 inches) between the bottom surface of each rubber jounce bumper and the rear axle tube.



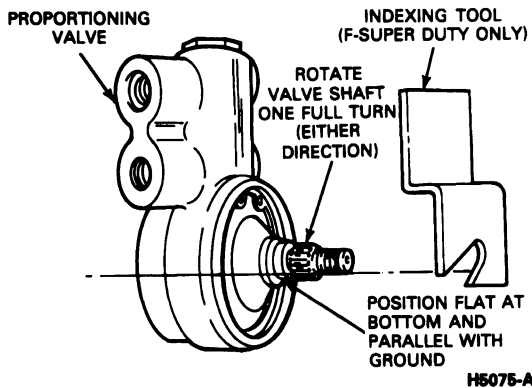
2. Remove the nut from the valve shaft and remove the leading arm of the linkage assembly. Save the nut.



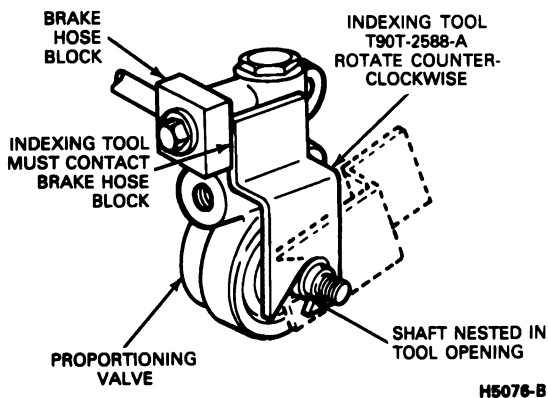
3. Remove the bushing and clip from the leading arm of the linkage assembly.
4. Install the new bushing and clip provided in the linkage kit E8TZ-2L 193-A or equivalent.

ADJUSTMENTS (Continued)

5. Rotate the valve shaft one full turn in either direction. Position the shaft with the flat at the bottom and parallel with the ground.



6. Install the Indexing Tool T90T-2588-A on the shaft so the flat on the tool aligns with the flat on the valve shaft. Make sure the valve shaft is nested fully in the tool opening and the upper surface of the tool rests on the valve body.
7. Make sure the tool and valve shaft are firmly engaged. Rotate the indexing tool counterclockwise until the edge surface of the tool contacts the brake hose block.



8. While holding the indexing tool in the position established in Step 6, install the leading arm of the linkage assembly over the splined section of the valve shaft. Use a 1/2-inch deep socket as a driver and tap it with a hammer to fully seat the linkage on the splines.
9. Re-install the valve shaft nut removed in Step 2. Tighten the nut to 11-14 N·m (8-10 ft·lb).
10. Remove the indexing tool.

Dump Valve Adjustment**(Vehicles with Speed Control Only)**

NOTE: Installation and adjustment of the dump valve must be done prior to draining and filling of the master cylinder.

The brake pedal must be pulled back toward the driver's seat to the full extension of the master cylinder push rod. Do not apply more than 15 pounds of force to the brake pedal to establish the maximum rearward position.

For dump valve adjustment, refer to Section 10-03A, F-Series and Bronco or Section 10-03B, Econoline.

Front Disc Brakes**F-150-250-350 (4x2), F-150-250-350 (4x4), Bronco, E-150-250-350 and F-Super Duty Series Vehicles**

The front disc brake assembly is self-adjusting. Refer to Section 06-03.

Rear Disc Brakes**F-Super Duty Series Vehicles**

The rear disc brake assembly is self-adjusting. Refer to Section 06-03.

Rear Drum Brakes**F-150-250-350 (4x2), F-150-250-350 (4x4), Bronco and E-150-250-350**

Rear drum brakes are adjusted automatically by alternately driving the vehicle forward and reverse, and sharply applying the brakes when the vehicle is driven in reverse. Manual brake adjustment is required only when the brake shoes are relined or replaced or the adjusters are not functioning adequately. Refer to Section 06-02, Brake.

Hydraulic System Bleeding

When any part of the hydraulic system has been disconnected for repair or replacement, air may get into the lines and cause spongy brake pedal action. This requires the bleeding of the hydraulic system after it has been properly connected so all air is expelled from the brake cylinders and lines. The hydraulic system can be bled with pressure bleeding equipment Rotunda Brake Bleeder model 104-00064 or equivalent.

ADJUSTMENTS (Continued)

- Bleed one brake cylinder at a time.
- On E-150-250-350, F-150-250-350 and Bronco vehicles, start the bleeding at the right rear brake wheel cylinder and then at the left rear wheel brake cylinder. After completing, proceed to the Rear Anti-lock Brake (RABS) Valve. Then proceed to bleed the front brakes, starting with the right front brake, and finish bleeding on the left front brake.
- On F-Super Duty vehicles, start the bleeding at the right rear brake, then the left rear brake. After completing, proceed to bleed the right front brake and then the left front brake.
- Keep the master cylinder reservoir filled with the specified Ford Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent. **Never use brake fluid that has been drained from the system.**

WARNING: BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

Pressure Bleeding, Dual Brake System Hydraulic Master Cylinder

NOTE: Bleed the longest lines first. Be sure the bleeder tank contains enough specified brake fluid, Ford Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent to complete the bleeding operation. Charge the tank with approximately 69-206 kPa (10-30 psi) of air pressure. Never exceed 345 kPa (50 psi) of pressure. Never re-use brake fluid that has been drained from the hydraulic system.

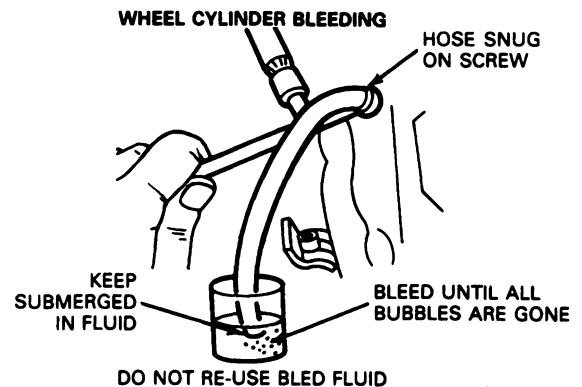
WARNING: BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

1. Clean all dirt from the master cylinder cap.
2. Remove master cylinder reservoir cap, and fill the master cylinder reservoir with the specified brake fluid.

3. Install pressure bleeder adapter Rotunda Brake Bleeder Model 104-00064 to the master cylinder, and attach bleeder tank hose to fitting on adaptor.

NOTE: Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adaptor.

4. Place a 3/8-inch box wrench on right rear brake wheel cylinder bleeder fitting. Attach a bleeder tube snugly around bleeder fitting.
5. Open valve on bleeder tank to admit pressurized brake fluid to the master cylinder reservoir.
6. Submerge free end of tube in a partially filled container with clean brake fluid and loosen bleeder fitting.



H4667-1A

7. When air bubbles no longer appear in the fluid at the submerged end of the bleeder tube, close bleeder fitting and remove tube.
8. Continue bleeding rest of the system going in order from the left rear brake wheel cylinder, then proceed to the front right brake wheel cylinder, ending with front left brake wheel cylinder.
9. When the bleeding operation is completed, close bleeder tank valve and remove the tank hose from adaptor fitting.
10. Remove the pressure bleeder adapter tool.
11. Fill master cylinder reservoir to minimum fill level line indicated on reservoir.
12. Install master cylinder cap.

Bleed Procedure, ABS System

The anti-lock brake system must be bled in two steps:

ADJUSTMENTS (Continued)

1. The master cylinder and Hydraulic Control Unit must be bled using Special Service Tool, Anti-lock Brake Adapter T90P-50-ALA and Jumper T93T-50-ALA. If this procedure is not followed, air will be trapped in the HCU which eventually leads to a spongy brake pedal.

To bleed the master cylinder and HCU, disconnect the 40-pin plug from the Electronic Control Unit and install the anti-lock brake adapter to the wire harness 40-pin plug.

- a. Place the bleed / harness switch in bleed position.
 - b. Turn the ignition switch ON. At this point the red OFF indicator should turn on.
 - c. Push the motor button on the adapter down. This starts the pump motor. The red OFF indicator turns off and the green ON indicator turns on. The pump motor will run for 60 seconds once the motor button is pushed (you do not need to hold the button down). If the pump motor is to be turned off for any reason before this 60 seconds has elapsed, push the abort button and the pump motor will turn off.
 - d. After the first 20 seconds have passed, push and hold the valve button for 20 seconds. This bleeds any trapped air from the master cylinder and HCU.
 - e. The pump continues to run for an additional 20 seconds after the valve button is released.
2. The brake lines can be bled in the conventional manner. Refer to Section 06-06. Bleed the brake lines in the following order.
 - a. Right rear
 - b. Left front
 - c. Left rear
 - d. Right front

SPECIFICATIONS

PREFERRED ALIGNMENT SPECIFICATIONS

Model	Alignment	Specification
All	Toe-in Adjust	+ .03 ± .06 Inch or + .06 ± .13 Degrees
Bronco, F-150 4x2 / 4x4	Caster Split — LH Caster / RH Caster (See TSB 89-21-10)	0 + .50 Degrees -.3 ± .50 Degrees
All	Camber Split — LH Camber / RH Camber	0 ± .50 Degrees
All	Average Camber ^a	0.25 + .50

(Continued)

PREFERRED ALIGNMENT SPECIFICATIONS (Cont'd)

Model	Alignment	Specification
All	Average Caster ^b	Min. 2.00 / Max. 6.00

- a Defined as (LH camber + RH camber) divided by 2. Vehicles set to this specification, as measured with the vehicle loaded to normal loading conditions, will result in optimum tire wear.
- b Defined as (LH caster + RH caster) divided by 2. These are not recommended values for settings. They are only maximum and minimum limitations.



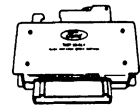

TH5087A

Part Number	Part Name	Class
E6AZ-19582-AA	Steering Fluid	AM
D7AZ-19590-A	Lubricant	AW
E8TZ-3L095-A	Right Side Radius Arm Bracket Hardware Kit	CG

TORQUE SPECIFICATIONS

Description	N·m	Lb·Ft
Front Brake Anchor Pin Nut	109-135	80-100
Valve Shaft Nut	11-14	8-10

SPECIAL SERVICE TOOLS / EQUIPMENT

Tool Number / Description	Illustration
TOOL-4201-C Dial Indicator	 TOOL-4201-C
T90T-2588-A Indexing Tool	 T90T-2588-A
T90P-50-ALA Anti-lock Brake Adapter	 T90P-50-ALA
T93T-50-ALA Anti-lock Brake Adapter	 T93T-50-ALA

**SPECIAL SERVICE TOOLS/EQUIPMENT
(Continued)****ROTUNDA EQUIPMENT**

Tool Number	Description
104-00064	Brake Bleeder
021-00014	Vacuum Tester
091-00001	Brake and Clutch Service Vacuum
065-00016	Brake Parts Washer

(Continued)

ROTUNDA EQUIPMENT (Cont'd)

Tool Number	Description
059-00008	Vacuum and Pressure Tester
104-00090	Bleeder Box
D79L-33610-A	Power Steering Analyzer
D81L-1103-A	Brake Shoe Adjustment Gauge

SECTION 06-02 Brake, Rear Drum

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Rear Brake Shoe Adjustment	06-02-13	Brake Shoe and Adjusting Screw, Standard	
DESCRIPTION	06-02-1	Self-Adjusting Brake Design	06-02-6
DIAGNOSIS AND TESTING.....	06-02-4	Brake Wheel Cylinder	06-02-11
DISASSEMBLY AND ASSEMBLY		Rear Brake Backing Plate.....	06-02-12
Brake Wheel Cylinder	06-02-12	Rear Brake Drum.....	06-02-5
REMOVAL AND INSTALLATION		SPECIAL SERVICE TOOLS/EQUIPMENT	06-02-15
Brake Shoe Adjusting Screw	06-02-9	SPECIFICATIONS	06-02-15
		VEHICLE APPLICATION	06-02-1

VEHICLE APPLICATION

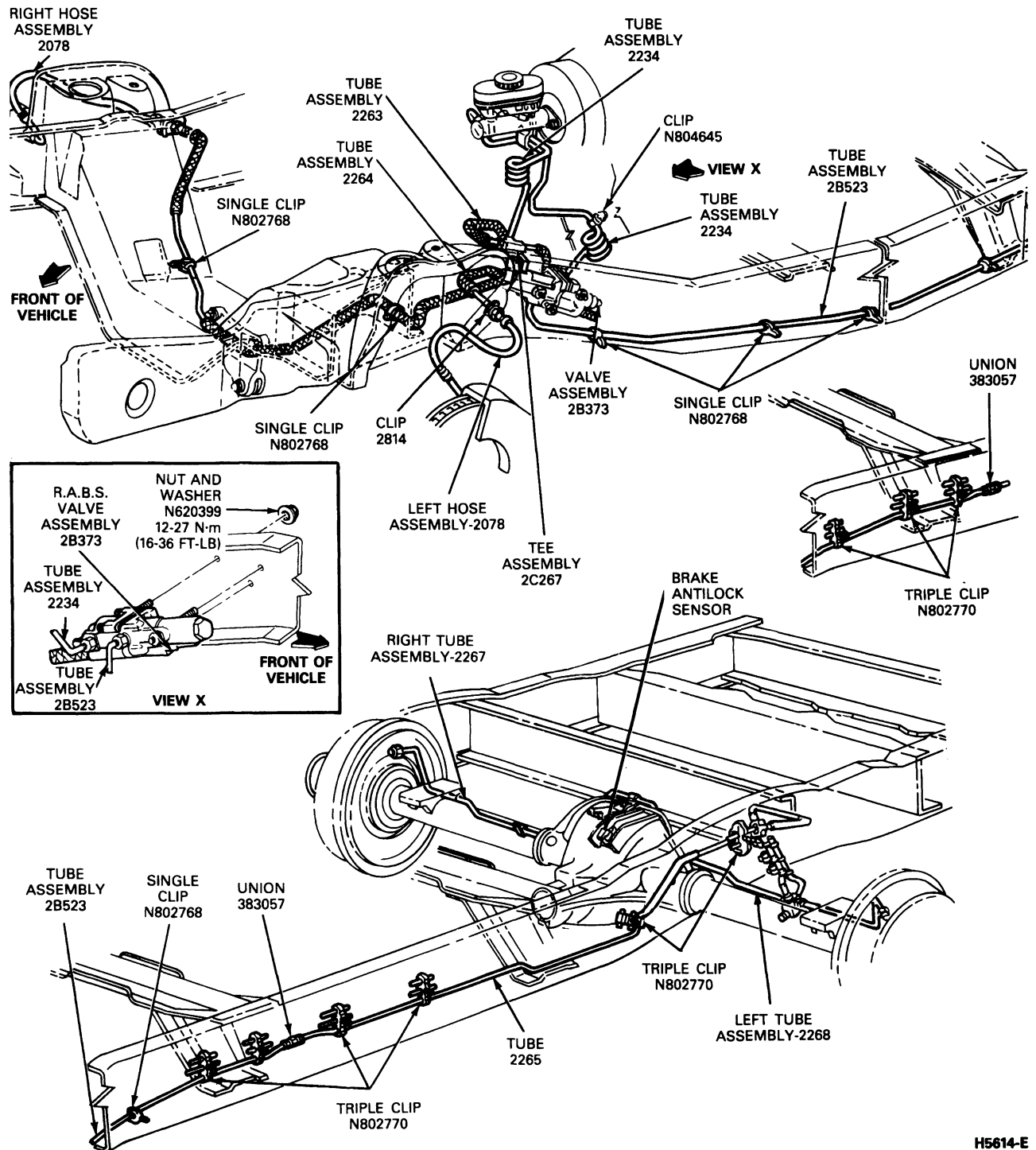
Bronco, E-150-250-350, F-150-250-350 4x2 and 4x4 Vehicles

DESCRIPTION

The rear brakes are drum type with internal shoes that expand against the drum when the brakes are applied. The rear drum brakes are of the single anchor type, mounted to the same anchor, and actuated by one wheel cylinder. The wheel cylinder has two pistons. One piston exerts force against the upper end of the primary shoe; the other piston exerts force against the upper end of the secondary shoe.

DESCRIPTION (Continued)

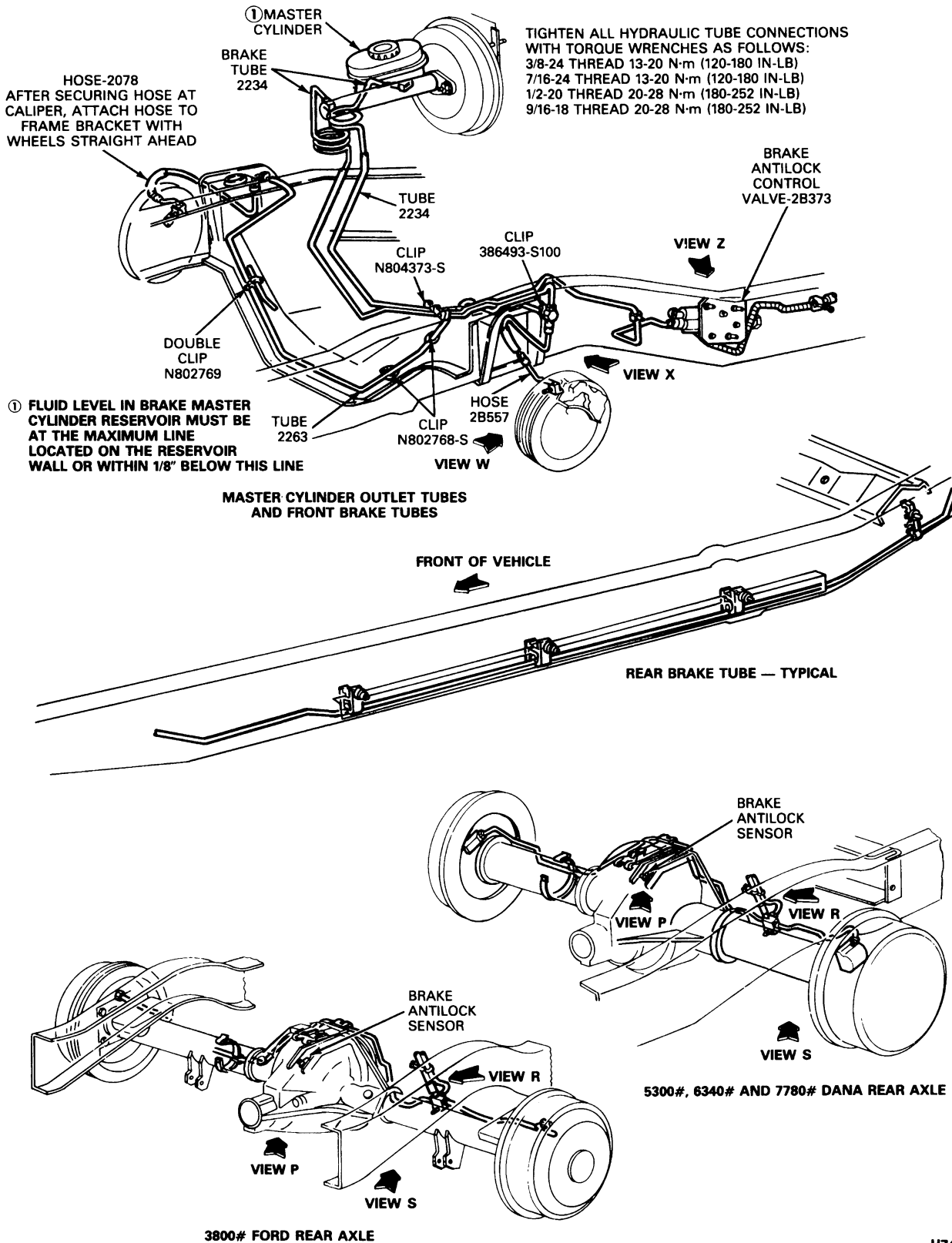
Brake System, F-150-250-350 and Bronco, Typical



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DESCRIPTION (Continued)

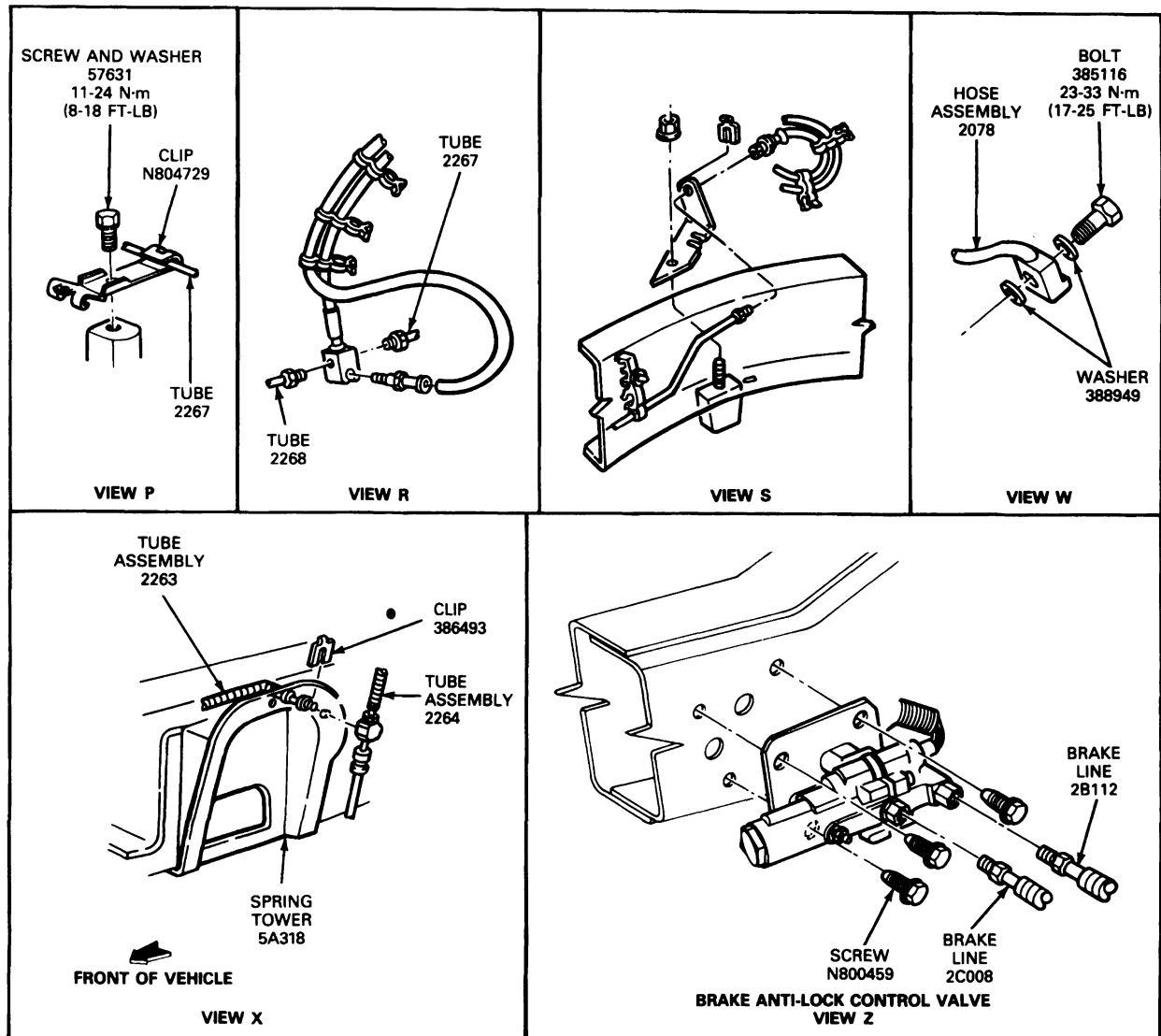
Brake System, E-150-250-350, Typical



H7454-C

DESCRIPTION (Continued)

Brake System, E-150-250-350, Typical (Continued)



H7458-B

DIAGNOSIS AND TESTING

Refer to Section 06-00 for drum brake diagnosis and testing procedures.

ADJUSTER NOT FUNCTIONING PROPERLY

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK CABLE END FITTINGS	Yes	GO to A2.
	<ul style="list-style-type: none"> Check to see if the cable completely fills or extends slightly beyond the crimped section of the fittings. Does cable check OK? 	No	REPLACE cable assembly.

DIAGNOSIS AND TESTING (Continued)**ADJUSTER NOT FUNCTIONING PROPERLY (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
A2	CHECK CABLE GUIDE		
	<ul style="list-style-type: none"> Check for worn or damaged cable guide. Check to see if cable groove is parallel to the shoe web. Check to see if the body of the guide lies flat against the web. Does cable guide check OK? 	Yes No	GO to A3 . REPLACE the guide.
A3	CHECK PIVOT HOOK ON LEVER		
	<ul style="list-style-type: none"> Check for worn or damaged hook. Check to see if the hook surfaces are square with the lever. <p>NOTE: Hook surfaces must be square with lever body for proper pivoting.</p> <ul style="list-style-type: none"> Does the pivot hook check OK? 	Yes No	GO to A4 . REPAIR or replace hook as required.
A4	CHECK ADJUSTING SCREW SOCKET SEATING		
	<ul style="list-style-type: none"> Check to see if the adjusting screw socket is properly seated in the notch of the web. Does the adjusting screw socket check OK? 	Yes No	GO to A5 . RESEAT adjusting screw socket.
A5	CHECK ADJUSTER THREADS		
	<ul style="list-style-type: none"> Check to see that adjuster threads are not binding due to damage or lack of proper lubricant. Do adjuster threads check OK? 	Yes No	LEVER and adjuster are OK. DISASSEMBLE, clean and inspect threads. REPLACE adjuster if damaged. If no damage found, lubricate with Disc Brake Caliper Slide Grease D7AZ-19590-A (ESA-M1C172-A) or equivalent.

TH8542A

REMOVAL AND INSTALLATION**Rear Brake Drum**

E-150-250-350, F-150-250-350 and Bronco

WARNING: DO NOT INHALE DUST FROM BRAKES, CLUTCHES OR ASSOCIATED COMPONENTS. INHALATION OF DUST CONTAINING ASBESTOS FIBERS CAN BE INJURIOUS TO YOUR HEALTH AND COULD CAUSE CANCER OR ASBESTOSIS. COMPRESSED AIR OR BRUSHES MUST NOT BE USED TO CLEAN BRAKES, BRAKE DRUMS, CLUTCHES AND ASSOCIATED COMPONENTS. A VACUUM CLEANER EQUIPPED FOR THIS PURPOSE SHOULD BE CAREFULLY USED TO REMOVE ANY DUST (ROTUNDA MODEL 091-00001). ADHERENT DUST SHOULD BE REMOVED WITH A DAMP RAG. ANY DUST SHOULD BE CONTAINED IN A SEALED AND LABELED BAG FOR DISPOSAL. WEAR AN APPROVED HIGH EFFICIENCY CARTRIDGE OR AIR LINE RESPIRATOR AND USE EXTRA CAUTION TO AVOID BREATHING THIS DUST. USE NON-ASBESTOS REPLACEMENT PARTS WHENEVER POSSIBLE.

Removal

1. Raise the vehicle so the wheel and tire assembly is clear of the floor and install safety stands under the axle.
2. Remove the hub cap if equipped, and wheel and tire assembly. Remove the spring retaining nuts and remove the brake drum.
3. If the drum is rusted to the axle shaft pilot diameter, use coarse sandpaper to remove the rust build-up, then remove the drum.

CAUTION: Use of a drum puller or a torch is not recommended. Drum distortion may result.

REMOVAL AND INSTALLATION (Continued)

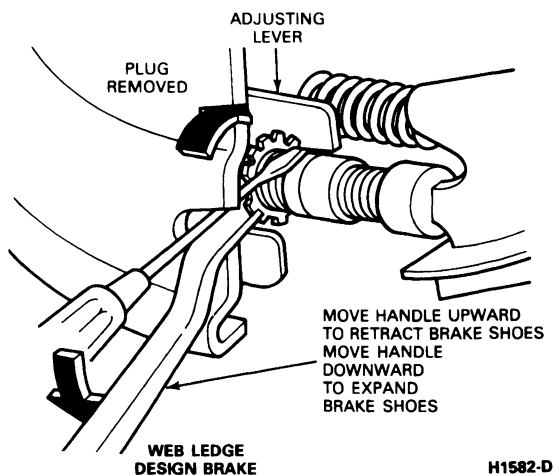
4. Check the brake drum surface. If surface is worn or if drum is suspected of having excessive runout, the drum should be machined. After machining, check maximum drum diameter. Drum must be replaced if diameter is outside maximum limit. Maximum drum diameter is stamped on the outside of the drum.

If the brake drum will not come off, insert a narrow screwdriver through the brake adjusting hole in the backing plate, and disengage the adjusting lever from the adjusting screw. While holding the adjusting lever away from the adjusting screw, loosen the adjusting screw with the Brake Adjusting Tool D8 1L-1103-C or equivalent.

Loosen the adjusting screw only if the drum cannot be removed. Do not burr, chip, or damage the notches in the adjusting screw or the self adjusting mechanism will not function properly.

If the adjusting screw was loosened, check to be sure the adjusting lever is still properly seated in the shoe web.

Retracting Brake Shoes, Rear, F-250-350, E-250-350



Installation

1. Remove the protective coating from a new drum with Brake Parts Cleaner E6AZ-19579-BA or equivalent.
2. Adjust the brakes as described in this section.
3. Install the drum onto the axle shaft flange or hub assembly.
4. Install the brake drum retaining clips securely. Install the wheel on the axle shaft flange or hub studs against the drum, and tighten the wheel retaining nuts to specification listed at the end of this section.

Brake Shoe and Adjusting Screw, Standard Self-Adjusting Brake Design

F-150, E-150 and Bronco

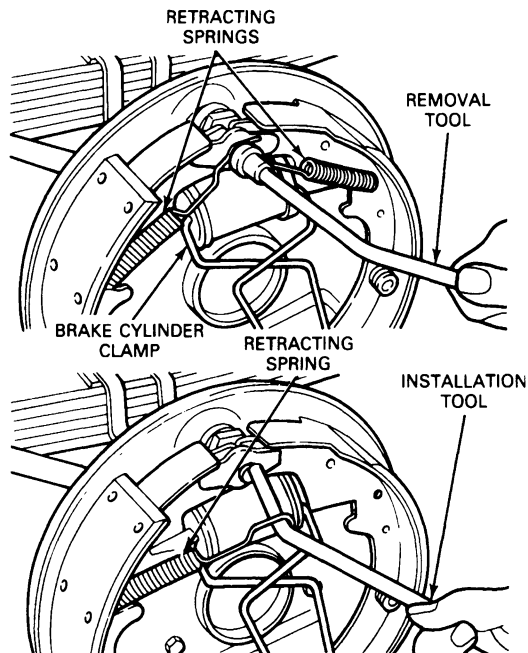
Removal

1. Remove the wheel and drum.
2. Pull back the boots of the wheel cylinder and inspect for signs of leakage. Cylinders that show evidence of leakage (water getting in past the boots or fluid leaking out past the cups) must be removed and repaired or replaced. Refer to procedure in this section.
3. If no leaks are found, install Brake Cylinder Clamp D8 1L-1103-B or equivalent over the ends of the cylinder as shown.
4. Contract the shoes as follows:
 - a. Disengage the adjusting lever from the adjusting screw by pulling backward on the adjusting lever cable.
 - b. Shorten the length of the adjuster by screwing the threaded rod in. This is done by moving the outward side of the adjusting screw upward until the pivot nut is backed off as far as it will go.
5. Pull the adjusting lever, cable and automatic adjuster spring down and toward the rear to unhook the pivot hook from the large hole in the secondary shoe web. **Do not pry the pivot hook out of the hole.**
6. Remove the automatic adjuster spring and adjusting lever.

CAUTION: Note the color and position of each spring. They must be re-assembled in same position.
7. Remove the secondary shoe-to-anchor spring using a brake spring removal/installation tool. Using the same tool, remove the primary shoe-to-anchor spring and unhook the cable anchor. Remove the anchor pin plate (if equipped).
8. Remove the cable guide from the secondary shoe.
9. Remove the shoe hold-down springs, shoes, adjusting screw, pivot nut, and socket. **Note the color and position of each hold-down spring. They must be re-assembled in the same position.**
10. Remove the parking brake link and spring. Disconnect the parking brake cable from the parking brake lever.
11. Remove the brake secondary shoe and disassemble the parking brake lever from the shoe by removing the retaining clip and spring washer.

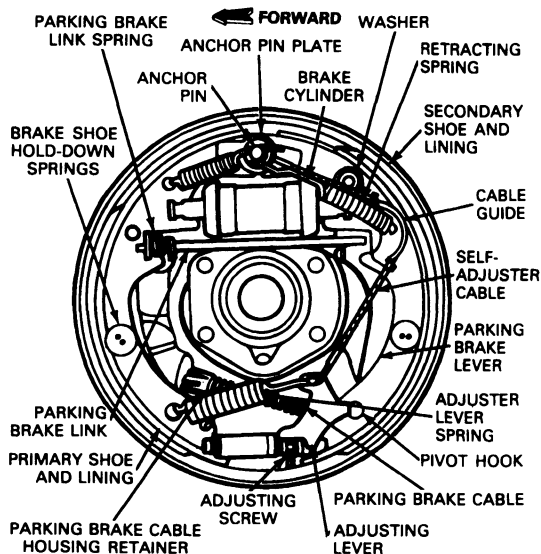
REMOVAL AND INSTALLATION (Continued)

Spring Replacement, Typical



H4963-C

Self-Adjusting Brake Assemblies, Rear, Standard, F-150, E-150 and Bronco



10-INCH REAR BRAKE (LEFT SIDE)

H4686-C

Installation

1. Clean the ledge pads on the backing plate. Sand lightly to bare metal.
2. Apply a light coating (0.80mm [1/32 inch] thick) of high temperature lithium-base grease Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent or Disc Brake Caliper Lubricant D7AZ-19590-A (ESA-M1C172-A) or equivalent at the points where the brake shoes touch the backing plate. Also lubricate the adjusting cable eye and the anchor pin area.
3. Before installing the rear brake shoes, assemble the parking brake lever on the secondary shoe and secure with the spring washer and retaining clip.
4. Position the brake shoes on the backing plate, and install the hold-down spring pins, springs, and cups. Install the parking brake link, spring, and washer. Connect the parking brake cable to the parking brake lever.
5. Install the anchor pin plate, if equipped, and place the cable anchor over the anchor pin with the crimped side toward the backing plate.
6. Install the primary shoe-to-anchor spring using a brake spring removal/installation tool.
7. Install the cable guide on the secondary shoe with the flanged hole fitted into the hole in the secondary shoe. Thread the cable around the cable guide groove.

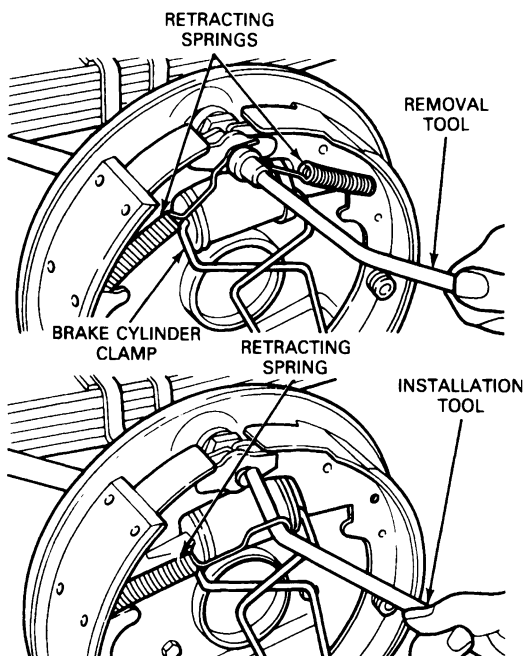
Make sure the cable is positioned in this groove, and not between the guide and the shoe web.

8. Install the secondary shoe-to-anchor (long) spring.

Make sure the cable end is not cocked or binding on the anchor pin when installed. All parts should be flat on the anchor pin.
Remove the brake cylinder clamp.

REMOVAL AND INSTALLATION (Continued)

Spring Replacement, Typical



H4963-C

9. Apply Disc Brake Caliper Lubricant D7AZ-19590-A (ESA-M1C172-A) or equivalent to the threads and the socket end of the adjusting screw. Turn the adjusting screw into the adjusting pivot nut to the end of the threads and then loosen it one-half turn.

CAUTION: Install the adjusting screw assembly in the same location from which it was removed. Interchanging the brake shoe adjusting screw assemblies from one side of the vehicle to the other will cause the brake shoes to retract rather than expand each time the automatic adjusting mechanism is operated.

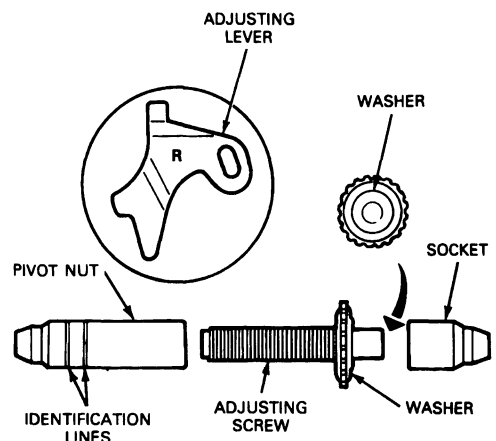
NOTE: To prevent incorrect installation, the socket end of each adjusting screw is stamped with R or L to indicate their installation on the right or left side of the vehicle. The adjusting pivot nuts can be distinguished by the number of lines machined around the body of the nut. Two lines indicate a right-hand nut; one line indicates a left-hand nut.

NOTE: Another way to identify adjusters is to check thread pitch. The right side adjuster has right-hand threads while the left side adjuster has left-hand threads. The adjuster will also increase in length when the lever is operated if properly installed.

10. Place the adjusting socket on the screw and install the assembly between the shoe ends with the adjusting screw nearest the secondary shoe.

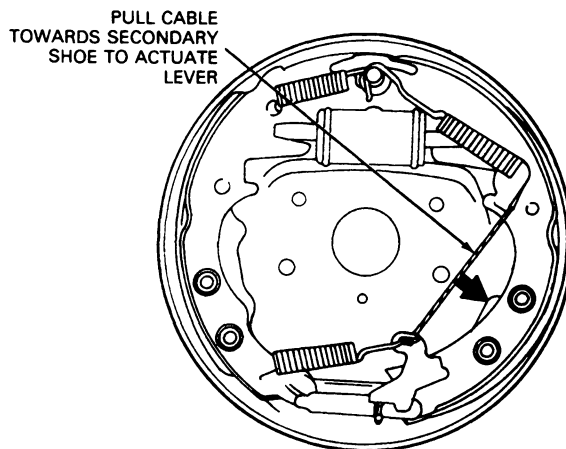
11. Hook the cable hook into the hole in the adjusting lever from the outboard plate side. The adjusting levers are also stamped with an R or L to indicate their installation on the right or left hand brake assembly.

Adjusting Screw and Lever, Rear, E-150, F-150 and Bronco

E-150, F-150, BRONCO REAR
STANDARD DESIGN

H4964-B

12. Place the hooked end of the adjuster spring in the large hole in the primary shoe web. Connect the loop end of the spring to the adjuster lever hole.
13. Pull the adjuster lever, cable and automatic adjuster spring down toward the rear to engage the pivot hook in the large hole in the secondary shoe web.
14. Check the action of adjuster by pulling cable toward secondary shoe, activating lever. Lever should snap in behind the next tooth of adjuster. Release cable to return adjuster lever to original position and the adjuster should turn one notch.



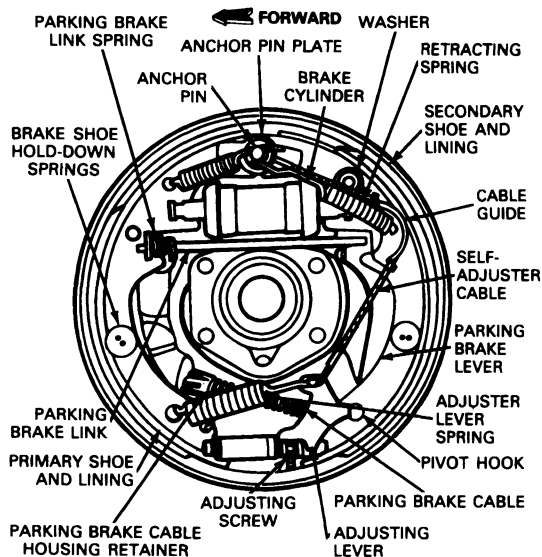
H4719-1B

REMOVAL AND INSTALLATION (Continued)

If pulling the cable does not produce the action described, or if lever action is sluggish instead of positive and sharp, check the position of the lever on the adjusting screw toothed wheel. With the brake in a vertical position (anchor at the top), the lever should contact the adjusting wheel one tooth above the center line of the adjusting screw. If the contact point is below this center line, the lever will not lock on the teeth in the adjusting screw wheel, and the screw will not be turned as the lever is actuated by the cable.

To find the cause of this condition refer to Diagnosis and Testing in this section.

Self-Adjusting Brake Assemblies, Rear, Standard, F-150, E-150 and Bronco



10-INCH REAR BRAKE (LEFT SIDE)

H4686-C

Brake Shoe Adjusting Screw

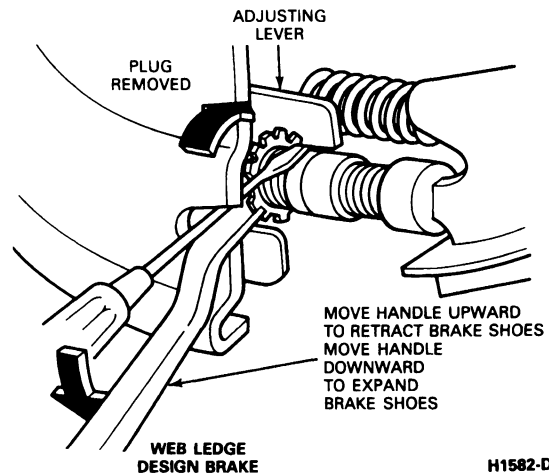
Web Ledge Design, Rear, E-250-350 and F-250-350

Removal

1. Raise the vehicle so the wheels clear the floor and install safety stands under the axle.

2. Remove the wheel and drum. If the drum does not clear the brake shoes, retract the brake shoes where shown.
3. Remove the parking brake lever assembly retaining nut from behind the backing plate.
4. Remove the parking brake lever assembly.
5. Remove the adjusting cable assembly from the anchor pin, cable guide, and adjusting lever.
6. Remove the brake shoe retracting springs.
7. Remove the brake shoe hold-down spring (use Hold-down spring Tool Number T73T-2300-A) from each shoe.
8. Remove the brake shoes and adjusting screw assembly.
9. Disassemble the adjusting screw assembly.

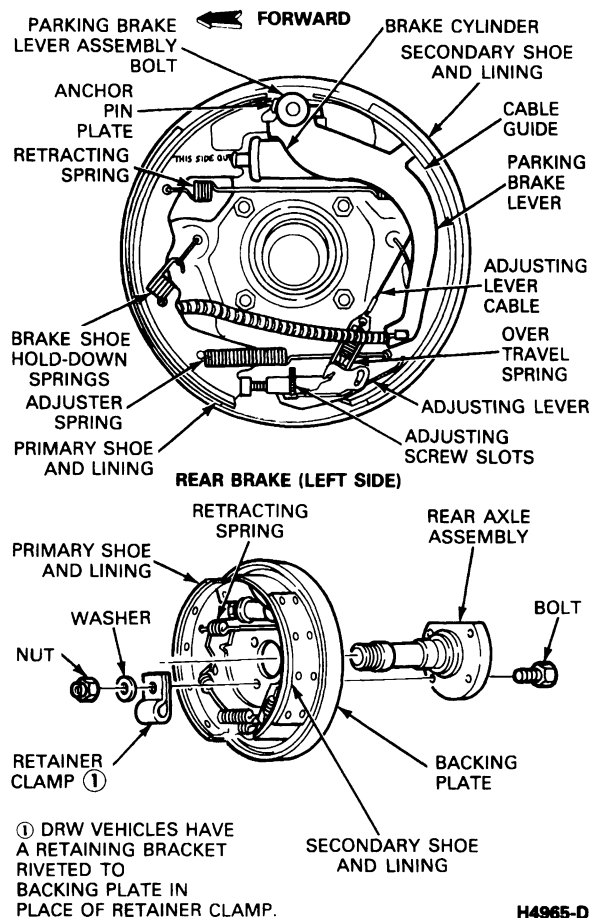
Retracting Brake Shoes, F-250-350 and E-250-350, Rear



H1582-D

REMOVAL AND INSTALLATION (Continued)

Self-Adjusting Brake Assemblies, Heavy-Duty, E-250-350 and F-250-350

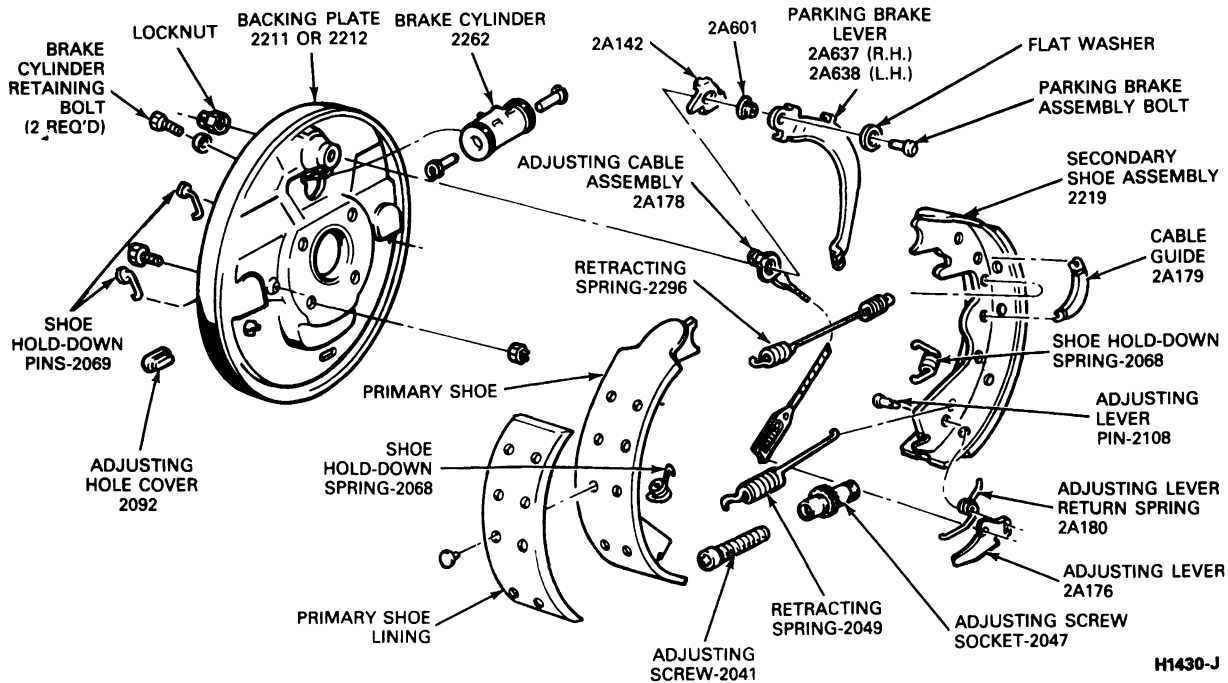


Installation

1. Clean the ledge pads on the backing plate.
2. Apply a lithium-base grease, Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent or Disc Brake Caliper Lubricant D7AZ-19590-A (ESA-M1C172A) or equivalent to the retracting and hold-down spring contacts on the brake shoes and backing plate.
3. Apply a lithium-base grease, Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent or Disc Brake Caliper Lubricant D7AZ-19590-A (ESA-M1C172A) or equivalent to the threads and socket end of the adjusting screw.
4. Install the upper retracting spring on the primary and secondary shoes as shown.
5. Position the shoe assembly on the backing plate with the wheel cylinder push rods in the shoe slots.
6. Install the brake shoe hold-down springs. Use tool number T73T-2300-A.

REMOVAL AND INSTALLATION (Continued)

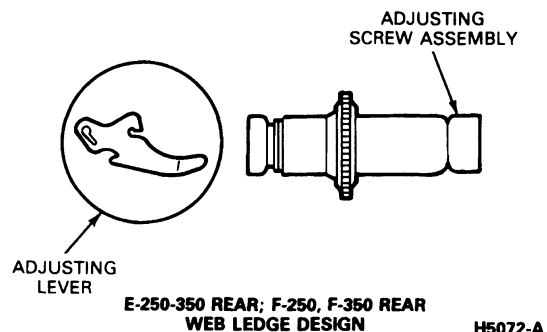
Rear Web Ledge Single Anchor Brake, E-250 and F-250-350, Disassembled



7. Install the brake shoe adjustment screw assembly with the slot in the head of the adjusting screw toward the primary shoe.
8. Install the lower retracting spring, adjusting lever spring, adjusting lever assembly, and connect the adjusting cable to the adjusting lever.
9. Position the cable in the cable guide and install the cable anchor fitting on the anchor pin.

NOTE: Install the adjusting screw assemblies in the same locations from which they were removed. Interchanging the brake shoe adjusting screw assemblies from one side of the vehicle to the other will cause the brake shoes to retract rather than expand each time the automatic adjusting mechanism is operated. To prevent incorrect installation, the socket end of each adjusting screw is stamped with an R or L to indicate their installation on the right or left side of the vehicle. The adjusting pivot nuts can be distinguished by the number of lines machined around the body of the nut. Two lines indicate a right-hand nut; one line indicates a left-hand nut.

10. Install the parking brake assembly in the anchor pin and washer and secure with the retaining nut behind the backing plate.
11. Adjust the brakes before installing the drums as described in this section.



H5072-A

Brake Wheel Cylinder

Removal

1. Raise vehicle on hoist and position suitable safety stands under vehicle.
2. Remove wheel and tire assembly.
3. Remove the wheel, drum, and brake shoes. Remove the cylinder-to-shoe connecting links.
4. Disconnect the brake line from the brake cylinder.
5. Remove the brake cylinder retaining bolts and lockwashers, and then remove the cylinder from the backing plate.

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Place the brake cylinder on the backing plate and install the retaining bolts and lockwashers.
2. Install a new gasket on the brake line fitting (if equipped) and connect the brake line to the brake cylinder.
3. Install the brake shoes and the connecting links between the shoes and cylinder. Install the drum and the wheel.
4. Adjust the brakes as described in this section and bleed the system as described in Section 06-00. Check pedal operation before moving the vehicle.

Rear Brake Backing Plate**Removal**

1. On F-150-250, E-150-250 and Bronco, remove the rear wheel and brake drum. Disconnect the brake line from the brake cylinder and submerge the end of the brake line in a can containing a small amount of brake fluid to prevent air from entering the system.
2. If the rear backing plate is being removed from a Ford 8.8-inch ring gear axle on an F-150, E-150, Bronco refer to Section 05-02G. For the Dana Semi-Float axle installed on an E-250 refer to Section 05-02D. Ford semi-float rear axle for F-250, refer to Section 05-02A.
3. Remove the brake shoes and brake cylinder.
4. Disconnect the parking brake lever from the cable.
5. Remove the C-clip in the differential case which holds the axle shaft in place. After the C-clip has been removed, slide the axle shaft out of the housing.
6. Remove the backing plate after the axle shaft has been removed.
7. For backing plate removal procedures from a Dana full-float rear axle installed on E-350, refer to Section 05-02E. For Ford full-float rear axle for F-250 HD and F-350, refer to Section 05-02B.
8. Remove the backing plate after the axle shaft and hub have been removed.

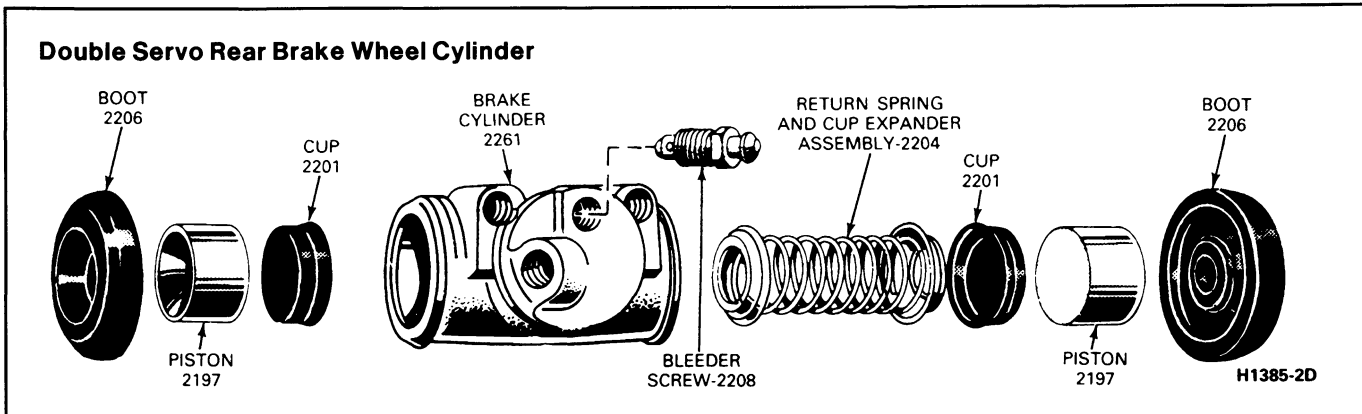
Installation

1. Position the rear backing plate on the retaining bolts in the axle housing flange.
2. Insert the axle shaft assembly into the housing so the splines engage the differential side gear, with the bearing retainer sliding onto the retaining bolts and against the backing plate.
3. Install the retaining nuts through the access hole in the axle shaft flange.
4. On E-250 equipped with Dana semi-float rear axles, install the backing plate, hub and axle shafts after referring to Axle Shafts Installation in Section 05-02D.
5. On F-250 vehicles with Ford semi-float rear axles, refer to Section 05-02A. On F-250 HD with Ford full-float rear axles, refer to Section 05-02A.
6. On E-350 vehicles with Dana full-float rear axles, refer to Section 05-02D.
7. Install the brake cylinder and brake shoes. On rear brakes, connect the parking brake cable to the lever.
8. Connect the brake line to the brake cylinder and install the wheel and brake drum. Adjust the brake shoes (described in this Section) and bleed air from the system as described in Section 06-00.
9. Tighten the wheels to the specification given at the end of this section.

DISASSEMBLY AND ASSEMBLY**Brake Wheel Cylinder****Disassembly**

1. With the wheel cylinder removed, remove the rubber boots from the ends of the brake cylinder.
2. Remove the pistons, cups, and piston return spring and piston expander assembly from the cylinder.
3. Remove the bleeder screw from the cylinder.

DISASSEMBLY AND ASSEMBLY (Continued)

**Assembly**

1. Coat all brake cylinder parts with clean Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent.
2. Install the bleeder screw in the brake cylinder.
3. Place the piston return spring and cup expander assembly, cups, and pistons in the cylinder bore.
4. Install a boot and link over each end of the cylinder. Clamp the brake cylinder pistons against the ends of the cylinder. **When using a brake cylinder repair kit follow the instructions in the kit and use all of the parts provided.**

ADJUSTMENTS**Rear Brake Shoe Adjustment**

The rear brakes are automatically adjusted while driving the vehicle forward, and then in reverse and sharply applying the brakes. It may be necessary to do this several times to obtain the proper rear brake adjustment. Manual brake adjustment is required only after the brake shoes have been relined or replaced or the adjusters are malfunctioning. Perform the manual adjustment with the drums removed, using the tool and the procedure described below.

After adjusting the rear brake shoes, check the parking brake cables for proper adjustment. Make sure the equalizer operates freely. Refer to Section 06-05 for additional information.

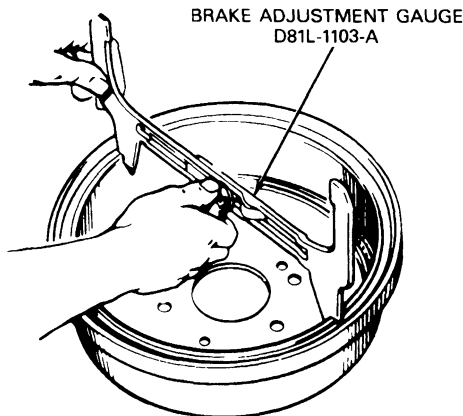
Manual Adjustment With Drums Removed

1. With drums removed, use Rotunda Brake and Clutch Service Vacuum 091-00001 or equivalent to remove any dust present on the brake assembly.
2. Carefully remove the brake shoe hold-down spring assemblies. Using sandpaper, clean the shoe-to-backing plate contact points while holding the shoe away from the backing plate.

3. Check backing plate for damage. If any damage is found, it must be replaced. Refer to procedure in this section. If no damage is found, apply a small amount (0.80mm [1/32 inch] thick) of Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent or Disc Brake Caliper Slide Grease D7AZ-19590-A (ESA-M1C172-A) or equivalent to the ledges where the shoes touch the backing plate. Be careful not to get the lubricant on the linings. Also lubricate the adjusting cable eye and the anchor pin area.
4. Reinstall brake shoe hold-down spring assemblies.
5. For E-150, F-150 and Bronco, use a brake Adjustment Gauge D81L-1103-A or equivalent to adjust the brake linings to the inside diameter of the drum braking surface. On E-250-350 and F-250-350 use Rotunda Brake Shoe Setting Gauge Model 104-00063 or equivalent to adjust the brake linings to the inside diameter of the drum braking surface.
6. Reverse the tool as shown and adjust the brake shoes until they touch the gauge.
 - The gauge contact points on the shoes must be parallel to the vehicle with the center line through the center of the axle.
 - Hold the automatic adjusting lever out of engagement while rotating the adjusting screw, to prevent burring the screw slots. Make sure the adjusting screw rotates freely.
 - If necessary, remove adjuster from the brake assembly. Disassemble and clean the adjuster. Lubricate the adjusting screw threads with a thin, uniform coating of lithium-base grease, Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent.

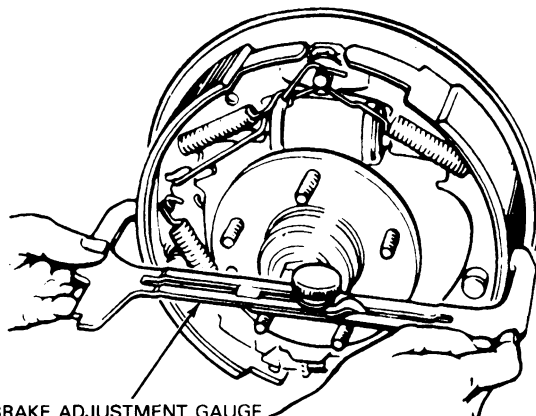
ADJUSTMENTS (Continued)

Measuring Drum



H1411-J

Measuring Shoes



H1412-J

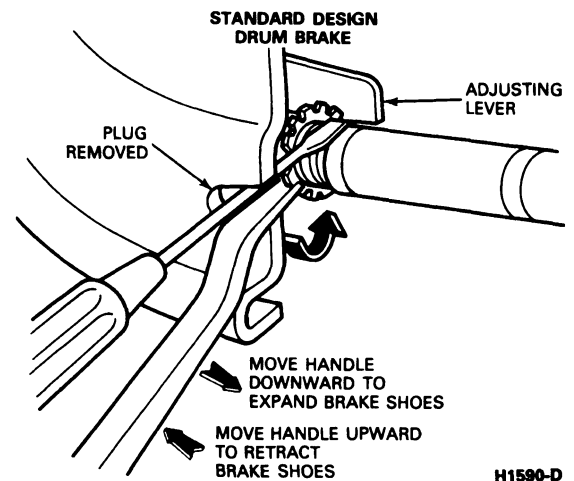
7. Install the drums. Install the retaining clips.
8. Install the wheels on the hubs or axle shaft flanges against the drums and tighten the wheel mounting nuts to specification, as listed at the end of this section.
9. Complete the adjustment by applying the brakes sharply several times while driving the vehicle in reverse.
10. After adjusting the brake shoes, check brake operation by making several stops while driving forward.

Manual Adjustment With Drums Installed

Adjust the single anchor brake by turning self adjusting screw located between the lower ends of the shoes.

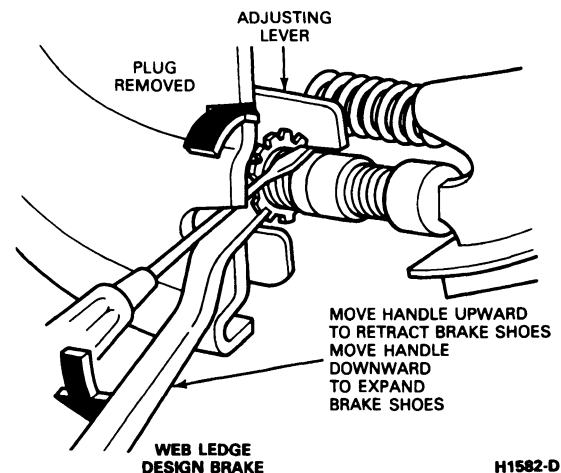
1. Raise the vehicle until the tires clear the floor. Install safety stands under the axle.
2. Remove the cover from the adjusting hole at the bottom of the brake backing plate, and turn the adjusting screw (inside the hole) to expand the brake shoes until they drag against the brake drum as shown.

Backing Off Brake Adjustment, E-150, F-150 and Bronco



H1590-D

Expanding Brake Shoes, F-250-350, E-250-350, Rear



H1582-D

3. When the shoes are against the drum, loosen the adjusting screw so the drum rotates freely without drag. If the drum does not rotate freely, remove the wheel and drum. Using Rotunda Brake and Clutch Service Vacuum, vacuum out any dust and dirt from the linings. Remove brake shoe hold-down springs. Using sand paper, remove any rust from the points where the shoes touch the backing plate while holding shoe away from backing plate. Apply a light coating of lithium-base grease, Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent or Disc Brake Caliper Lubricant D7AZ-19590-A (ESA-M1C172-A) or equivalent. Do not get the lubricant on the linings. Install brake shoe hold-down springs. Install the wheel and drum and adjust the shoes.
4. Install the adjusting hole cover on the brake backing plate.
5. Check and adjust the other brake assembly.

ADJUSTMENTS (Continued)


6. Apply the brakes. If the pedal travels more than halfway to the floor, there is too much clearance between the brake shoes and the drums. Repeat Steps 2 and 3 above.
7. When all brake shoes have been properly adjusted, lower the vehicle and road test to check brake operation. Perform the road test only when the brakes will apply and the vehicle can be safely stopped.

SPECIFICATIONS**WHEEL TORQUE SPECIFICATIONS**

Description	N·m	Lb·Ft
E-150, F-150, Bronco (5-Lug Wheel — 1/2-20)	135	100
E-250, E-350, F-250, F-350 (8-Lug Wheel — 9/16-18)	190	140

NOTE: Torque specifications are for clean, dirt-and-paint-free dry bolt and nut threads. Never use oil or grease on studs or nuts.

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number / Description	Illustration
T73T-2300-A Hold-Down Spring Tool (F-150-250-350)	 T73T-2300-A

Tool Number	Description
D81L-1103-A	Brake Adjustment Gauge
D81L-1103-C	Brake Adjustment Tool

ROTUNDA EQUIPMENT

Tool Number	Description
091-00001	Brake and Clutch Service Vacuum
104-00063	Brake Shoe Adjusting Gauge

SECTION 06-03 Brake, Front Disc

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DISASSEMBLY AND ASSEMBLY (Cont'd.)	
Disc Brake Shoe Adjustment	06-03-20	Disc Brake Caliper, Sliding Caliper, LD	06-03-19
Hydraulic System Bleeding	06-03-20	REMOVAL AND INSTALLATION	
DESCRIPTION AND OPERATION		Disc Brake Hub and Rotor	06-03-17
HD (Heavy-Duty) Pin Rail Slider Caliper Disc		HD Pin Rail Slider Caliper, Brake Shoes and	
Brakes	06-03-1	Linings	06-03-12
Hydraulic Lines	06-03-5	Hydraulic Line Repair	06-03-17
LD (Light Duty) Pin Rail Slider Caliper Disc		LD Pin Rail Sliding Caliper, Brake Shoes and	
Brakes	06-03-5	Linings	06-03-15
DIAGNOSIS AND TESTING		SPECIAL SERVICE TOOLS	06-03-22
Disc Brake Rotor	06-03-10	SPECIFICATIONS	06-03-21
DISASSEMBLY AND ASSEMBLY		VEHICLE APPLICATION	06-03-1
Disc Brake Caliper, HD Rail Sliding			
Caliper	06-03-18		

VEHICLE APPLICATION

F-150-250-350 4x2 and 4x4, E-150-250-350, Bronco and F-Super Duty Vehicles

DESCRIPTION AND OPERATION

HD (Heavy-Duty) Pin Rail Slider Caliper Disc Brakes

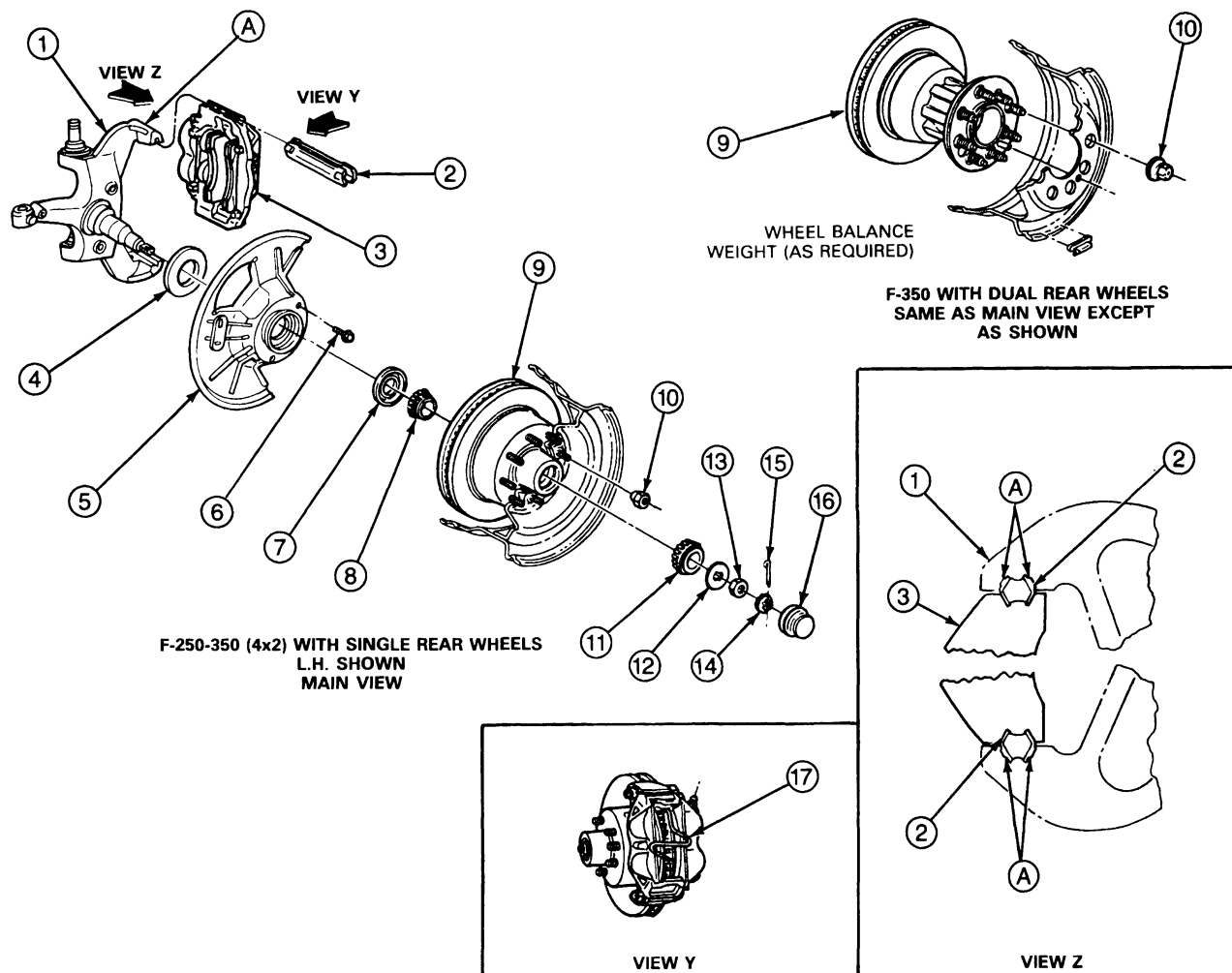
F-250-350 4x2 and 4x4, and E-250-350 trucks are equipped with dual piston, pin rail slider caliper disc-brakes in the front, and conventional drum brakes in the rear. The system has a dual master cylinder and vacuum booster. F-Super Duty series vehicles are equipped with dual piston, pin rail slider caliper disc brakes in the front and rear. The system uses a dual master cylinder and a Hydro-Boost.

The disc brake is of the pin rail slider caliper design, with two pistons on the same side of the rotor. The unit consists of a caliper which slides on two pins that also attach the caliper to the spindle (or anchor plate on F-Super Duty rear disc brakes).

The caliper contains the two pistons. The pistons and cylinder bores are protected by boot seals fitted to a groove in the piston and a groove in the cylinder housing. The spindle mounting positions the caliper assembly over the rotor rearward.

DESCRIPTION AND OPERATION (Continued)

Disc Brake, F-250 (Above 6900 GVWR), F-350 4x2



H4949-C

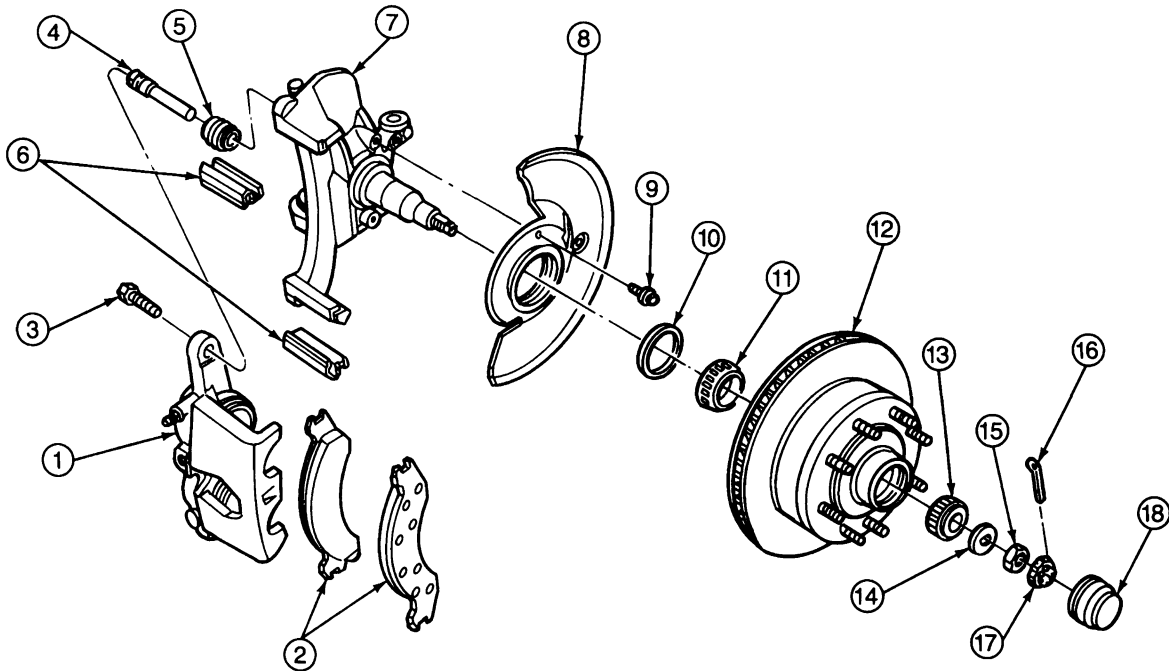
Item	Part Number	Description
1	3105	Spindle, RH
1	3106	Spindle, LH
2	2C150	Caliper Support Pin Assembly
3	2B120	Caliper, RH
3	2B121	Caliper, LH
4	2B160	Gasket
5	2K004	Splash Shield, RH
5	2K005	Splash Shield, LH
6	N611171-S2	Screw, 7-10 N-m (62-89 In-Lb)
7	1190	Grease Seal
8	4221	Inner Cone and Roller Assembly
9	1102	Hub and Rotor Assembly

(Continued)

Item	Part Number	Description
10	1012	Lug Nut
11	1216	Outer Cone and Roller Assembly
12	1195	Washer
13	374504	Nut, 3/4-16
14	390622-S	Nut, Retainer 3/4
15	N642569-S36	Cotter Pin, must be installed as shown
16	1131	Cap
17	Ref.	Anti-Rattle Clip
A	—	Pins (2C150) must be installed so that the retention tabs are touching spindle surface, not the caliper surface (4 places). Pins may be installed from either direction.

DESCRIPTION AND OPERATION (Continued)

Disc Brake System, E-250-350



H8278-A

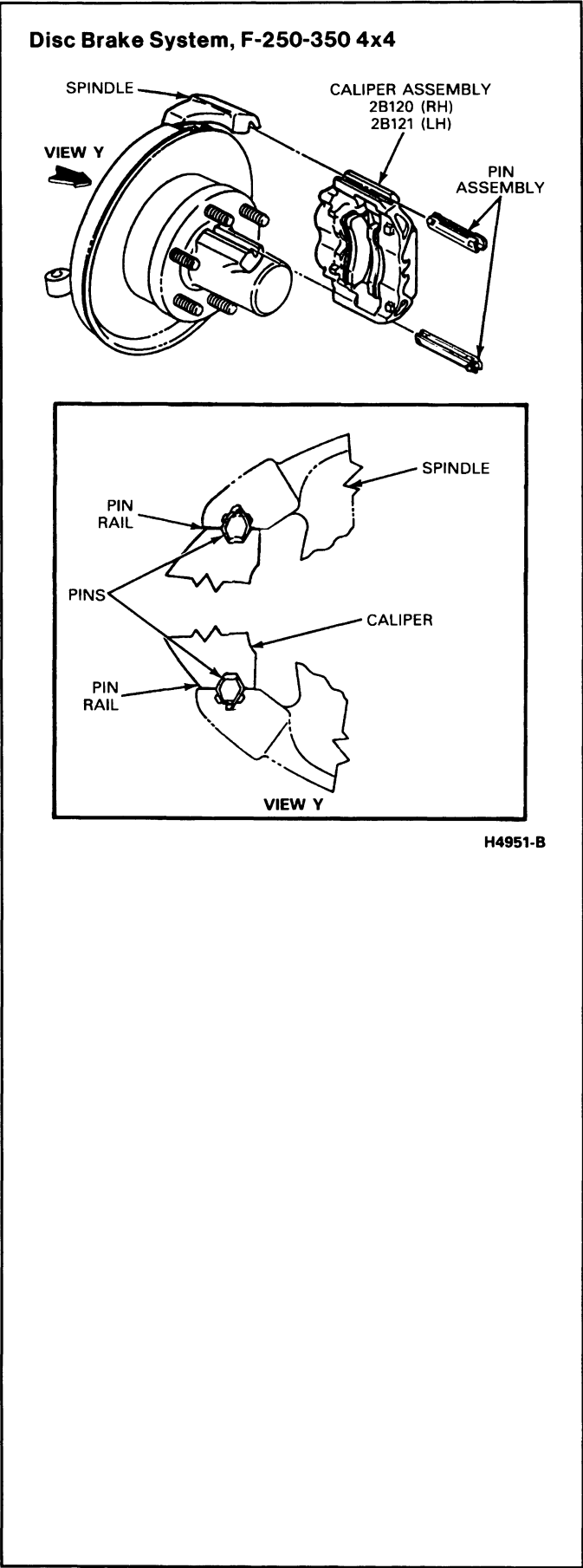
FRONT DISC BRAKE COMPONENTS E-250-350 (LEGEND)

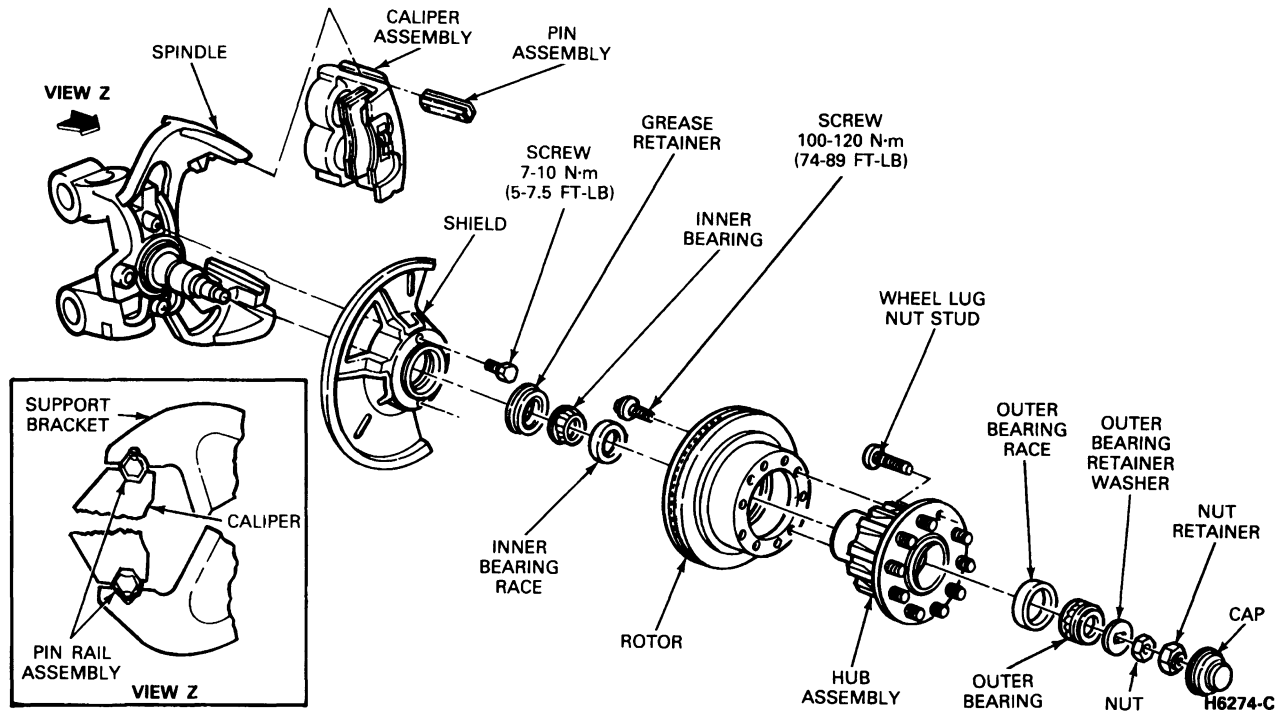
Item No.	Part Number	Description
1	2B120	Caliper Assembly, Brake, Right
	2B121	Caliper Assembly, Brake, Left
2	2018	Shoe and Lining Assembly, Outer
	2019	Shoe and Lining Assembly, Inner
3	N601797-S2	Bolt, Caliper Mount, M12 × 1.75 × 30 Hex Head Lock
4	—	Pin, Caliper Slide
5	—	Boot, Slide Pin
6	2B164	Spring, Anti-Rattle
7	3105	Spindle Assembly, Right
	3106	Spindle Assembly, Left
8	2K004	Shield, Splash, Right
	2K005	Shield, Splash, Left

Item No.	Part Number	Description
9	N611171-S2	Screw, Self-Tapping, M6 — 1.0 × 10 (Three Required)
10	1190	Seal, Grease
11	4221	Cone and Roller Assembly, Inner
12	1102	Hub and Rotor Assembly
13	1216	Cone and Roller Assembly, Outer
14	1195	Washer, Spindle
15	374504-S100	Nut, Spindle
16	N642569-S36	Pin, Cotter
17	390622-S	Nut Retainer
18	1131	Cap, Grease

CH8294-A

DESCRIPTION AND OPERATION (Continued)



DESCRIPTION AND OPERATION (Continued)**Disc Brake System, F-Super Duty Chassis Cab, Stripped Chassis and Motorhome Chassis, Typical****LD (Light Duty) Pin Rail Slider Caliper Disc Brakes**

The disc brake assembly used on F-150, E-150, Bronco and F-150 4x4 vehicles is a pin rail sliding caliper, single piston type and attaches to supporting member similar to the dual piston pin rail slider design.

The ends of the inner shoe and lining assembly are confined within the spindle assembly. An anti-rattle clip is positioned between the shoe and spindle assembly at the bottom of the caliper. The outer shoe flange rests against the shoe locating and torque surfaces on the caliper housing. The inner and outer shoes are not interchangeable.

The caliper housing is a single piece finished casting positioned on the spindle (knuckle on 4x4) assembly.

Pins are inserted between the machined surfaces of the caliper and spindle assemblies (as seen in View Z of the following illustrations).

These pins retain the calipers to the spindle assemblies.

A single hydraulic piston is located in the cylinder bore in the caliper housing, with the hydraulic fluid inlet at the bottom of the bore. A square section seal fitted into an annular groove in the caliper cylinder bore, and a rubber boot seal the piston and caliper bore from road splash and contamination. A bleeder screw located above the cylinder bore is used to bleed air from the system.

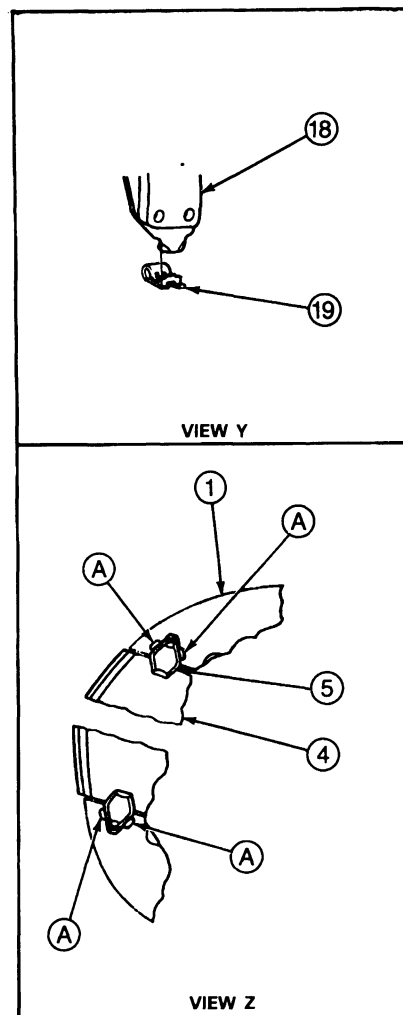
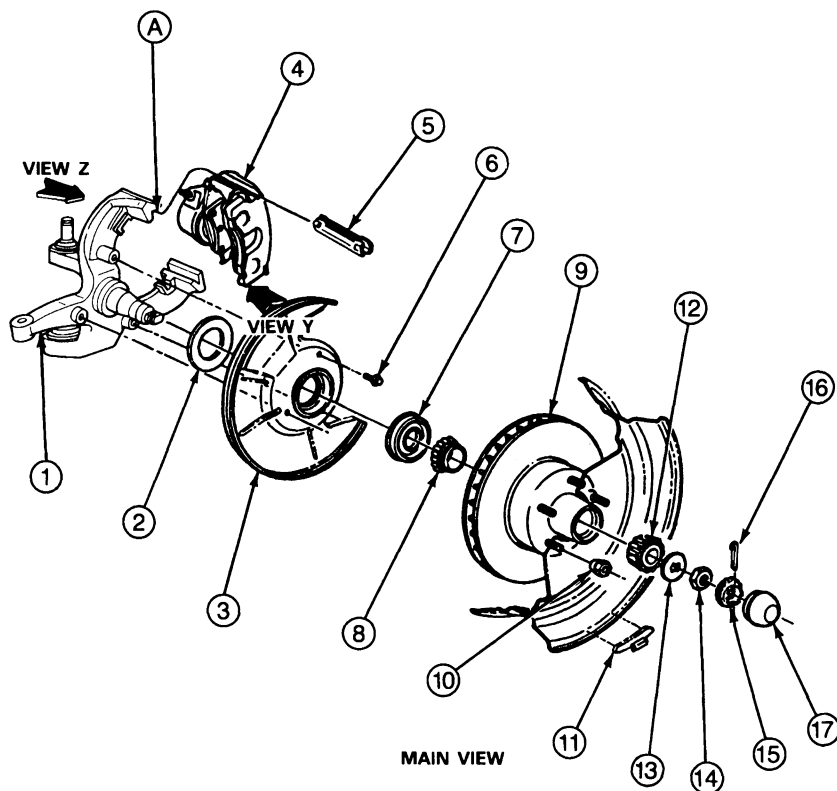
For F-150-250-350 4x2, and E-150-250-350 with SRW (Single Rear Wheels), the hub and ventilated rotor is an integrally cast assembly. The F-150-250-350 4x4 and the E-350 and F-350 with DRW (Dual Rear Wheels) and F-Super Duty series vehicles utilize separate hub and rotor assemblies which are bolted together. A single piece splash shield, bolted to the spindle, protects the bearings and inboard surface of the rotor from road splash. The wheel protects the outboard surface of the rotor and brake assembly.

Hydraulic Lines

Steel tubing is used in the hydraulic lines between the master cylinder and the front brake tube connector, between the rear brake tube connector and the rear brake cylinders and between the master cylinder along the frame rail to the flexible hose connected to the rear brake tube connector. Flexible hoses connect the brake tube to the front brake cylinders and to the rear brake tube connector.

DESCRIPTION AND OPERATION (Continued)

Sliding Caliper Disc Brake Installation, F-150



H4953-D

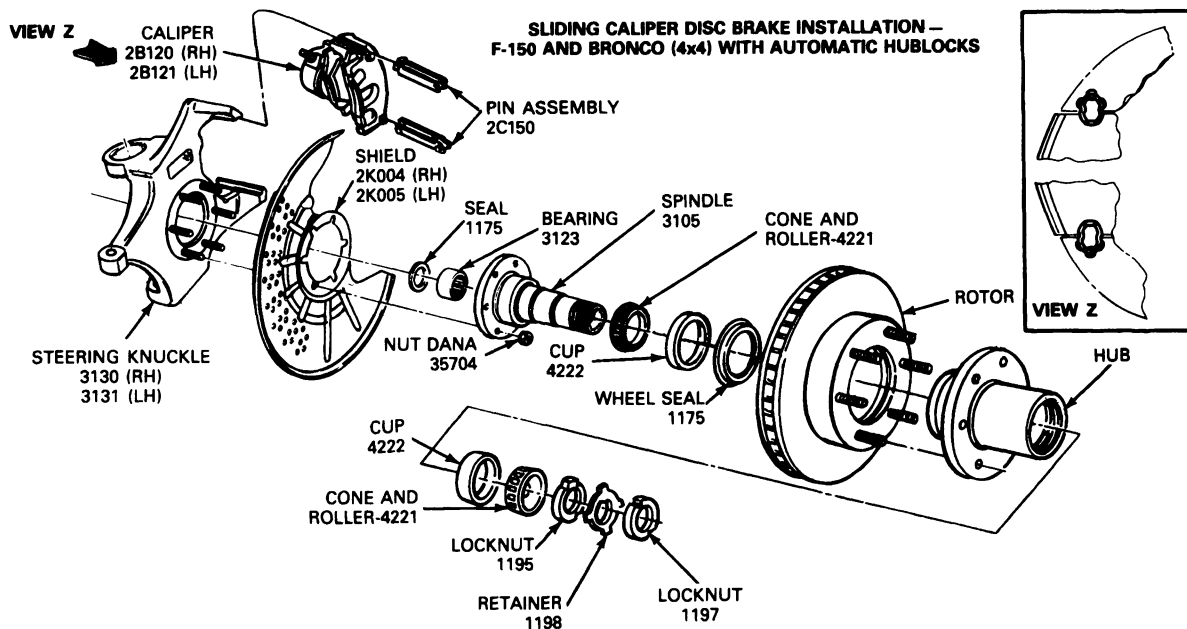
Item	Part Number	Description
1	3105	Spindle, RH
1	3106	Spindle, LH
2	2B160	Gasket
3	2K004	Splash Shield, RH
3	2K005	Splash Shield, LH
4	2B120	Caliper, RH
4	2B121	Caliper, LH
5	2C150	Pin
6	N611171-S2	Screw, 9-13 N·m (80-115 In-Lb)
7	1190	Retainer
8	1201	Inner Bearing
9	1102	Hub and Rotor
10	1012	Lug Nut

(Continued)

Item	Part Number	Description
11	1040	Balance Weight
12	1216	Outer Bearing
13	1195	Washer
14	374504-S100	Nut 3/4-16
15	390622-S	Nut, Retainer
16	N642569-S36	Cotter Pin, must be installed as shown
17	1131	Cap
18	2007	Brake Pad, Inner
19	2B164	Anti-Rattle, Clip
A	—	Pins (2C150) must be installed so that retention tabs are touching spindle surface, not the caliper surface (4 places). Pins may be installed from either direction.

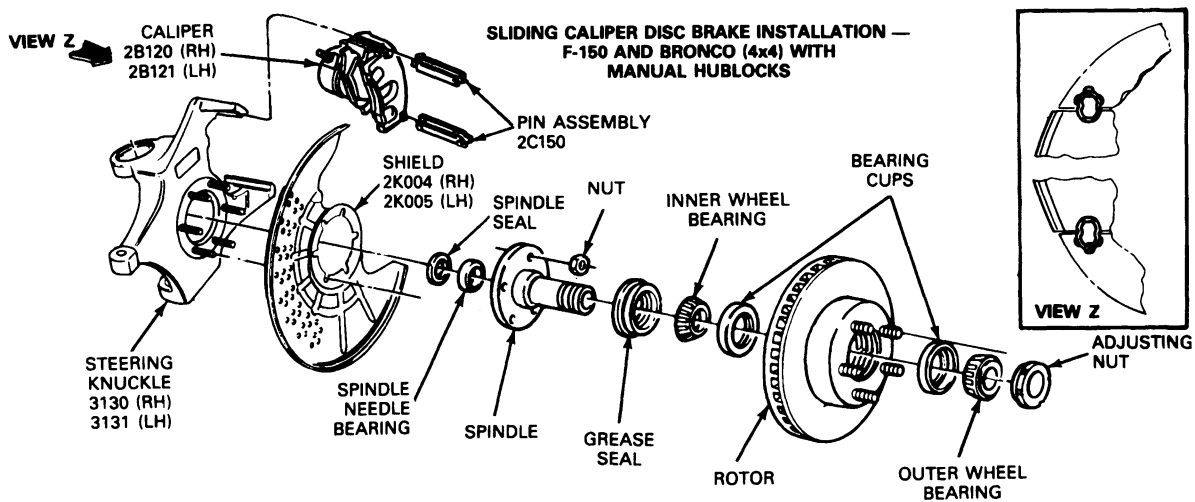
DESCRIPTION AND OPERATION (Continued)

Sliding Caliper Disc Brake Installation, F-150 and Bronco 4x4 with Automatic Hublocks



H5065-B

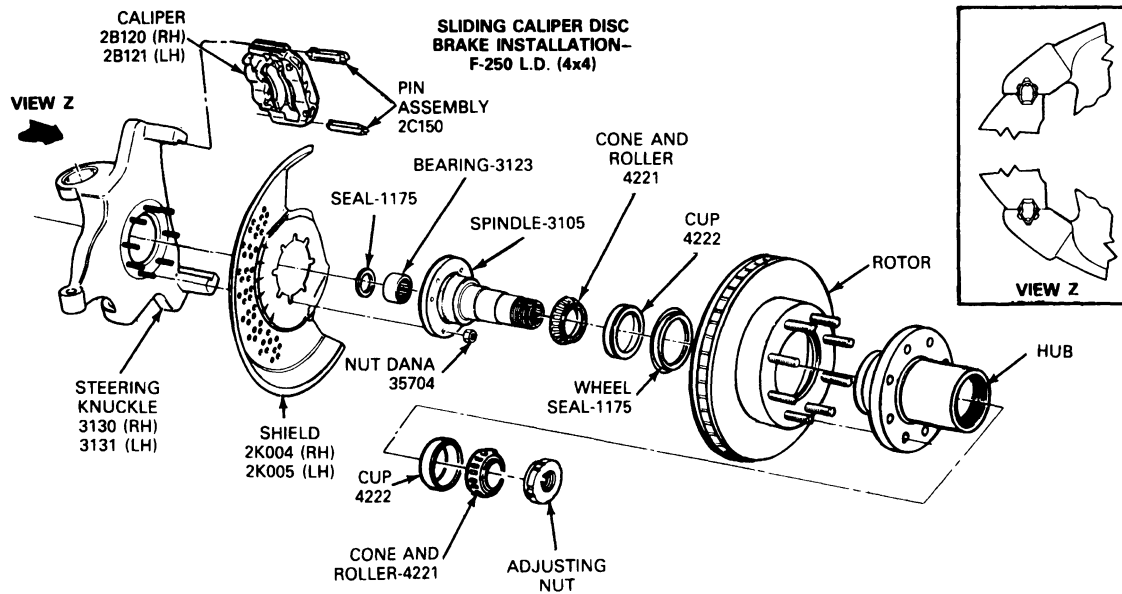
Sliding Caliper Disc Brake Installation, F-150 4x4 and Bronco with Manual Hublocks



H5066-B

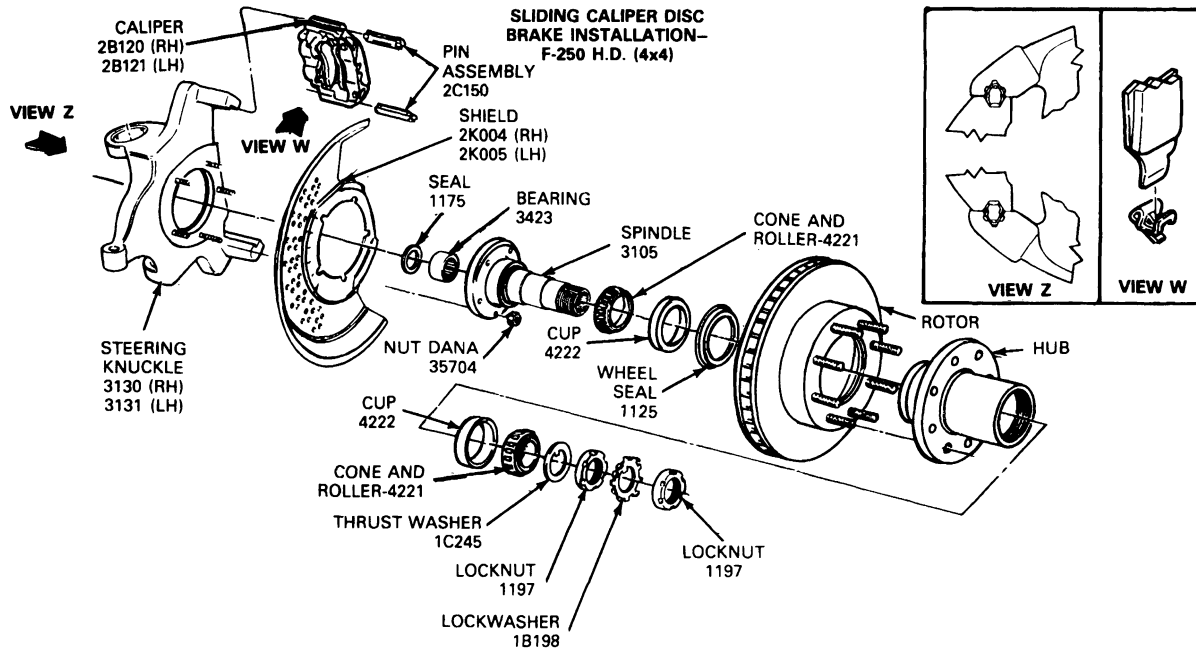
DESCRIPTION AND OPERATION (Continued)

Sliding Caliper Disc Brake Installation, F-250 LD 4x4



H5067-B

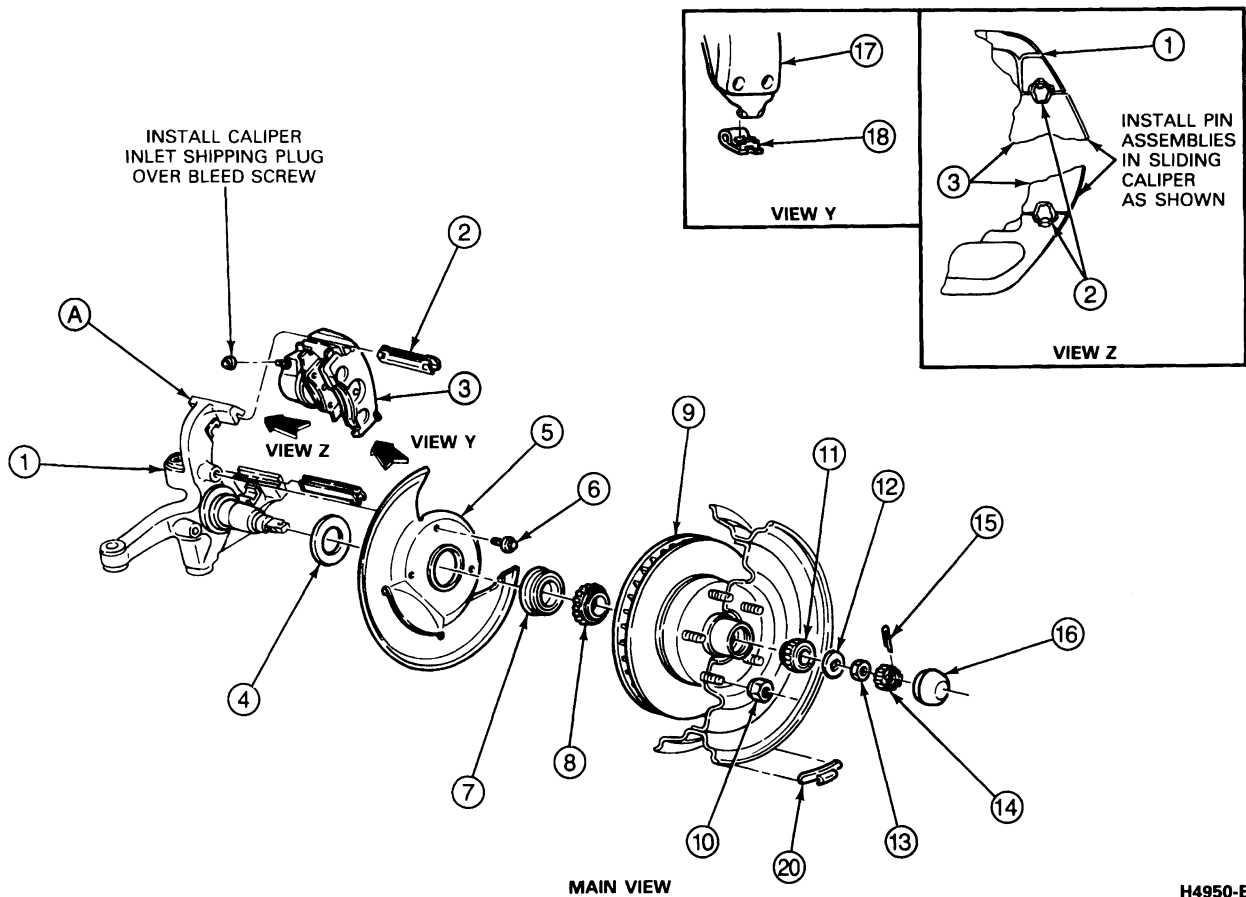
Sliding Caliper Disc Brake Installation, F-250 HD 4x4



H5068-B

DESCRIPTION AND OPERATION (Continued)

Disc Brake System, E-150



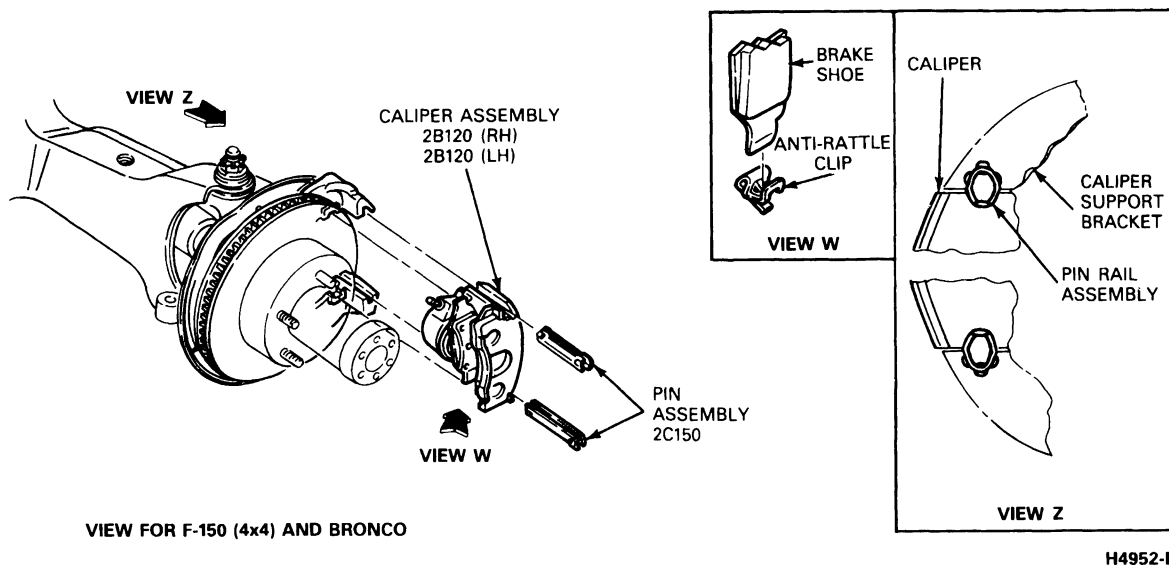
Item	Part Number	Description
1	3105	Spindle, RH
1	3106	Spindle, LH
2	2C150	Pin Assembly
3	2B120	Caliper, RH
3	2B121	Caliper, LH
4	2B160	Gasket
5	2K004	Splash Shield, RH
6	2K005	Splash Shield, LH
7	1190	Grease Seal
8	1201	Inner
9	1102	Hub and Rotor Assembly
10	1012	Lug Nut
11	1216	Outer Cone and Roller Assembly

(Continued)

Item	Part Number	Description
12	1195	Washer
13	374504-S100	Nut, 3/4-16
14	390622-S	Nut, Retainer 3/4
15	N642569-S36	Cotter Pin, must be installed as shown
16	1131	Cap
17	2007	Inner Brake Pad
18	2B164	Anti-Rattle Clip
A	—	Pins (2C150) must be installed so that retention tabs are in contact with spindle surface, not the caliper surface (4 places). Pins may be installed from either direction.

DESCRIPTION AND OPERATION (Continued)

Disc Brake System, F-150 4x4 and Bronco



DIAGNOSIS AND TESTING

Refer to Section 06-00 for disc brake diagnosis and testing procedures not covered below.

Disc Brake Rotor

Each time the brakes are serviced, the disc brake rotor should be checked for scoring, runout, parallelism and thickness.

Rotor scoring and runout may be checked on most brakes with the caliper either on or off. To check parallelism and thickness, the caliper must be removed.

Rotor specifications are listed in the Specifications at the end of this section.

Rotor Runout

Rotor runout is the side-to-side movement or wobble of the rotor as it rotates. Excessive runout may cause vibration, pedal pumping, low pedal or brake chatter. Use the following procedure to check rotor runout.

VIBRATION, PEDAL PUMPING, LOW PEDAL OR BRAKE CHATTER — TEST A

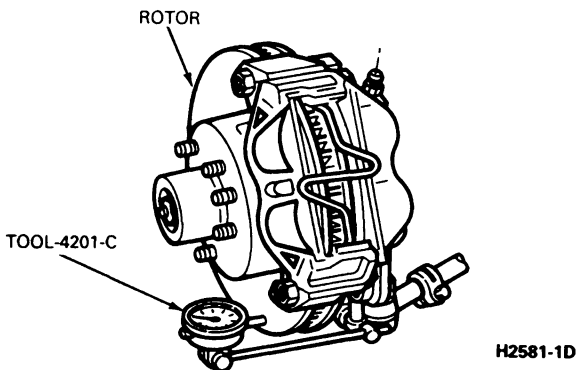
TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK BEARING END PLAY, FRONT BRAKES ONLY		
	<ul style="list-style-type: none"> Tighten the spindle nut to eliminate all end play from bearings. Be sure hub and rotor can be turned. Is the end play eliminated and can the hub and rotor be turned? 	<p>Yes</p> <p>No</p>	<p>GO to A2.</p> <p>READJUST spindle nut until there is no end play and the hub and rotor can be turned. GO to A2.</p>

DIAGNOSIS AND TESTING (Continued)

VIBRATION, PEDAL PUMPING, LOW PEDAL OR BRAKE CHATTER — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A2	CHECK ROTOR RUNOUT		
<ul style="list-style-type: none"> ● Attach dial indicator TOOL-4201-C to suspension. ● Place the indicator stylus 25.4mm (1 inch) from the outer edge of the rotor. ● Adjust the dial indicator to mid travel and zero the scale. ● Slowly turn the rotor one complete revolution and note the high and low readings. ● Is the runout within the specified limits? <p>CAUTION: Be sure to adjust the spindle nut to specifications after the runout check.</p>		Yes	▶ Rotor runout is OK. RETURN to service.
		No	▶ REFINISH or REPLACE the rotor as required.

TH8538A

**Parallelism**

Parallelism is the variations in the thickness of the rotor. If the two rubbing surfaces of the rotor are not parallel, the rotor may cause excessive pedal travel, a pulsating pedal, or noise.

Two methods can be used to check if the two faces of a rotor are parallel. A micrometer can be used to measure the rotor thickness at 12 points approximately 30 degrees apart and 25.4mm (1 inch) from the outer edge of the rotor.

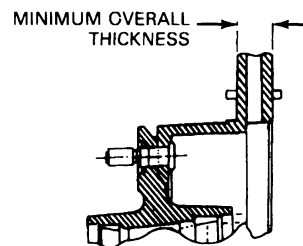
The other method is to measure the rotor on a precision lathe designed for machining disc brake rotors. Attach two dial indicators, one on each side of the rotor, so that the stylus of each indicator contacts the rubbing surface, directly opposite each other, 25.4mm (1 inch) from the outer edge of the rotor.

Zero both indicators and rotate the rotor while watching both dials. If the total readings of both indicators exceed the specified limit for parallelism, the rotor must be refinished or replaced.

Rotor Thickness

Measure the thickness of the rotor to determine if it is within the specifications listed at the end of this section. Rotor minimum (discard) thickness is also stamped on the rotor. Disc brake rotors have a minimum thickness dimension (minimum wear thickness or discard thickness). This is not the refinishing dimension.

CAUTION: Never refinish a rotor to the minimum wear or discard thickness.

DISC BRAKE ROTOR SERVICE LIMITS

H8190-A

Refinishing

Use a disc brake lathe to refinish the disc brake rotors. (Follow manufacturer's instructions.)

Replace the rotor when the overall thickness is at or below the specified minimum thickness shown on the rotor. Refer to Specifications at the end of this section for minimum (discard) rotor thickness, maximum brake surface lateral runout, thickness variation, and surface finish.

REMOVAL AND INSTALLATION

HD Pin Rail Slider Caliper, Brake Shoes and Linings

F-250-350, F-250-350 4x4, F-Super Duty Chassis Cab, Commercial Chassis and Motorhome Chassis

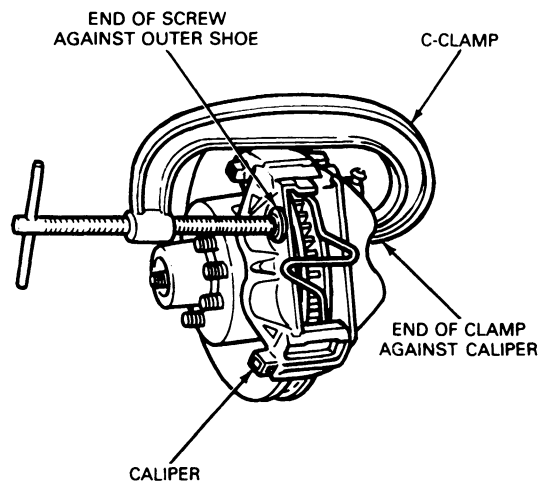
Replace shoe and lining assemblies as follows when the lining is worn to a minimum thickness of 0.794mm (1/32 inch) above the backing plate. Always replace all shoes and lining assemblies on an axle. Never service one wheel only.

Removal

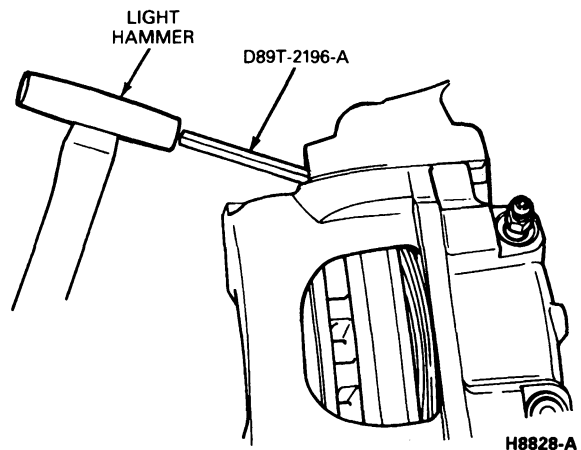
NOTE: On F-Super Duty, Commercial Chassis and Motorhome Chassis, remove the rear disc brake caliper as outlined in section 04-02. Repair as outlined in this section.

1. To avoid fluid overflow when the caliper pistons are pressed into the caliper cylinder bores, siphon or dip part of the brake fluid out of the master cylinder reservoir. Discard the removed fluid.
2. Raise the vehicle and install safety stands. Remove the front wheel and tire assembly.
3. Place an appropriate size C-clamp on the caliper as shown and tighten the clamp to bottom the caliper pistons in the cylinder bores. Remove the clamp.

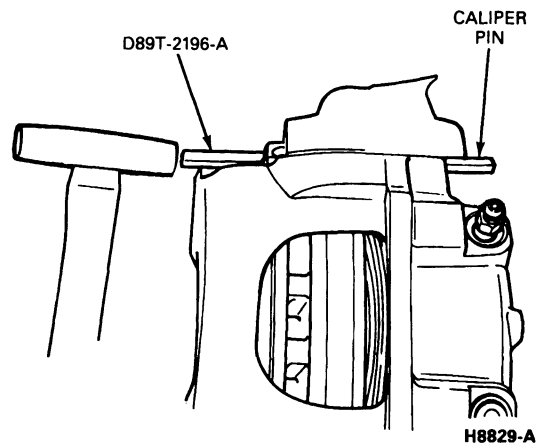
NOTE: Do not use a screwdriver or similar tool to pry piston away from the rotor.



4. Clean excess dirt from area around pin tabs.
5. Tap upper caliper pin toward inboard side until pin tabs touch the spindle face.
6. Using Caliper Pin Remover D89T-2196-A or equivalent and a light hammer, drive the pin from the caliper as follows:
 - a. Position the notched end of the tool against the caliper pin (retention tab half), at a 45 degree angle from the pin retention tabs.



- b. Tap the tool with the hammer to compress the retention tabs.



- c. As the retention tabs are compressed, move the tool to gain a straight approach to the pin, and continue tapping to drive the pin through the caliper / spindle groove.
7. Repeat removal procedure for lower pin.
 8. Remove the caliper from the rotor. If the caliper is to be removed for service, remove the brake hose from the caliper. Plug the end of the hose to prevent fluid loss and entry of air into the system. If the caliper is not to be removed, wire it up to the frame of the vehicle to avoid damage to the hose.

CAUTION: Do not let the caliper hang by the flexible hose. The hose could become stretched or twisted which can cause the hose to leak and rupture, resulting in brake failure.

9. Remove the outer and inner lining and remove the anti-rattle spring.

REMOVAL AND INSTALLATION (Continued)

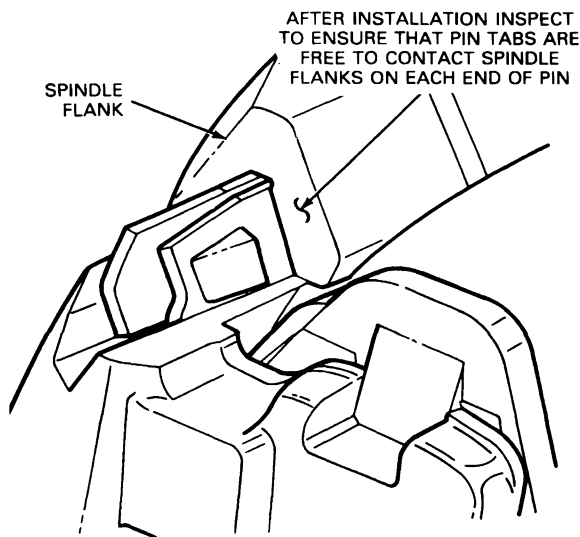
Installation

1. Install new inner and outer lining. Install anti-rattle spring. **Always replace all shoe and lining assemblies on an axle. Never service one wheel only.**

NOTE: There is a raised section at one end of each shoe so installation can be made in one direction only.

2. Lubricate the knuckle upper and lower inner pad grooves and caliper grooves with Disc Brake Caliper Slide Grease D7AZ-19590-A (ESA-M1C172-A) or equivalent. Install the caliper on a spindle making sure the mounting surfaces are free of dirt.
3. Position pin with the pin retention tabs oriented adjacent to the spindle groove.
4. Tap the pin on the outboard end with a hammer. Continue tapping the pin inward until the retention tabs on the sides of the pin contact the spindle face. Repeat procedure for the lower pin.

CAUTION: During the installation procedure do not allow the tabs of the caliper pin to be tapped too far into the spindle groove. If this happens it will be necessary to tap the other end of the caliper pin until the tabs snap into place. The tabs on each end of the caliper pin must be free to catch on the spindle flanks.



H4150-B

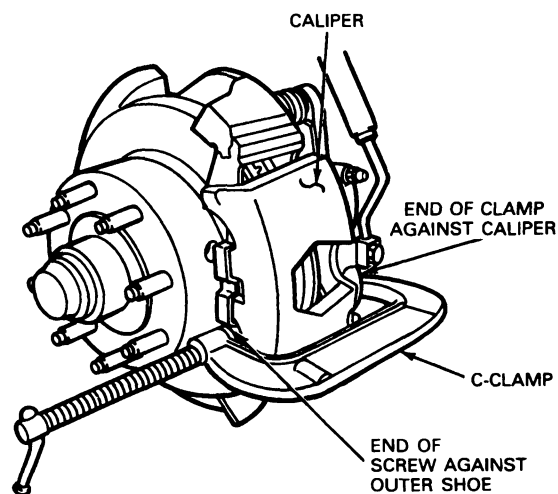
5. If removed, install the brake hose to the caliper and bleed the brakes as described in Section 06-00.
6. Install the wheel and tire assembly. Tighten the lug nuts to specification as outlined in the Specifications portion of this section.
7. Lower the vehicle, check the brake fluid level and fill as necessary. Check brakes for proper operation.

E-250-350

Removal

1. To avoid fluid overflow when the caliper pistons are pressed into the caliper cylinder bores, siphon or dip part of the brake fluid out of the master cylinder reservoir. Discard the removed fluid.
2. Raise the vehicle on a hoist and install safety stands. Remove the wheel and tire assembly.
3. Place an appropriate size C-clamp on the caliper as shown and tighten the clamp to bottom the pistons in the cylinder bores. Remove the C-clamp.

NOTE: Do not use a screwdriver or similar tool to pry the piston away from the rotor.

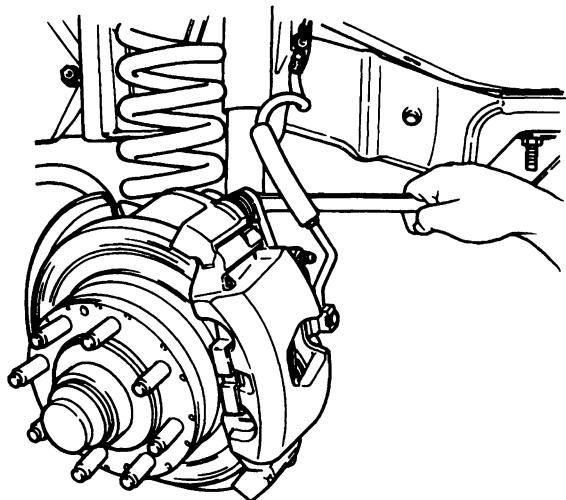


H8191-B

REMOVAL AND INSTALLATION (Continued)

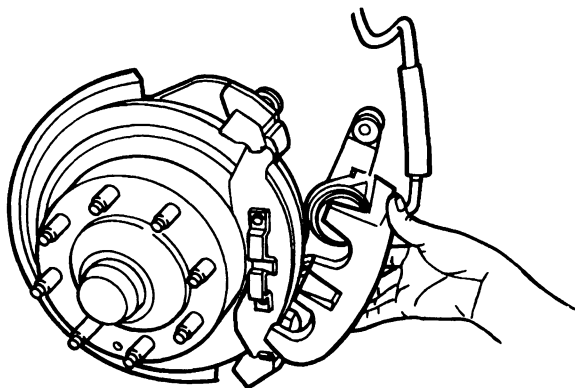
4. Remove the upper anchor bolt only.

NOTE: The caliper does not have to be completely removed to remove and install the brake shoe assemblies.



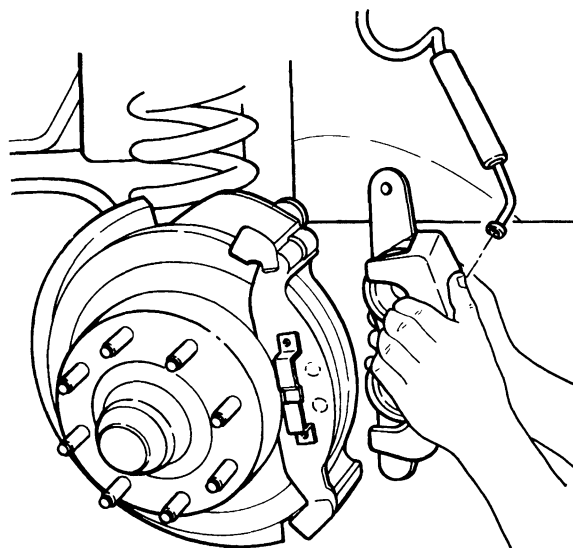
H8192-A

5. Swing the caliper down. Remove brake shoe assemblies from the spindle.



H8193-A

6. If the caliper is to be removed for repair or replacement, disconnect the brake line from the caliper. Plug the end of the line to prevent fluid loss and the entry of air into the system. Remove the lower anchor bolt and remove the caliper at this time.

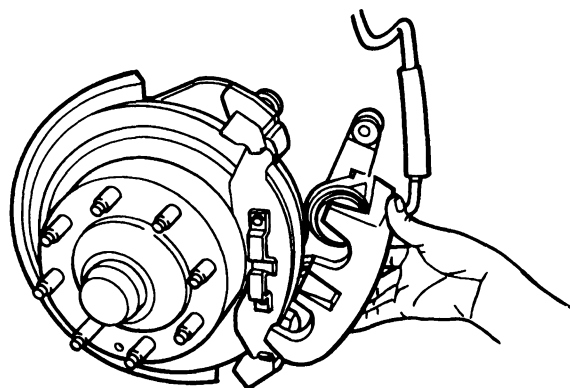


H8194-A

7. Inspect the slide pin assemblies for any damage or wear. Replace if necessary. Inspect the rubber boots over the anchor bolts. Replace if torn or deteriorated.

Installation

1. Install slide pin assemblies. Lubricate slides with Disc Brake Caliper Slide Grease D7AZ-19590-A (ESA-M1C172-A) or equivalent. Position shoes onto spindle. Rotate caliper back up into position. If the caliper was removed, position it to the spindle.

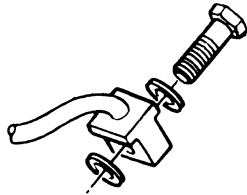


H8193-A

2. Install the anchor bolt(s) through caliper and spindle. Tighten bolts to 115-135 N·m (85-100 ft·lb).

REMOVAL AND INSTALLATION (Continued)

3. Replace both washers (each side of inlet block). Connect the fluid line. Tighten inlet block bolt to 14-20 N·m (10-15 ft·lb). Bleed the system as described in this section.



H8295-A

4. Install wheel and tire assembly. Remove the safety stands and lower the vehicle.
5. If the brakes were not bled, and caliper was not removed check the fluid level in the master cylinder reservoir and fill if required.
6. Pump the brakes several times to make sure you get a firm pedal.
7. Operate the vehicle to check brake operation.

LD Pin Rail Sliding Caliper, Brake Shoes and Linings

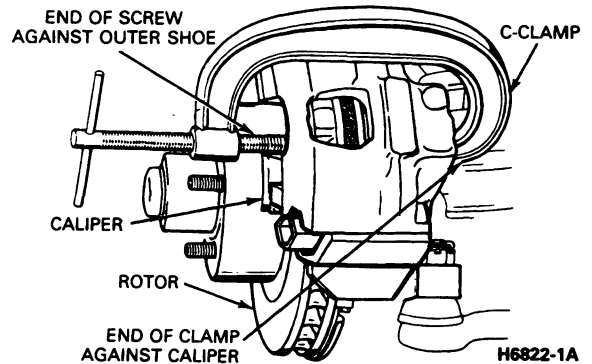
F-150 4x2 and 4x4, E-150 and Bronco

Removal

Replace shoe and lining assemblies as follows when the lining is worn to a minimum thickness of 1.5mm (1/16 inch) above the shoe plate. **Always replace all shoe and lining assemblies on an axle. Never service one wheel only.**

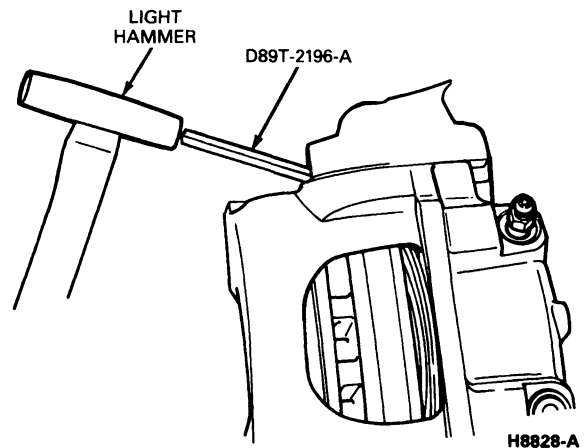
1. To avoid fluid overflow when the caliper piston is pressed into the caliper cylinder bores, siphon or dip part of the brake fluid out of the master cylinder reservoir. Discard the removed fluid.
2. Raise the vehicle and install safety stands. Remove a front wheel and tire assembly.
3. Place an eight-inch C-clamp on the caliper and tighten the clamp to bottom the caliper piston in the cylinder bore. Remove the clamp.

NOTE: Do not use a screwdriver or similar tool to pry piston away from the rotor.



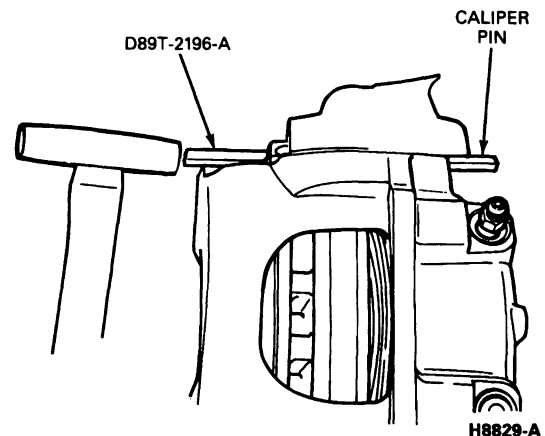
H6822-1A

4. Clean excess dirt from area around pin tabs.
5. Tap upper caliper pin toward inboard side until pin tabs touch the spindle face.
6. Using Caliper Pin Remover D89T-2196-A or equivalent, drive the pin from the caliper as follows:
 - a. Position the notched end of the tool against the caliper pin (retention tab half), at a 45 degree angle from the pin retention tabs.



H8828-A

- b. Tap the tool with the hammer to compress the retention tabs.



H8829-A

REMOVAL AND INSTALLATION (Continued)

- c. As the retention tabs are compressed, move the tool to gain a straight approach to the pin, and continue tapping to drive the pin through the caliper / spindle groove.

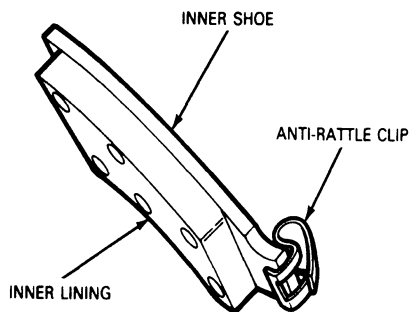
7. Repeat removal procedure for lower pin.
8. Remove the caliper from the rotor. If the caliper is to be removed for service, remove the brake hose from the caliper. Plug the end of the hose to prevent fluid loss or entry of air into the system. If the caliper is not going to be removed, wire it up to the vehicle to avoid damage to the brake hose.

CAUTION: Do not let the caliper hang by the flexible hose. The hose could become stretched or twisted which can cause the hose to leak and rupture, resulting in brake failure.

9. Remove the outer lining. Remove the anti-rattle clips and remove the inner lining.

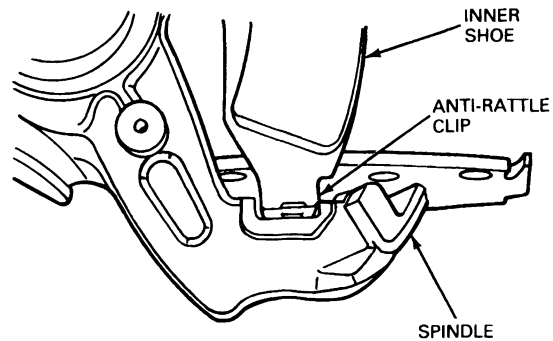
Installation

1. Lubricate the knuckle upper and lower inner pad grooves and caliper grooves with Disc Brake Caliper Slide Grease D7AZ-19590-A (ESA-M1C172-A) or equivalent.
2. Place a new anti-rattle clip on the **lower end** of the inner shoe. Position tabs on the clip and fully seat clip.



H2546-1B

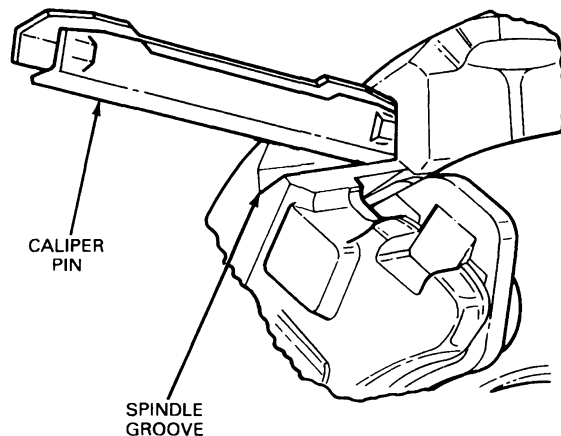
3. Position the inner shoe and anti-rattle clip in the shoe abutment of the spindle, with the anti-rattle clip tab against the shoe abutment and the loop-type spring away from the rotor. Compress the anti-rattle clip and slide the upper end of the shoe in position.



H8830-A

4. Install the outer shoe into the caliper.
5. Install the caliper on the spindle, making sure the mounting surfaces are free of dirt and corrosion.
6. Position pin with the pin retention tabs oriented adjacent to the spindle groove.

CAUTION: Be sure to install the caliper pins so the retention tabs will be in contact with the spindle, not the caliper. When the upper pin is properly positioned, the retention tabs will be at the top, against the spindle. When the lower pin is properly positioned, the retention tabs will be at the bottom, also in contact with the spindle.

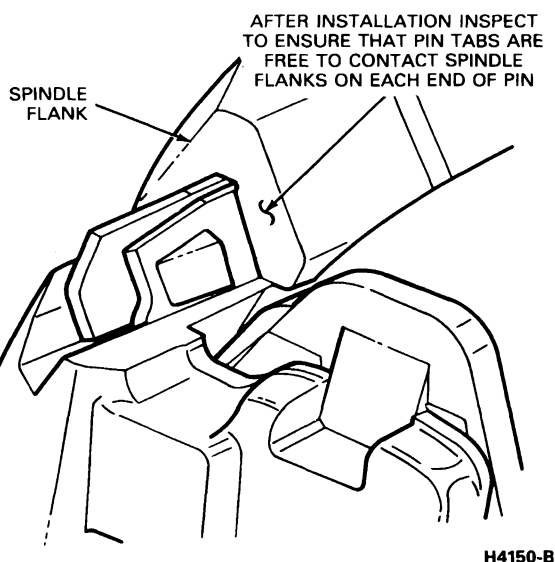


H4149-B

REMOVAL AND INSTALLATION (Continued)

7. Tap the pin on the outboard end with a hammer. Continue tapping the pin inward until the retention tabs on the sides of the pin contact the spindle face. Repeat procedure for the lower pin.

CAUTION: During the installation procedure do not allow the tabs of the caliper pin to be tapped too far into the spindle groove. If this happens it will be necessary to tap the other end of the caliper pin until the tabs snap into place. The tabs on each end of the caliper pin **MUST** be free to catch on the spindle flanks.



8. If removed, install the brake hose to the caliper and bleed the brakes as described in Section 06-00.
9. Install the wheel and tire assembly. Tighten the lugnuts to specification as outlined in the Specifications portion of this section.
10. Lower the vehicle, check the brake fluid level and fill as necessary. Check brakes for proper operation.

5. Check the condition of the rotor as described under Disc Brake Rotor in the Diagnosis and Testing portion of this section.
6. Remove inner bearing cone and seal. Discard the seal.
7. On F-Super Duty the rotor can be removed from the hub by removing the ten (10) M 12 x 1.75 x 32.50mm E-18 External Torx machine screws.

Installation

1. If installing a new hub and rotor, remove the protective coating or any dirt or grease deposits with degreaser. On F-Super Duty series vehicles the machine screw threads must be coated with a suitable adhesive before attaching the rotor to the hub. Tighten screws to 100-120 N·m (74-89 ft·lb).
2. Thoroughly clean the wheel bearings. Inspect for damage or wear. Refer to the appropriate section in Group 04 for bearing diagnosis. Replace if necessary.
3. Pack the inner and outer bearing cone with a lithium-base grease, Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent.
4. Install the inner bearing cone and seal as described in Section 04-01A, 4x2, or Section 04-01B, 4-Wheel Drive for procedures.
5. Install the hub and rotor on the spindle.
6. Install the outer bearing cone, washer, and nut.
7. Adjust bearing end play and install the locknut, cotter pin and dust cap as described in Section 04-01A.
8. Install the caliper as described in this section.
9. Install the wheel and tire assembly. Tighten the lugnuts to the proper torque, as listed in the Specifications portion of this section.
10. Lower the vehicle. Check brakes for proper operation.

Disc Brake Hub and Rotor

Removal

1. Raise the front of the vehicle and install safety stands.
2. Remove the wheel and tire assembly.
3. Remove the caliper assembly from the rotor and hold it out of the way with wire. Refer to Caliper Removal in this section.
4. Remove the dust cap, cotter pin, locknut, bearing retaining nut, washer, and outer bearing, and remove the rotor from the spindle. Refer to the appropriate axle section in Group 05 for the vehicle being serviced.

Hydraulic Line Repair

When replacing hydraulic brake tubing, hoses, or connectors, tighten all connections securely. After replacement, bleed the brake system at the wheel cylinders and at the booster (if equipped).

Brake Tube

1. If a section of the brake tube is damaged, replace it with tubing of the same type, size, shape, and length.
NOTE: Do not use copper tubing in the hydraulic system. Be careful not to kink or crack the tubing when bending it to fit the frame or rear axle.
2. Double flare the brake tubing Section 06-00, to provide good leak-proof connections.
3. Always clean the inside of a new brake tube with clean isopropyl alcohol after making the flares prior to installation.

REMOVAL AND INSTALLATION (Continued)

Brake Hose

Replace a flexible brake hose if it shows signs of softening, cracking, or other damage.

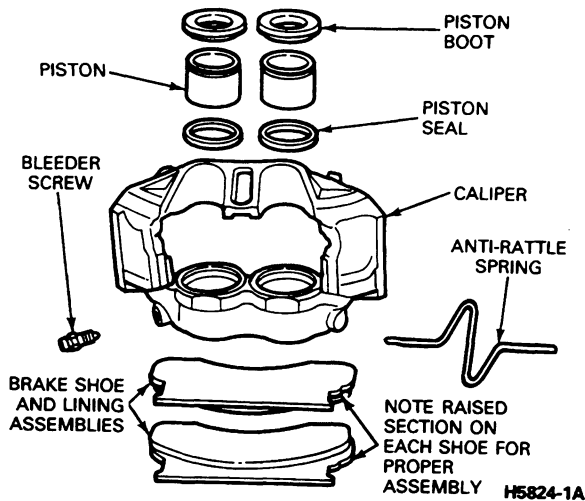
1. When installing a new brake hose, position the hose to avoid contact with other vehicle parts.
2. Whenever a brake hose is disconnected from a wheel cylinder or brake caliper, install a **new copper washer connecting the hose.**

DISASSEMBLY AND ASSEMBLY

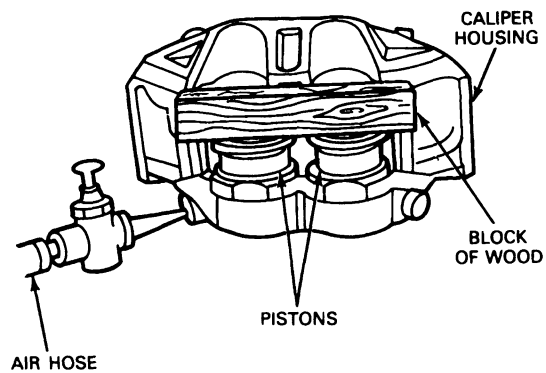
Disc Brake Caliper, HD Rail Sliding Caliper

Disassembly

1. Disconnect the flexible brake hose and plug the end to prevent brake fluid leakage. Remove the caliper assembly as described in this section.
2. Remove the brake shoe and lining assemblies and anti-rattle spring.
3. Drain the fluid from the cylinders.
4. Secure the caliper assembly in a vise.



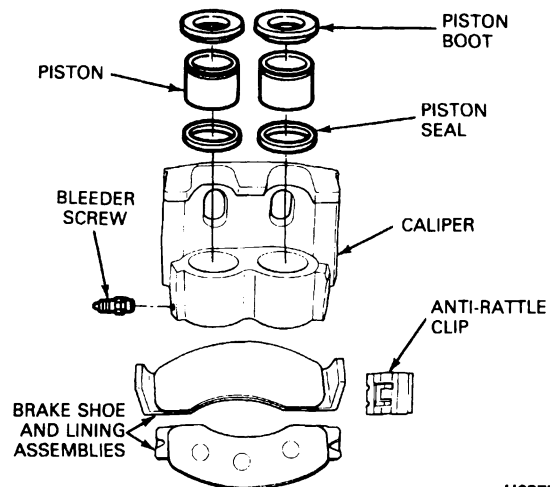
5. Place a block of wood between the caliper bridge and the cylinders, and apply low pressure air to the fluid port in the caliper with an air nozzle equipped with Rubber Tipped Nozzle TOOL-7000-DD to remove the pistons. The pistons will be forced out to the wood block.



H5069-A

6. Remove the wood block, and remove the pistons.
7. Remove and discard the piston seals and boots.
8. If the caliper assembly is leaking, replace the piston assemblies. If the cylinder bores are excessively scored or corroded, replace the caliper.

NOTE: Do not hone the cylinder bores. Piston assemblies are not available for honed cylinder bores.



H6275-1A

Assembly

CAUTION: Never re-use piston seals and dust boots. Install a new set each time the caliper is assembled.

1. Lubricate new piston seals with Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent and install into cylinder bore seal grooves.
2. Apply a film of clean brake fluid to the cylinder bores.
3. Lubricate the retaining lips of the dust boots with clean brake fluid and install into the boot retaining grooves in the cylinder bores.
4. Apply a film of clean brake fluid to the pistons.

DISASSEMBLY AND ASSEMBLY (Continued)

5. Insert the pistons into the dust boots and start them into the cylinders by hand until they are beyond the piston seals. **Be careful not to damage or dislodge the piston seal.**
6. Place a wood block over one piston and press the piston into the cylinder being careful not to cock the piston in the cylinder. Install the second piston in the same manner. Seat boots correctly.
7. Install the shoe and lining assemblies and anti-rattle spring in the caliper assembly. Place the caliper assembly on the spindle and install the caliper pins, as outlined in this section.
8. Install the flexible brake hose with new copper washers and tighten to specification listed at the end of this section.
9. Bleed the brake system as described in Section 06-00. **Do not move the vehicle until a firm brake pedal is obtained.**

Disc Brake Caliper, Sliding Caliper, LD

NOTE: Do not use a screwdriver or any similar tool to pry piston into or out of the bore to prevent chipping or scuffing damage to the phenolic piston.

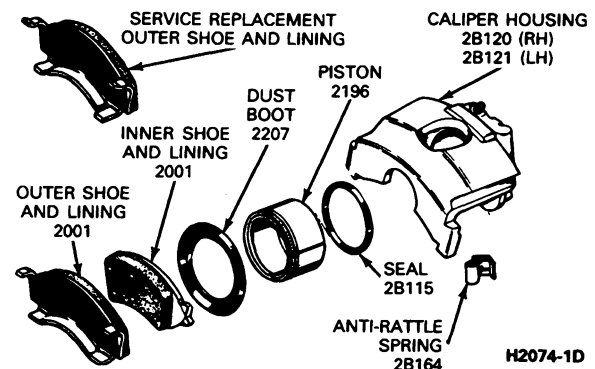
Disassembly

1. Remove the caliper assembly from the vehicle as outlined in Caliper Removal.
2. Remove outer brake shoe to avoid damage to lining material. Substitute shoe with a piece of wood of similar size and shape, or use a worn out shoe and lining assembly.
3. Place a cloth over the piston before applying air pressure to prevent damage to the piston.
4. Apply air pressure to the fluid port in the caliper with an air nozzle equipped with Rubber-Tipped Nozzle TOOL-7000-DD as shown previously to remove the piston.
5. If the piston is seized and cannot be forced from the caliper, tap lightly around the piston while applying air pressure.

NOTE: Use care because the piston can develop considerable force from pressure build-up.

6. Remove the dust boot from the caliper assembly.
7. Remove the rubber piston seal from the cylinder, and discard it.

NOTE: Do not remove the steel ring from the piston.

Disc Brake Caliper, Disassembled, LD Sliding Caliper**Cleaning and Inspection**

Clean all metal parts with isopropyl alcohol. Then, clean out and dry the grooves and passageways with compressed air. Make sure that caliper bore and component parts are thoroughly clean and dry prior to assembly.

Check the cylinder bore and piston for excessive scoring or corrosion.

Assembly

1. Apply a film of clean brake fluid to the new caliper piston seal, and install it in the cylinder bore. Be sure the seal does not become twisted but is firmly seated in the groove.
2. Install a new dust boot by setting the flange squarely in the outer groove of the caliper bore.
3. Coat the piston with brake fluid, and install the piston in the cylinder bore. Spread the dust boot over the piston as it is installed. Seat the dust boot in the piston groove, behind the pressed on steel ring.
4. Install the lining assemblies and anti-rattle spring in the caliper assembly. Place the caliper assembly on the spindle and install the caliper pins, as outlined in this section.
5. Install the flexible brake hose with new copper washers and tighten to specification listed at the end of this section.
6. Bleed the brake system as outlined in Section 06-00. **Do not move the vehicle until a firm brake pedal is obtained.**

ADJUSTMENTS

WARNING: DO NOT INHALE THE DUST FROM BRAKES, CLUTCHES OR ASSOCIATED COMPONENTS. INHALATION OF DUST FROM THESE COMPONENTS COULD BE INJURIOUS TO YOUR HEALTH. COMPRESSED AIR OR BRUSHES MUST NOT BE USED TO CLEAN BRAKES, BRAKE DRUMS, CLUTCHES OR ASSOCIATED COMPONENTS. A VACUUM CLEANER EQUIPPED FOR THIS PURPOSE SHOULD BE CAREFULLY USED TO REMOVE ANY DUST (ROTUNDA MODEL 091-00001). ADHERENT DUST SHOULD BE REMOVED WITH A DAMP RAG. ANY DUST SHOULD BE CONTAINED IN A SEALED AND LABELED BAG FOR DISPOSAL. WEAR AN APPROVED HIGH EFFICIENCY CARTRIDGE OR AIR LINE RESPIRATOR AND USE EXTRA CAUTION TO AVOID BREATHING THIS DUST.

Disc Brake Shoe Adjustment

The disc brake assembly is designed so that it is inherently self-adjusting and requires no manual adjustment.

Automatic adjustment for lining wear is achieved by the piston sliding outward in the cylinder bore. The piston assumes a new position in the cylinder and maintains the correct adjustment.

Hydraulic System Bleeding

When any part of the hydraulic system has been disconnected for repair or replacement, air may get into the lines and cause spongy pedal action. This requires the bleeding of the hydraulic system after it has been properly connected to be sure all air is expelled from the brake cylinders and lines. The hydraulic system can be bled manually or with pressure bleeding equipment such as the Rotunda Brake Bleeder model 104-00064 or equivalent.

When bleeding the brake system, bleed the master cylinder first, then bleed one brake cylinder at a time, beginning at the cylinder with the longest hydraulic line first. This will be the right rear brake, then bleed the left rear brake. Next, bleed the rear Anti-lock Brake System Valve if applicable. Then bleed the right front brake, finally the left front brake. Keep the master cylinder reservoir filled with the specified brake fluid during the bleeding operation. Never use brake fluid which has been drained from the hydraulic system.

Manual Bleeding

Bleed the front and rear hydraulic brake systems separately. Bleed the longest line first on each system. **DO NOT allow the reservoir to run dry during the bleeding operation. Keep the master cylinder reservoirs filled with Ford Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent DOT 3 fluid. Never reuse the fluid that has been drained from the hydraulic system.**

WARNING: BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

1. On the master cylinder, loosen the master cylinder-to-hydraulic line fitting.
2. Wrap a shop cloth around the tubing below the fitting to absorb escaping brake fluid.
3. Push the brake pedal down slowly to the floor of the cab. This will force air trapped in the master cylinder to escape at the fitting.
4. Hold the pedal down and tighten the fitting. Release the brake pedal.

NOTE: Do not release the brake pedal until the fitting is tightened or air will re-enter the master cylinder.

5. Repeat this procedure until air ceases to escape at the fitting.
6. Place a 3/8-inch box wrench on the bleeder fitting on the brake wheel cylinder. Attach a rubber drain tube to the bleeder fitting making sure the end of the tube fits snugly around the bleeder fitting.
7. Submerge the free end of the tube in a container partially filled with clean brake fluid. Loosen the bleeder fitting approximately three-quarters of a turn.
8. Slowly push the brake pedal all the way down. Close the bleeder fitting, and return the pedal to the fully-released position. Repeat this operation until air bubbles no longer appear at the submerged end of the bleeder tube.
9. When the fluid is completely free of air bubbles, close the bleeder fitting and remove the bleeder tube.
10. Repeat this procedure at the brake wheel cylinder on the opposite side. Refill the master cylinder to the fill line on the reservoir after each wheel cylinder is bled. When the bleeding operation is complete, fill the master cylinder to within 3mm (1/8 inch) from the top of the reservoir chambers.

ADJUSTMENTS (Continued)**Pressure Bleeding**

Be sure the bleeder tank contains enough of the specified brake fluid to complete the bleeding operation. Charge the tank with approximately 69-206 kPa (10-30 psi). **Never exceed 345 kPa (50 psi).** **Never use brake fluid that has been drained from the hydraulic system. Bleed the longest lines first.**

WARNING: BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

1. Clean all dirt from the master cylinder reservoir cap.
2. Remove the master cylinder reservoir cap and fill the master cylinder reservoir with the specified brake fluid. Install the pressure bleeder adapter tool on the master cylinder, and attach the bleeder tank hose to the fitting on the adapter.

Master cylinder pressure bleeder adapter tools are available from the manufacturers of pressure bleeding equipment. Follow the manufacturer's instructions when installing the adapter.

3. Open the valve on the bleeder tank to admit pressurized brake fluid to the master cylinder reservoir.
4. Place a 3/8-inch box wrench on the bleeder fitting on the right rear brake wheel cylinder or caliper. Attach a bleeder tube snugly to the bleeder fitting.
5. Submerge the free end of the tube in a container partially filled with clean brake fluid, and loosen the bleeder fitting.
6. When air bubbles no longer appear in the fluid at the submerged end of the bleeder tube, close the bleeder fitting and remove the tube.
7. Repeat Steps 4 through 6 at the left rear wheel cylinder or caliper. On front brakes, bleed the right front caliper first.
8. When the bleeding operation is completed, close the bleeder tank valve and remove the tank hose from the adapter fitting.
9. Remove the pressure bleeder adapter tool. Fill the master cylinder reservoirs with the specified brake fluid to within 3mm (1/8 inch) from the top of the reservoir chambers. Install the master cylinder cover.

SPECIFICATIONS**TORQUE LIMITS**

Description	N-m	Ft-Lbs
Brake Hose to Caliper Attaching Bolt Except E-250-350	23-34	17-25
Caliper Anchor Bolts, E-250-350	115-135	85-100
Fluid Inlet Block Bolt, E-250-350	14-20	10-15
Screws, Rotor-to-Hub, F-Super Duty	100-120	74-89

TORQUE LIMITS — HYDRAULIC TUBE / LINE NUTS (FT-LBS)

Thread Size	N-m	Ft-Lbs
3/8-24	14-20	10-15
7/16-24	14-20	10-15
1/2-20	14-23	10-17
9/16-18	14-23	10-17

All hydraulic line connections (nuts) must be tightened to the specified value and free of fluid leakage.

ROTOR REPAIR DIMENSIONS

Vehicle	Minimum Rotor Thickness (Discard Thickness)		Rotor Thickness Maximum Variation		Brake Surface Lateral Runout (maximum)		Rotor Surface Finish	
	mm	Inch	mm	Inch	mm	Inch	mm	Micro-Inches
E-150, F-150 (4x2)	28.50	1.12	0.013	0.0005	0.08	0.003	.38-2.0	15-80
F-150, Bronco (4x4) (Integral)	28.50	1.12	0.013	0.0005	0.08	0.003	.38-2.0	15-80
F-150, Bronco (4x4) (2-Piece)	28.50	1.12	0.018	0.0007	0.13	0.005	.38-2.0	15-80
E-250-350, F-250-350 (4x2) SRW (Integral)	30.00	1.18	0.018	0.0007	0.08	0.003	.38-2.0	15-80
F-350, E-350 (4x2) DRW (2-Piece)	30.00	1.18	0.025	0.0010	0.13	0.005	.38-2.0	15-80
F-250-350, (4x4) SRW	30.00	1.18	0.025	0.0010	0.13	0.005	.38-2.0	15-80

(Continued)

SPECIFICATIONS (Continued)

ROTOR REPAIR DIMENSIONS (Cont'd)

Vehicle	Minimum Rotor Thickness (Discard Thickness)		Rotor Thickness Maximum Variation		Brake Surface Lateral Runout (maximum)		Rotor Surface Finish	
	mm	Inch	mm	Inch	mm	Inch	mm	Micro-Inches
F-350 (4x4) DRW	30.00	1.18	0.025	0.0010	0.13	0.005	.38-2.0	15-80
F-Super Duty Chassis Cab, Commercial and Motorhome Stripped Chassis DRW	36.3	1.43	0.025	0.0010	0.20	0.008	.38-2.0	15-80

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WHEEL TORQUE SPECIFICATIONS

Vehicle	Wheel	Bolt Size	Torque	
			N-m	Ft-Lbs
E-150, F-150, Bronco	5-Lug Wheel	1 / 2-20	135	100
E-250, E-350, F-250, F-350	8-Lug Wheel	9 / 16-18	190	140
F-Super Duty and F-Super Duty Stripped Chassis Vehicles	10-Lug Wheel	9 / 16-18	190	140

NOTE: Torque specifications are for clean, dirt-and-paint-free dry bolt and nut threads. Never use oil or grease on studs or nuts.

TF3943A

SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
TOOL-4201-C Dial Indicator with Bracketry	 TOOL-4201-C
TOOL-7000-DE Rubber Tipped Nozzle	 TOOL-7000-DE

Tool Number	Description
D89T-2196-A	Hydraulic Caliper Pin Remover

SECTION 06-05 Brake, Parking

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DISASSEMBLY AND ASSEMBLY (Cont'd.)	
Cable Actuated Rear Wheel Parking Brake	06-05-20	Transmission Mounted Parking Brake	06-05-15
Cable Actuated Transmission-Mounted Parking Brake	06-05-20	REMOVAL AND INSTALLATION	
DESCRIPTION AND OPERATION		Front Parking Brake Cable Assembly to Equalizer.....	06-05-12
Cable Actuated Rear Wheel Parking Brake	06-05-1	Parking Brake Control	06-05-11
Cable Actuated Transmission-Mounted Parking Brake, All F-Super Duty Series Vehicles	06-05-2	Parking Brake Equalizer to Rear Wheel Cable	06-05-14
DIAGNOSIS AND TESTING		Transmission-Mounted Parking Brake Assembly, F-Super Duty Series Vehicles	06-05-14
Diagnosis Guide	06-05-10	SPECIAL SERVICE TOOLS	06-05-22
DISASSEMBLY AND ASSEMBLY		SPECIFICATIONS	06-05-22
Brake Shoes	06-05-17	VEHICLE APPLICATION	06-05-1

VEHICLE APPLICATION

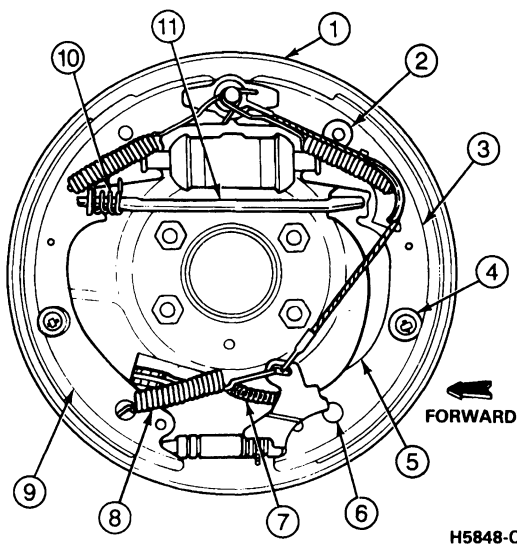
Bronco, E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab, Commercial Chassis and Motorhome Chassis Vehicles

DESCRIPTION AND OPERATION

Cable Actuated Rear Wheel Parking Brake

On F-150-250-350, E-150-250-350 and Bronco, each rear wheel brake assembly contains a cable actuated parking brake assembly. F-150-250-350 and Bronco use a release handle which is built into the control assembly.

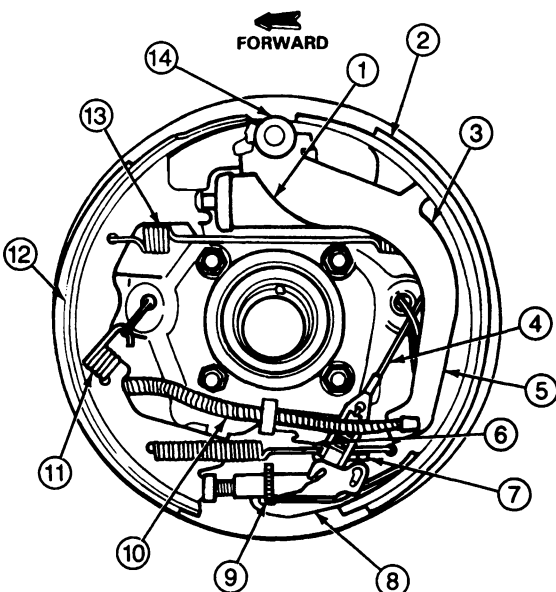
PARKING BRAKE ASSEMBLY — E-150, F-150 AND BRONCO



Item	Part Number	Description
1	2211	Rear Brake Backing Plate Assembly
2	Ref.	Parking Lever Pivot Point
3	2200	Secondary Shoe and Lining Assembly
4	2A094	Brake Shoe Hold-down Assembly
5	2A637	Parking Brake Lever
6	Ref.	Pivot Hook
7	2A809 2A635	Parking Brake Cable, Left Parking Brake Cable, Right
8	2049	Automatic Adjuster Spring
9	2200	Primary Shoe and Lining Assembly
10	2A601	Parking Brake Link Spring
11	2A642	Parking Brake Link

DESCRIPTION AND OPERATION (Continued)

PARKING BRAKE ASSEMBLY
E-250-350, F-250-350



LEFT SIDE

H7425-D

Item	Part Number	Description
1	2262 2261	Brake Wheel Cylinder, Left Brake Wheel Cylinder, Right
2	2001	Secondary Shoe and Lining Assembly
3	2A719	Cable Guide (Shows Location Only)

(Continued)

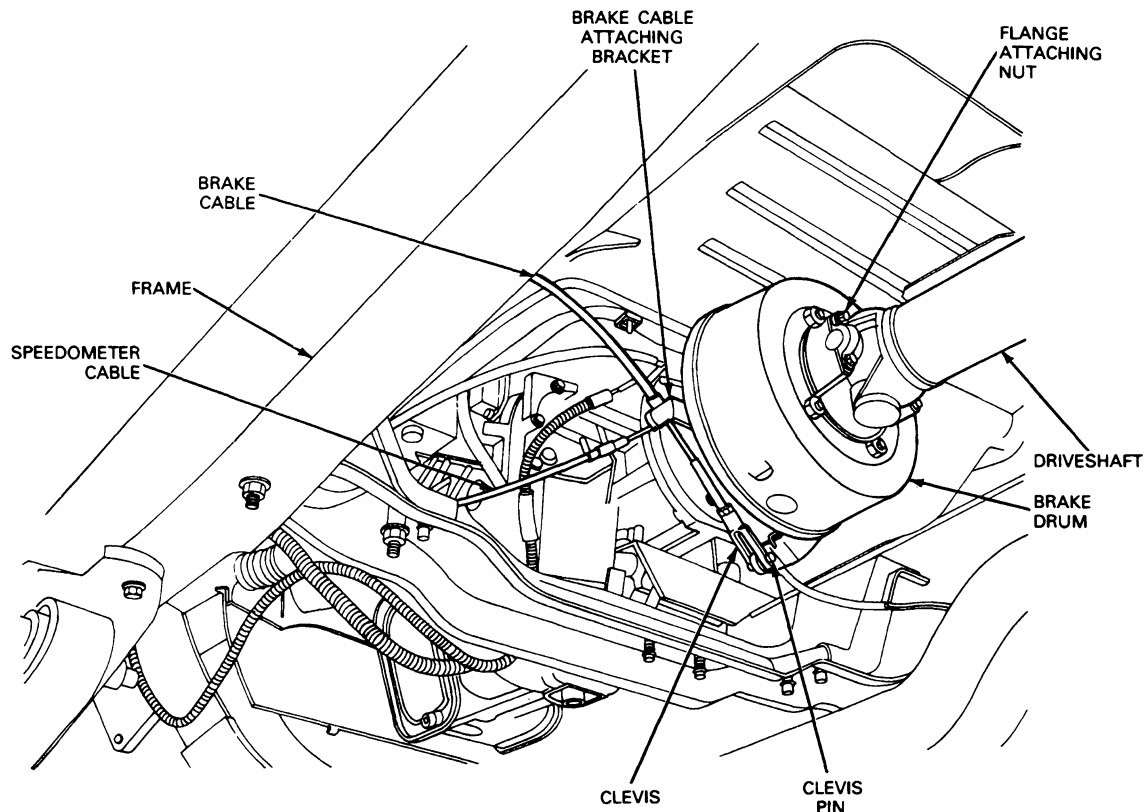
Item	Part Number	Description
4	2A178	Self-Adjuster Cable
5	2A638 2A637	Parking Brake Lever, Left Parking Brake Lever, Right
6	Ref.	Cable Retainer Bracket
7	2049 or 2296	Over-Travel Spring
8	2A176	Adjusting Lever
9	Ref.	Adjusting Screw Slots
10	2A809 2A635	Parking Brake Cable, Left Parking Brake Cable, Right
11	2068	Brake Shoe Hold-down Spring
12	2001	Primary Shoe and Lining Assembly
13	2035	Retracting Spring
14	2A142 or 2A642	Anchor Pin Plate

E-150-250-350 vehicles use a push on-push off type release mechanism. Once the parking brakes are applied, simply push down on the pedal again to release. These control assemblies are self-adjusting and require no adjustments.

Cable Actuated Transmission-Mounted Parking Brake, All F-Super Duty Series Vehicles

A transmission mounted manually operated parking brake is used on F-Super Duty vehicles.

It is mounted to the transmission extension housing and it incorporates a case assembly and a cable actuated 9x3-inch Bendix brake assembly.

DESCRIPTION AND OPERATION (Continued)**Parking Brake Assembly, F-Super Duty**

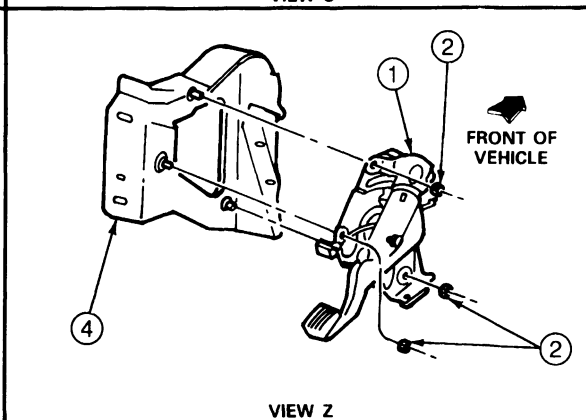
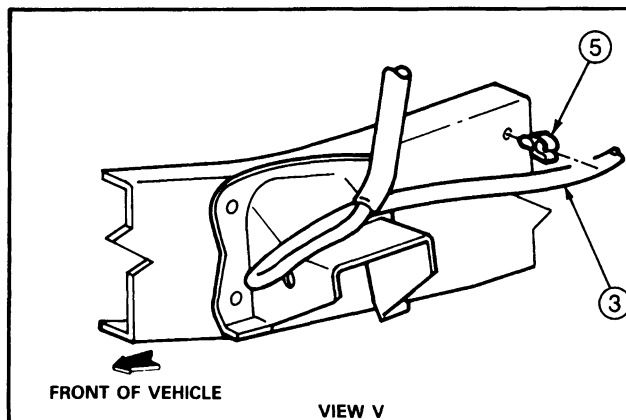
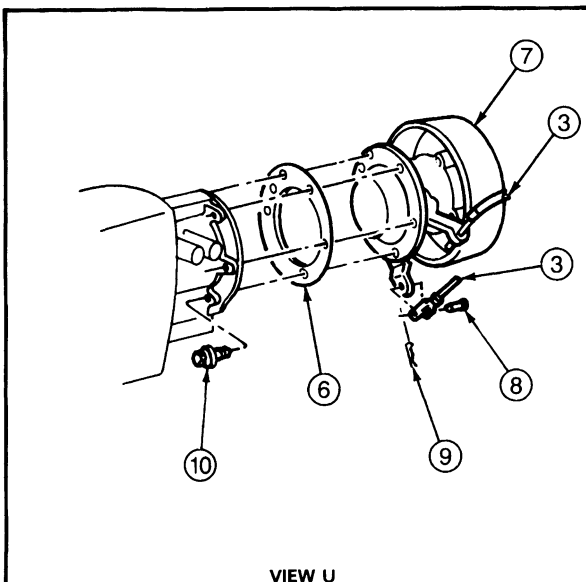
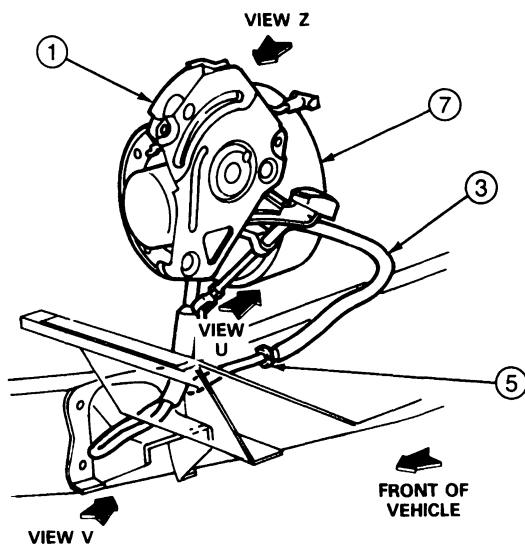
H5982-2A

The case assembly consists of opposed mounted roller bearings, companion flange and mainshaft assembly installed in a one-piece aluminum housing. On F-Super Duty Motorhome vehicles only, the speedometer and speedometer cable assembly are driven by the speedometer drive gear, splined to the mainshaft. The case assembly has its own lubrication supply, separate from the transmission. The parking brake is applied and released by a parking brake pedal on F-Super Duty Chassis Cab and Motorhome Chassis Vehicles. On Commercial Stripped Chassis Vehicles an Orscheln lever is used.

The parking brake system on E-350 Commercial and Motorhome vehicles is similar in design and service to that on other vehicles. The control assembly is the same as F-150-250-350 vehicles, and should be serviced in the same manner. The cable assemblies are in the same as the E-150-250-350 vehicles, except for front cable lengths, the parking brake cable support assembly and the clevis which is integral to the cable.

DESCRIPTION AND OPERATION (Continued)

Parking Brake Assembly, F-Super Duty Chassis Cab



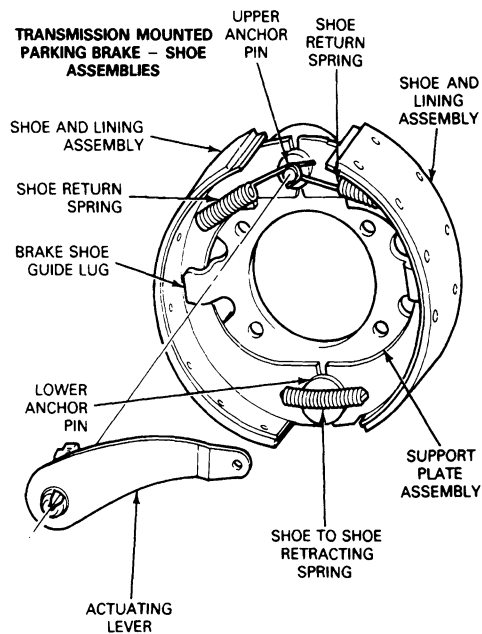
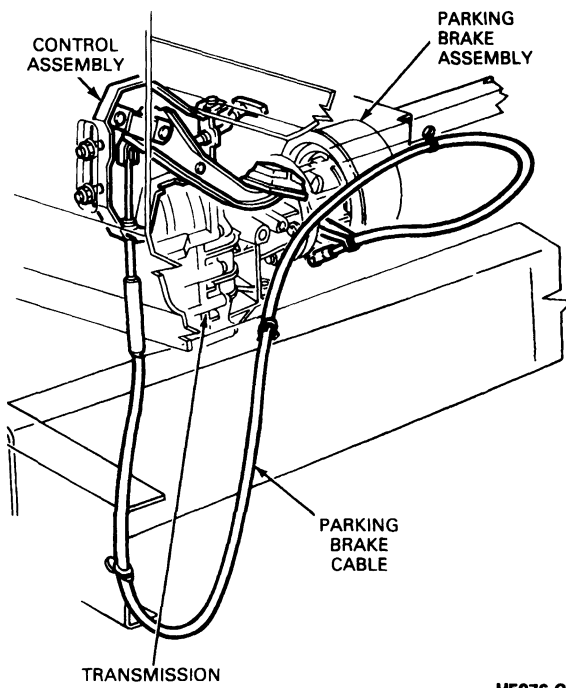
H8178-A

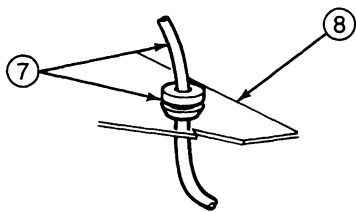
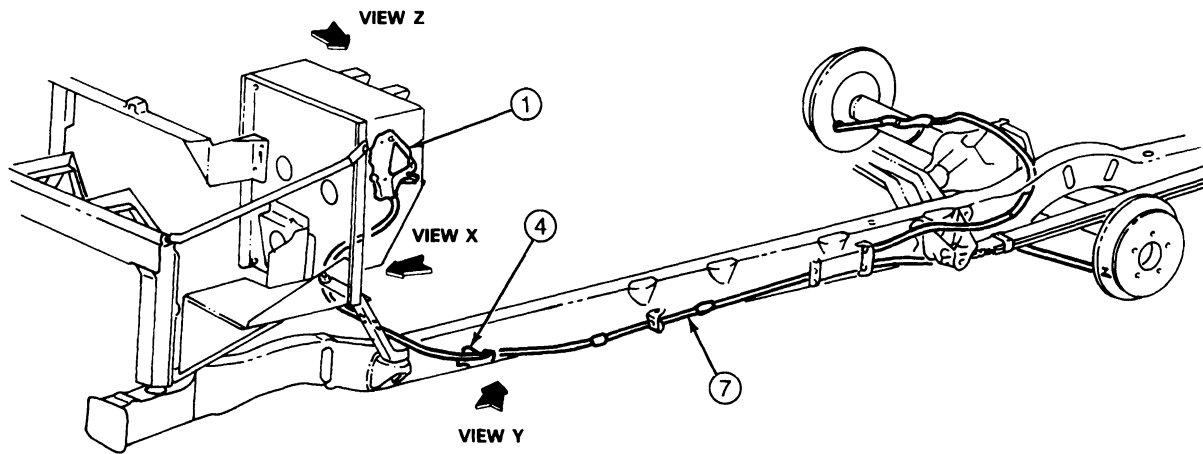
Item	Part Number	Description
1	2780	Control Assembly
2	N620481-S2	Nut M8 x 1.25 Hex Flange 17-23 N·m (13-17 Ft-Lb)
3	2853	Cable Assembly, Front
4	3B139	Steering Column Support
5	N802768-S	Clip, Push in Type

(Continued)

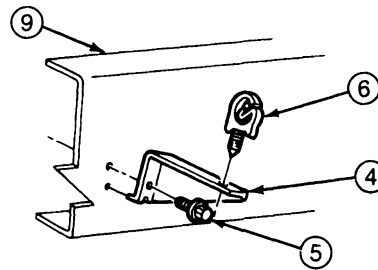
Item	Part Number	Description
6	7086	Gasket
7	2598	Brake Assembly, Parking
8	76007-S8	Clevis Pin
9	352358-S2	Pin, Self-Locking
10	N605804-S100	Bolt M10 x 45 Hex Flange 34-58 N·m (25-43 Ft-Lb)

TH8178A

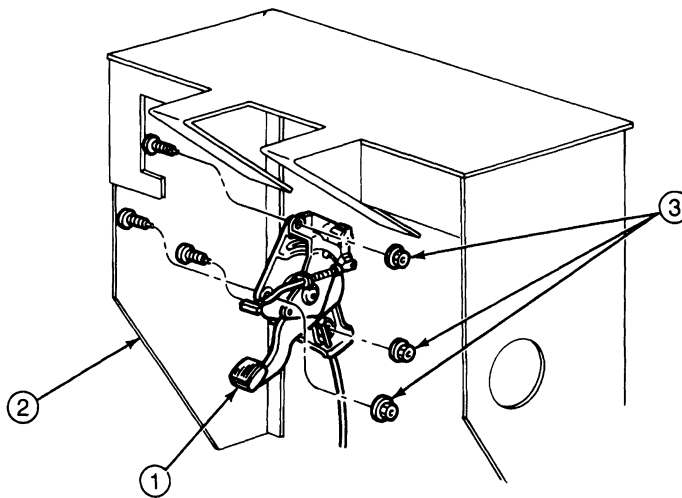
DESCRIPTION AND OPERATION (Continued)**Parking Brake Assembly, F-Super Duty
Motorhome Chassis**

DESCRIPTION AND OPERATION (Continued)**Parking Brake Assembly, E-350 Motorhome and Commercial Chassis Vehicles**

VIEW X



VIEW Y



VIEW Z

H8297-A

Item	Part Number	Description
1	2780	Lever, Parking Brake
2	3G656	Plate, Steering Column Support
3	N620481	Nut 17-23 N-m (13-17 Ft-Lb)

(Continued)

Item	Part Number	Description
4	2649	Bracket Assembly, Parking Brake Cable Support (Commercial Stripped Chassis Only)

(Continued)

DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
5	381877	Screw 5-7 N-m (44-62 In-Lb) (Commercial Stripped Chassis Only)
6	N802768	Clip (Commercial Stripped Chassis Only)

(Continued)

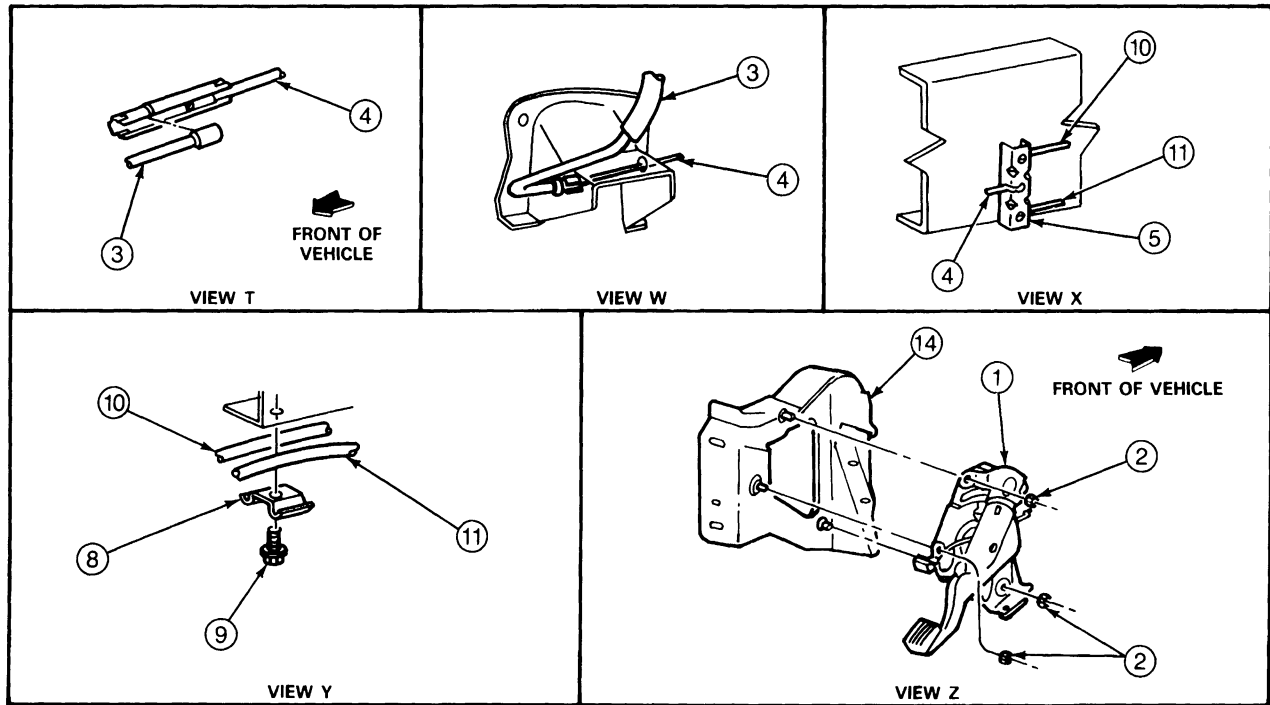
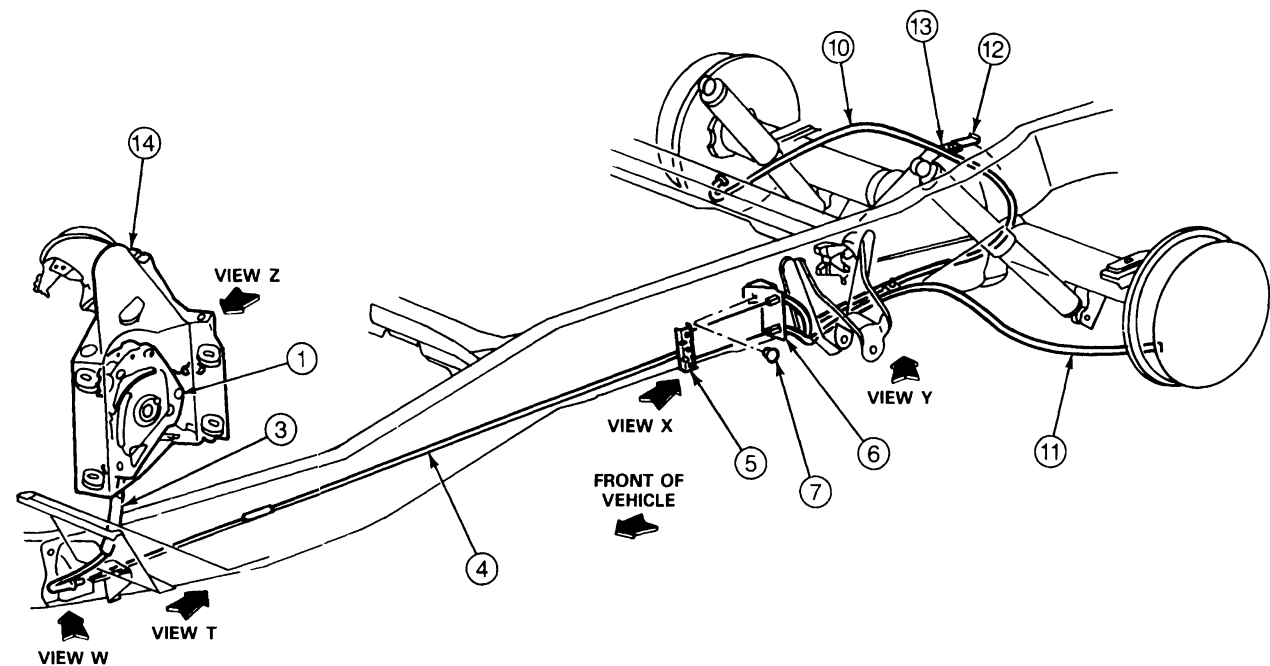
Item	Part Number	Description
7	2853	Cable Assembly, Front Parking Brake
8	2A266	Bracket Assembly, Brake Pedal Plate
9	5005	Vehicle Frame Assembly (Reference)

TH8297A

On F-150-250-350, E-150-250-350 and Bronco, the manually operated parking brake pedal cable is routed to the equalizer lever which connects to the parking brake lever assembly in each rear wheel, through the equalizer assembly and brake cables.

DESCRIPTION AND OPERATION (Continued)

Parking Brake System, Bronco and F-150-250-350



H8180-A

Item	Part Number	Description
1	2780	Control Assembly
2	N620481-S2	Nut M8 x 1.25 Hex Flange 17-23 N·m (13-17 Ft·Lb)
3	2853	Cable Assembly, Front

(Continued)

Item	Part Number	Description
4	2A793	Cable Assembly, Intermediate
5	2A602	Equalizer
6	2530	Bracket

(Continued)

DESCRIPTION AND OPERATION (Continued)

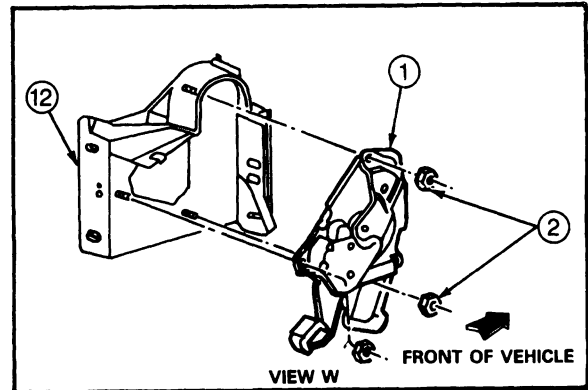
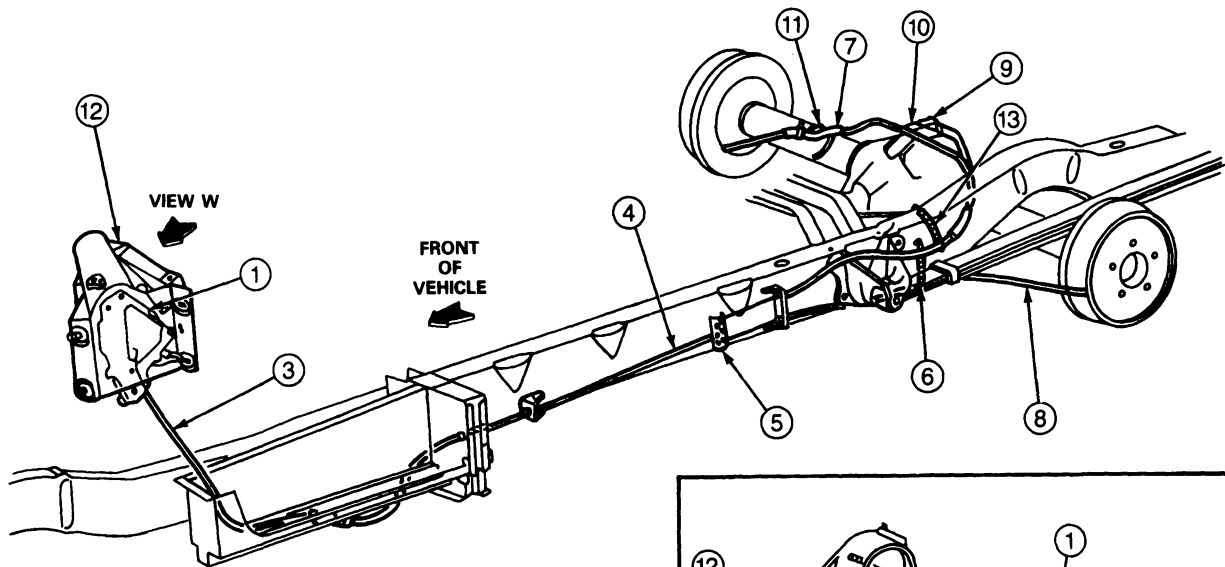
Item	Part Number	Description
7	N647097-S	Rivet
8	N800962-S32	Clip, 10 x 10
9	40949-S2	Screw, Tap 5/ 16-18 x 3/ 4 Hex Washer Head 24-30 N-m (18-22 Ft-Lb)
10	2A635	Cable and Conduit Assembly, Right

(Continued)

Item	Part Number	Description
11	2A809	Cable and Conduit Assembly, Left
12	N804729-S11	Clip
13	57632-S2	Screw and Washer 5/ 16 x 18 x .50 Hex Head 17-23 N-m (13-17 Ft-Lb)
14	3B139	Steering Column Support

TH8180A

Parking Brake Assembly, E-150-250-350



H8182-B

Item	Part Number	Description
1	2780	Control Assembly
2	N620481-S2	Nut M8 x 1.25 Hex Flange 17-23 N-m (13-17 Ft-Lb)
3	2853	Cable Assembly, Front
4	2A793	Extension Assembly, Cable
5	2A602	Equalizer
6	2A709	Spring
7	2A635	Cable and Conduit Assembly, Right

(Continued)

Item	Part Number	Description
8	2A809	Cable and Conduit Assembly, Left
9	N804729-S100	Clip
10	57631-S2	Screw and Washer 5/ 16-18 x .05 Hex Head 17-23 N-m (13-17 Ft-Lb)
11	2C218	Clip
12	3B139	Steering Column Support
13	2A709	Spring

TH8182A

DIAGNOSIS AND TESTING

Refer to Section 06-00 for diagnostic and testing procedures. For F-Super Duty transmission mounted parking brake refer to the following diagnosis guides.

Diagnosis Guide

CONDITION	POSSIBLE SOURCE	ACTION
Squeals or groans.	<ul style="list-style-type: none"> ● Glazed linings. ● Misaligning of parts. ● Dirt in drum. 	<ul style="list-style-type: none"> ● Remove glaze from linings using a file or emery cloth. ● Correct misalignment by tightening any loose brake or drum mounting bolts. Refer to Section 06-02. ● Remove drum and clean out lining dust and dirt.
Scraping noise.	<ul style="list-style-type: none"> ● Worn out lining. ● Bent or misaligned shoe. 	<ul style="list-style-type: none"> ● Check for lining worn down to rivets — reline shoes if necessary. ● Check for misaligned shoe, rubbing against drum. Reline shoes if necessary. Refer to Section 06-02.
Clicks.	<ul style="list-style-type: none"> ● Excessive clearance. ● Eccentric or wobbling drum. ● Excessive linkage friction. 	<ul style="list-style-type: none"> ● Adjust cable clevis. ● Inspect drum runout. Also check for worn or loose bearing on mainshaft. Check drum mounting bolts for tightness. ● Check linkage pivot points for rust, binding, or lack of lubrication.
Grabbing.	<ul style="list-style-type: none"> ● Brake lubricant or transmission oil on linings. 	<ul style="list-style-type: none"> ● Replace brake linings. Refer to Section 06-02. Clean oil and excess brake lubricant from brake and drum. Replace faulty oil seal at mainshaft.
Brake does not hold.	<ul style="list-style-type: none"> ● Excessive clearance prevents complete brake application. ● Grease soaked linings. ● Excessive linkage friction. ● Worn out linings. 	<ul style="list-style-type: none"> ● Adjust brake lining cable to take up slack in brake linkage. ● Repair source of leak, install new linings. Refer to Section 06-02. ● Check for linkage binding, and misalignment. Lubricate all pivot points. ● Reline brake shoes. Check drum / yoke for scoring and replace if necessary. Refer to Section 06-02.
Excessive lining wear.	<ul style="list-style-type: none"> ● Brake drag. ● Rough drum surface or abrasive dirt in drum. 	<ul style="list-style-type: none"> ● Adjust brake lever and camshaft. Inspect for broken or missing springs. ● Smooth drum with emery paper, or replace drum, if drum is badly scored. <p>CAUTION: Drum to be replaced if inside diameter exceeds 229.36mm (9.030 inches).</p>

TH6253C

REMOVAL AND INSTALLATION

Parking Brake Control

F-Super Duty Chassis Cab and F-Super Duty Motorhome Vehicles

Removal

1. Remove the clevis pin at the parking brake.
2. Remove the left kick panel.
3. Disconnect the parking brake indicator light switch connector.
4. Remove the nuts holding the parking brake control assembly to the steering column support.
5. Disconnect the front cable barrel end from the control assembly.
6. Disconnect the cable conduit from the control assembly housing by inserting a 1/2-inch 12-point box end wrench over the conduit snap fitting to compress the retaining fingers, and back out the snap fitting.

Installation

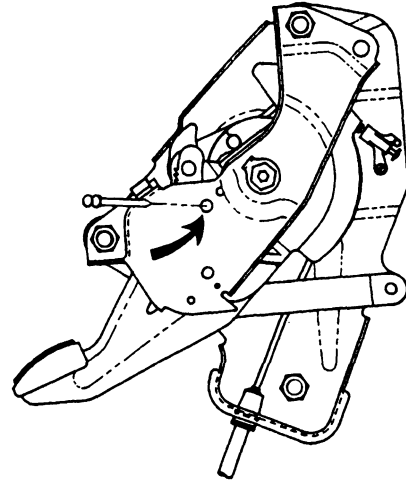
1. Route the cable end fitting over the cable shoe. Snap the conduit fitting into the control assembly housing. Insert the barrel end into the hole in the track.
2. Position the control assembly to the steering column support and install the three retaining nuts. Tighten to 17-23 N·m (13-17 ft·lb).
3. From under the vehicle, install the clevis to the parking brake by inserting the clevis pin.
4. Connect the parking brake indicator switch connector.
5. Install the left kick panel.
6. Check the tension on the system and adjust if required as described in this section.

E-150-250-350, F-150-250-350, Bronco and Econoline Motorhome and Commercial Chassis Vehicles

Removal

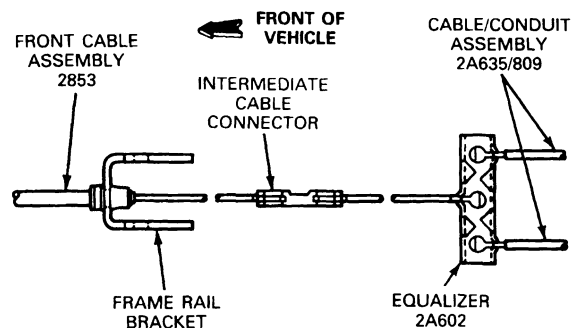
1. Remove the left kick panel.
2. Disconnect the parking brake indicator light switch connector at the control assembly.
3. Remove the three nuts holding the control assembly to the steering column support. Pull the control assembly away from the steering column support.
4. Relieve tension on the parking brake system by having an assistant pull on the intermediate cable until all cable is unwound from the control assembly.

5. Insert a 5/32-inch drill bit or equivalent into the hole provided in the control assembly.



H8184-A

6. Disconnect the front cable from the cable connector.



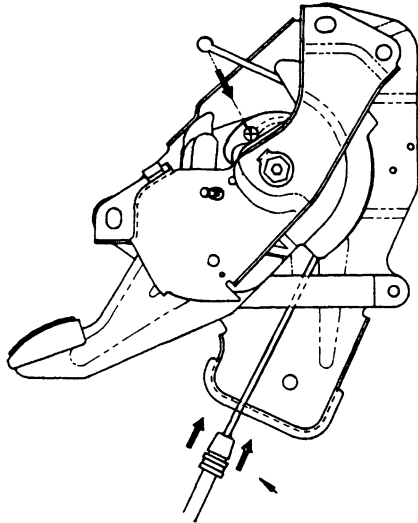
H8185-B

7. Disconnect the barrel end of the cable from the control assembly.
8. Disconnect the cable conduit from the control assembly by inserting a 1/2-inch 12-point box end wrench over the conduit snap fitting to compress the retaining fingers and backing out the snap fitting.

REMOVAL AND INSTALLATION (Continued)

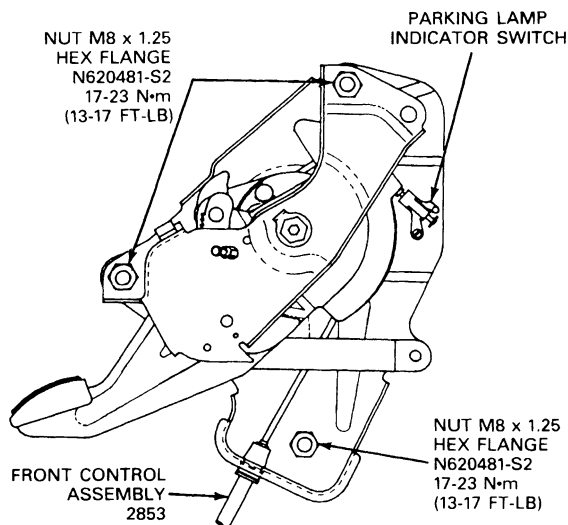
Installation

1. Route the cable end fitting over the cable shoe. Snap the conduit fitting into the control assembly housing. Insert the barrel end into the hole in the track.



H8187-A

2. Position the control assembly to the steering column support and install the three retaining nuts. Tighten to 17-23 N·m (13-17 ft-lb).



H8188-B

3. Connect the front cable to the cable connector.
4. Connect the parking brake indicator light switch connector.
5. Carefully remove the drill bit from the control assembly.

NOTE: The control assembly will tension itself when the drill bit is removed.

6. Stroke the parking brake several times. Rotate both rear wheels to be sure that the parking brakes are not dragging.
7. Install the left kick panel.

Front Parking Brake Cable Assembly to Equalizer

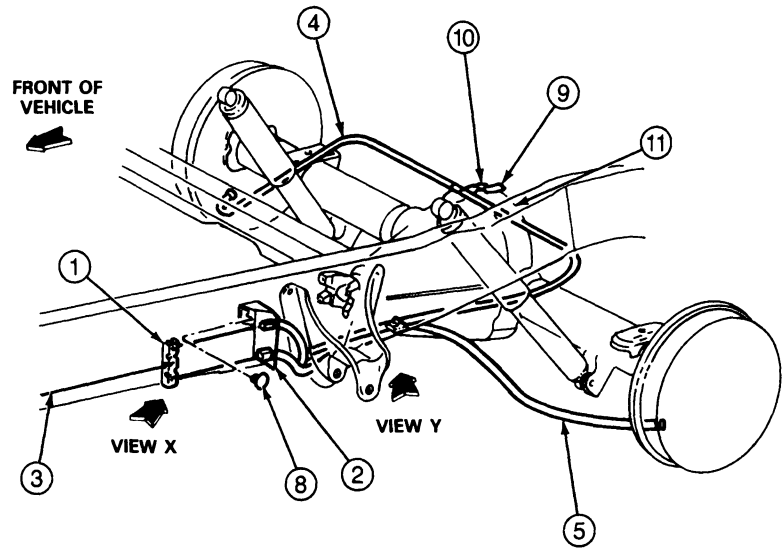
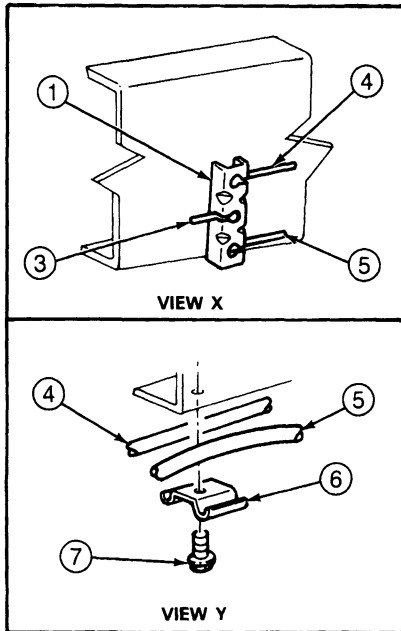
F-150-250-350, E-150,-250-350, Bronco, E-350 Motorhome and Commercial Vehicles

Removal

1. Remove the control assembly and disconnect the front cable as described in this section.
2. Remove the cable from the vehicle.

REMOVAL AND INSTALLATION (Continued)

Equalizer Installation, F-150-250-350, Bronco



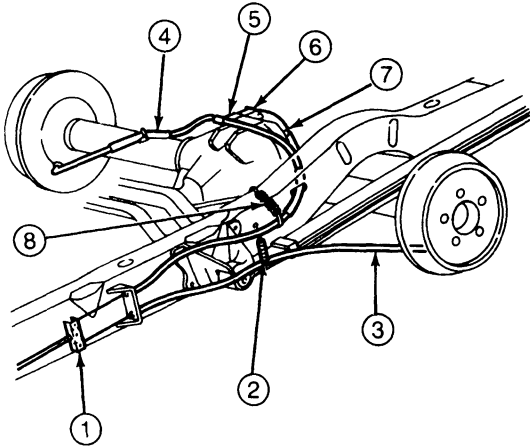
H8299-A

Item	Part Number	Description
1	2A602	Equalizer, Parking Brake
2	2530	Bracket
3	2A793	Cable Assembly, Intermediate
4	2A635	Cable and Conduit Assembly, Right
5	2A809	Cable and Conduit Assembly, Left
6	N800962-S32	Clip, 10 x 10

Item	Part Number	Description
7	40949-S2	Screw, Self-Tapping 24-30 N·m (18-22 Ft-Lb)
8	N647098-S	Rivet, 10 x 28 Solid Button
9	N804729-S100	Clip
10	57632-S2	Screw and Washer 17-23 N·m (13-17 Ft-Lb)
11	4001	Rear Axle Assembly (Reference)

TH8299A

(Continued)

REMOVAL AND INSTALLATION (Continued)**Equalizer Installation, E-150-250-350**

H8301-B

Item	Part Number	Description
1	2A602	Equalizer, Parking Brake
2	2A709	Spring
3	2A809	Cable and Conduit Assembly, Left
4	2A635	Cable and Conduit Assembly, Right
5	57631	Screw and Washer 17-23 N·m (13-17 Ft-Lb)
6	N804729-S100	Clip
7	4001	Rear Axle Assembly (Reference)
8	2A709	Spring

TH8301A

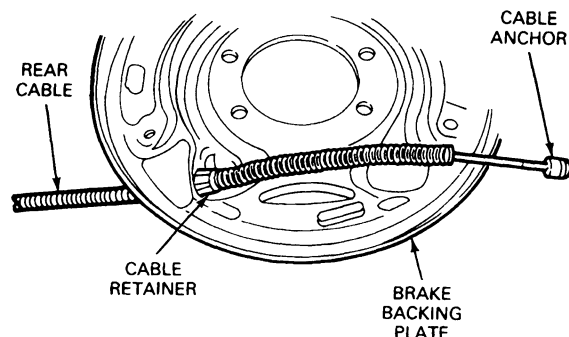
Installation

1. Position the cable in the vehicle, routing the cable through the floor pan on F-Series vehicles, or through the left stepwell on E-Series vehicles.
2. Install the control assembly as described in this section.

Parking Brake Equalizer to Rear Wheel Cable**F-150-250-350, E-150-250-350, Bronco****Removal**

1. Relieve tension on the system by having an assistant pull on the intermediate or front cable while you insert a 5/32-inch drill bit or equivalent into the hole provided in the control assembly.
2. Raise the vehicle and remove the hub cap, wheel and brake drum.
3. Disconnect the rear cable to be replaced from the equalizer.

4. Compress the prongs that retain the cable housing to the frame bracket by using a 1/2-inch 12-point box end wrench.
5. With the spring tension off the parking brake lever, lift the cable out of the slot in the lever, and remove the cable through the brake backing plate hole.
6. Working on the wheel side, compress the prongs on the cable retainer so they can pass through the hole in the brake backing plate. Draw the cable retainer out of the hole.



H5981-1A

Installation

1. Push the cable through the brake backing plate and through the routing clip (if present) until the end of the cable is inserted through the slot in the parking brake lever.
2. Pull the excess slack from the cable and insert the cable housing into the brake backing plate access hole until the retainer prongs expand.
3. Insert the front end of the cable housing through the frame bracket until the prong expands.
4. Install the rear brake drum, wheel, and hub cap, and adjust the rear brake shoes.
5. Remove the drill bit from the control assembly to tension the system.

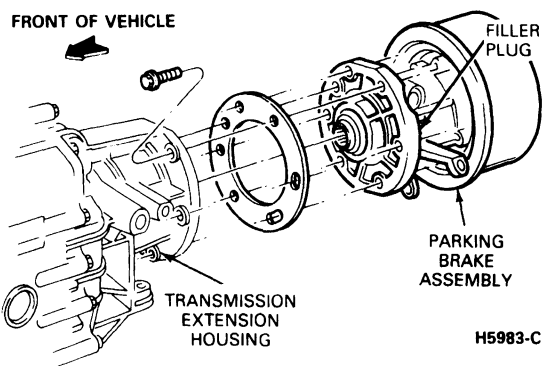
Transmission-Mounted Parking Brake Assembly, F-Super Duty Series Vehicles**Removal**

1. Place the transmission into gear and release the parking brake control cable. The pedal (or lever) must be in the fully released position.
2. Raise the vehicle on a twin post hoist and install safety stands.
3. On F-Super Duty Motorhome and Commercial vehicles, disconnect and remove the speedometer cable from the left hand side of the parking brake assembly.
4. Apply penetrating oil to the adjusting clevis, jam nut and the threaded end of the brake cable.

REMOVAL AND INSTALLATION (Continued)

5. Loosen the jam nut and remove the locking pin from the clevis pin.
6. Remove clevis pin, clevis, and jam nut from the brake cable.
7. Remove cable from the bracket on the case.
8. Remove the bolts attaching the driveshaft to the parking brake assembly output flange.
9. Remove the driveshaft and move it to one side out of the way. Wire it up to the frame.
10. Remove the six hex head bolts attaching the parking brake assembly to the transmission extension housing.
11. Remove the complete parking brake assembly from the transmission.

CAUTION: Keep the vent breather pointing up to prevent oil leakage onto brake shoes during storage and handling.



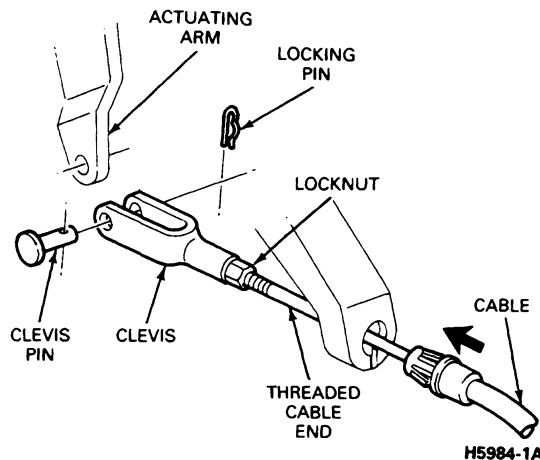
Installation

1. Using two guide bolts or drift pins, attach the parking brake assembly to the transmission splined output shaft, and transmission extension housing.
2. Install six new hex head bolts (Part Number N605804-S100) to attach parking brake assembly to the transmission extension housing (**Do not reuse old bolts**). Tighten the bolts to 34-58 N·m (25-43 ft·lbs).

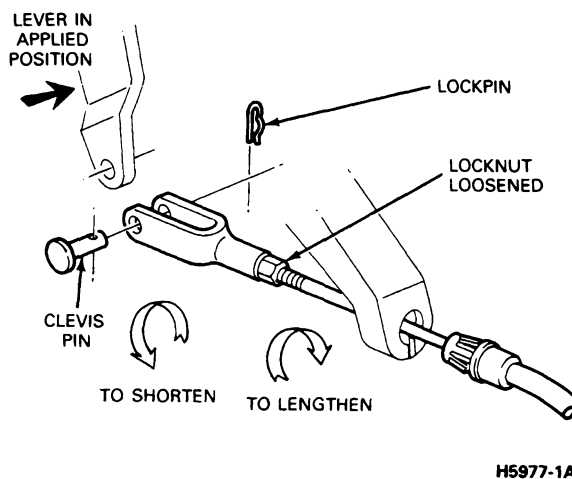
NOTE: If a new parking brake assembly is ordered through Ford Parts and Service Division, a container of Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid E4AZ-19582-B (ESP-M2C166-H) is also provided as part of the kit. This fluid is to be used to fill the parking brake assembly once the assembly is installed onto the transmission.

3. With the parking brake assembly installed, fill the parking brake assembly with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or -DDX E4AZ-19582-B (ESP-M2C166-H) or equivalent to the bottom of the filler hole. Install and tighten the filler plug to 35-40 N·m (25-30 ft·lb).
4. Attach the driveshaft to the output flange, tighten the bolts to 20-27 N·m (15-20 ft·lbs).

5. Install the parking brake cable into the mounting bracket, and snap into position.



6. Screw the jam nut and adjusting clevis onto the threaded end of the brake cable.



7. Hold parking brake actuating lever in the applied position. Turn adjusting clevis onto cable, in a clockwise direction.
8. Insert clevis pin through actuating lever and adjusting clevis, while holding cable tight.
9. Remove the clevis pin. Rotate the clevis 10 full turns in the counterclockwise (loosening) direction (about 12mm [1/2 inch]).
10. Install clevis pin and locking pin.

DISASSEMBLY AND ASSEMBLY

Transmission Mounted Parking Brake

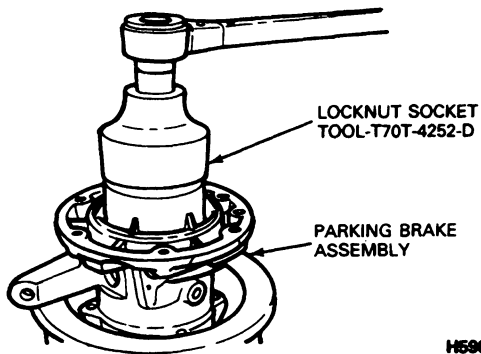
Disassembly

NOTE: To replace the brake assembly, brake shoe and lining assemblies, or other operational components the complete parking brake assembly must be removed from the vehicle.

DISASSEMBLY AND ASSEMBLY (Continued)

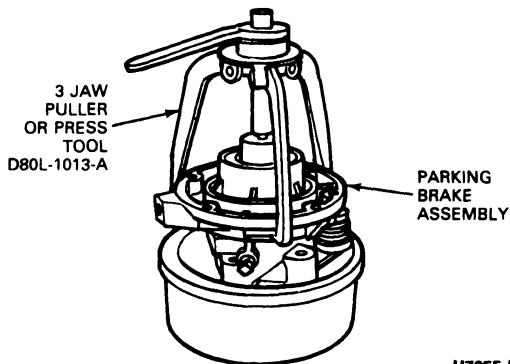
NOTE: Brake shoe and lining assemblies, shoe return springs and support plate assembly are only available as a complete assembly (Part Number 2L598). Refer to Master Parts Catalog for further information.

1. Remove the parking brake assembly as outlined in Removal and Installation, Transmission Mounted Parking Brake, in this section.
2. Remove filler plug and drain fluid from assembly.
3. Using T70T-4252-D Locknut Socket, mount parking brake assembly in vise, using brass jaw protectors to prevent damage. Remove the 65mm hex locknut from the mainshaft.



H5985-1C

4. Using 3-Jaw Puller D80L-1013-A or a suitable press, remove the mainshaft, brake drum and output flange out of the case assembly.

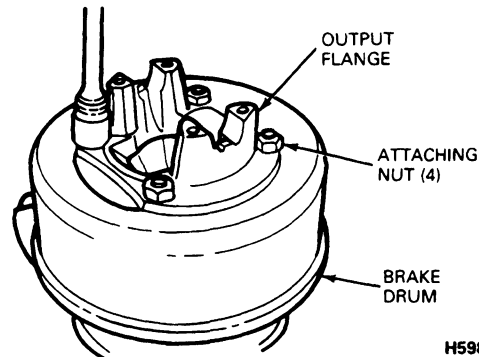


H7055-B

5. Using 2-Jaw Puller D80L-1002-L with Pinion Bearing Cone Remover D79L-4621-A and Step Plate D80L-630-6 or equivalents, remove the inner bearing cone from the mainshaft.

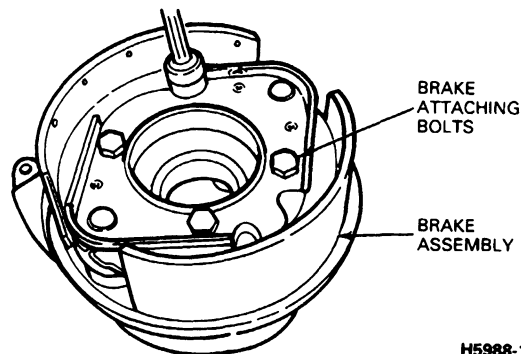
6. Remove the output shaft and brake assembly from the vise.
7. Turn the shaft assembly over and put the threaded end in the vise. Be sure to use soft jaw inserts to protect the mainshaft.
8. Remove the four hex nuts attaching the flange and brake drum to the output shaft.
9. Remove the drum and flange from the output shaft.

NOTE: The drum, yoke / flange, and mainshaft are balanced as a unit; mark for assembly in the same position. Leave the bolts in the output flange. Total assembly must be disassembled.



H5987-1A

10. Remove the input shaft oil seal, spacer, O-ring, bearing cone assembly and bearing cup from the input shaft end of the case using Bearing Cup Puller T77F-1102-A.
11. Remove the four bolts attaching the splash shield and brake assembly to the case.
12. Remove the brake assembly and splash shield from the case.

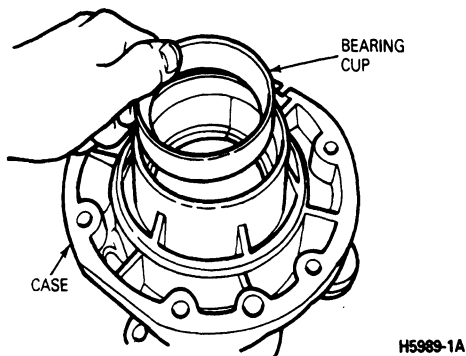


H5988-1A

DISASSEMBLY AND ASSEMBLY (Continued)

13. Remove the brake actuating lever and the lever spring from the case.

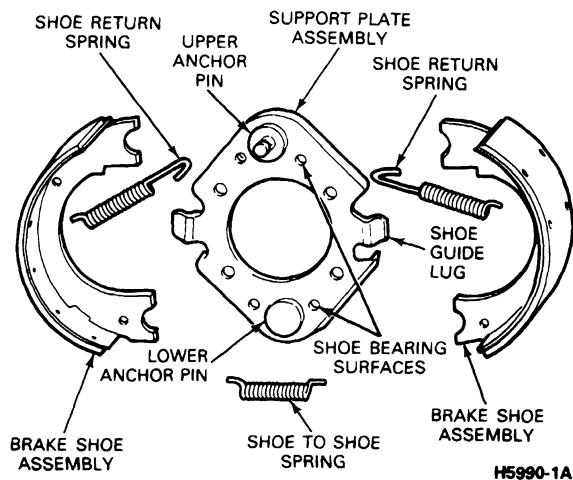
NOTE: For brake assembly component repair, refer to brake component repair in this section.



14. Using Bearing Cup Puller T77F-1102-A, remove the outer bearing cup.
15. Unscrew and remove the vent from the case.

Brake Shoes**Disassembly**

1. Holding the brake assembly securely, remove the two brake shoe return springs using a suitable brake spring tool.
2. Spread the free ends of the brake shoes apart and remove the brake shoes from the lower anchor pin.
3. Remove the shoe-to-shoe spring.
4. Clean any grease or contamination from the support plate. Remove contamination from the shoe guide lugs and other shoe bearing surfaces with sand paper.

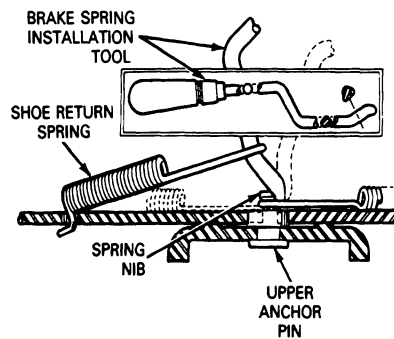


5. Coat the following areas with Ford Disc Brake Caliper Slide Grease D7AZ-19590-A (ESA-M1C172-A). Use only a light application of grease at these points.

- Camshaft lugs and ball of actuating lever.
- Shoe guide lugs and shoe bearing points of the support plate assembly.
- Upper and lower anchor pins.
- Anchor pin contact points of the brake shoes.

Assembly

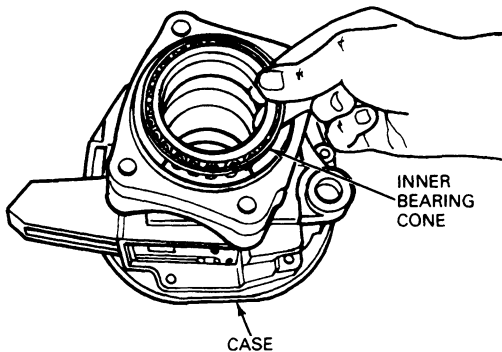
1. Using new brake shoe and lining assemblies, install new shoe-to-shoe springs into the lower holes of the brake shoes.
2. Assemble the lower ends of the shoes over the shoulder of the lower anchor pin, twisting the shoes into position.
3. Move the upper ends of the shoes to the upper anchor pin, inserting the shoe webs between the shoe guide lugs and the bearing surfaces of the support plate.
4. With the upper ends of the shoes against the upper anchor pin, install two new shoe return springs.
5. Install the short hooked end of each spring into the upper holes of the brake shoes and hook the opposite end of each spring over the anchor pin nib, using a suitable spring installation tool. Be sure the open end of the spring hook faces toward the brake centerline.

**Transmission Mounted Parking Brake****Assembly**

1. Apply sealer to the lip of the plug. Press plug into output flange, if removed, with lip of plug facing outward. The plug must be flush with the edge of the bore.
2. Turn the case over and install the outer bearing cup into the case. Using Bearing Cup Replacer T88T-2598-E until the bearing cup bottoms in the bore.

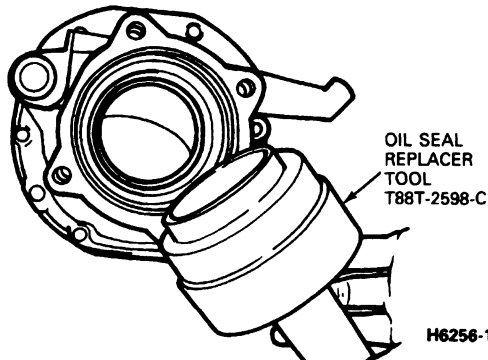
DISASSEMBLY AND ASSEMBLY (Continued)

3. Install the inner bearing cone assembly into the cup.



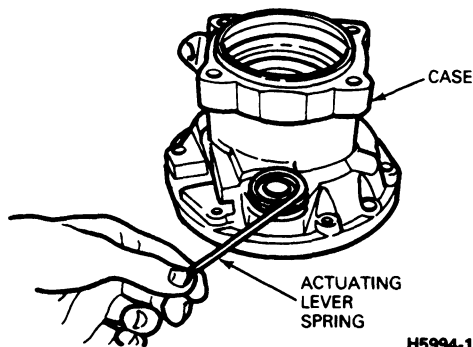
H7056-1A

4. Position the oil seal in the bore of the case with the sealing lip facing inward.
5. Press the seal into the bore of the case using Seal Replacer T88T-2598-C. Press the seal in flush with the bore surface.



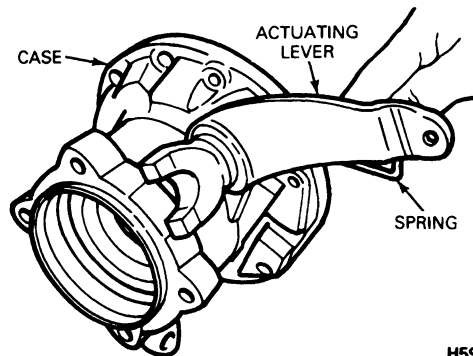
H6256-1A

6. Install the actuating lever spring in the boss in the case.



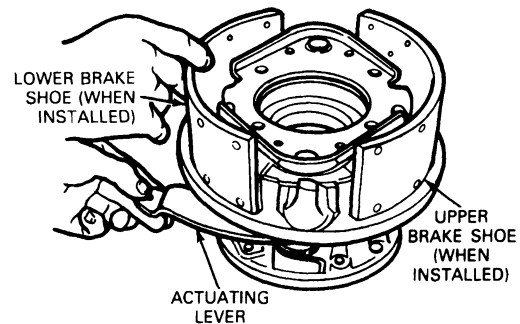
H5994-1A

7. Apply a light coating of Ford Disc Brake Caliper Slide Grease D7AZ-19590-A (ESA-M1C172-A), or equivalent to the ball of the actuating lever.
8. Install the lever (ball end) into the hole in the boss of the case, through the coiled end of the spring.



H5995-1A

9. Position the backing plate and brake assembly into position on the case. Insert the actuating lever (cam end) into position in the brake assembly.

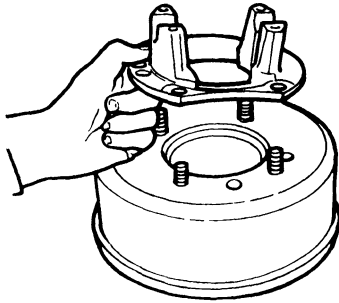


H5996-B

10. Attach the brake assembly and backing plate to the case with four hex head bolts. Tighten the bolts to 118-123 N·m (87-91 ft-lb).
11. Attach retracting spring to the actuating lever while bending the long end to snap over the lever.
12. Place the mainshaft in a vise with the flanged end up. Protect the shaft with soft jaw inserts.
13. Install the brake drum and output flange onto the flange end of the mainshaft.
14. Install the output flange onto the brake drum, aligning the marks made during disassembly (to make sure the balance is not disturbed).

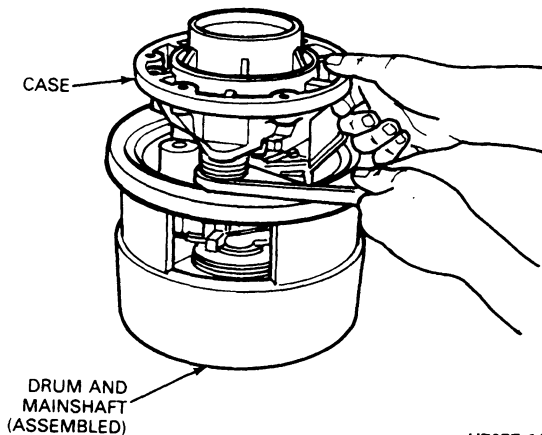
DISASSEMBLY AND ASSEMBLY (Continued)

15. Install the four hex nuts and tighten to 113-117 N-m (83-87 ft-lb).



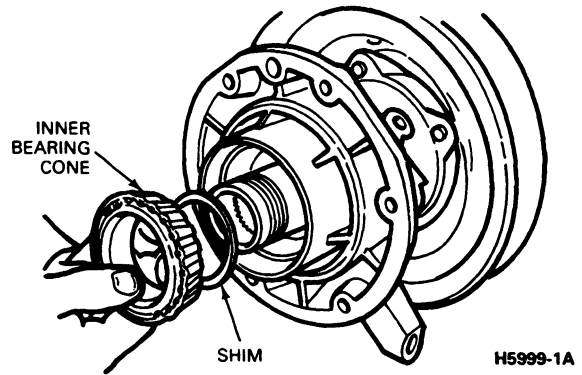
H5997-1B

16. Remove the mainshaft with drum assembly from the vise. Turn the unit over and clamp it securely in the vise.
17. Install the case onto the mainshaft guiding the shaft through the oil seal and bearing cone.



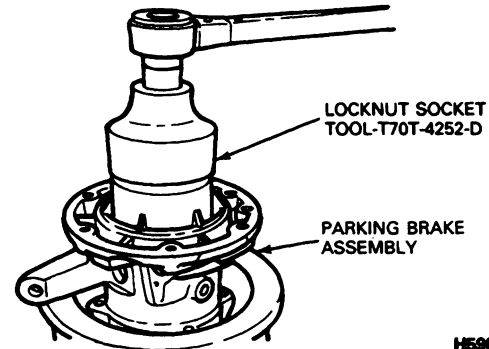
H7057-1A

18. Using Bearing Cone Replacer T88T-2598-F seat the output bearing onto the mainshaft.
19. Install the input bearing cup into the housing using Bearing Cup Replacer T88T-2598-D.
20. Install the shim on the mainshaft.
- NOTE: This shim determines mainshaft end play, and it is available in thicknesses in variances of 0.0019 inches.
21. Install the inner bearing cone onto the mainshaft.



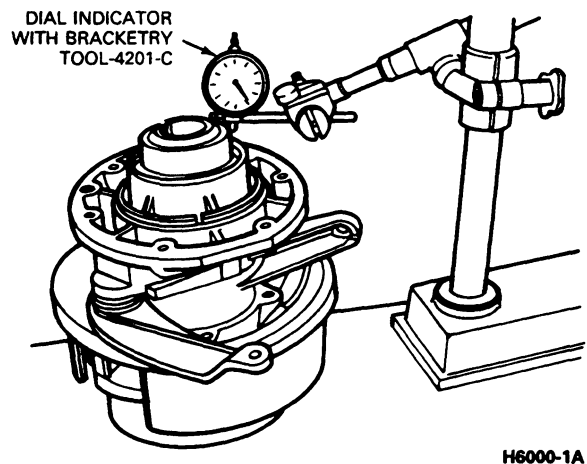
NOTE: In order to measure mainshaft end play, install the bearing spacer without the O-ring onto the mainshaft.

22. With the case assembly and mainshaft clamped firmly in the vise, screw the hex locknut onto the mainshaft. Tighten the nut to 288-292 N-m (212-216 ft-lb) using 65mm Locknut Wrench T70T-4252-D.



H5905-1C

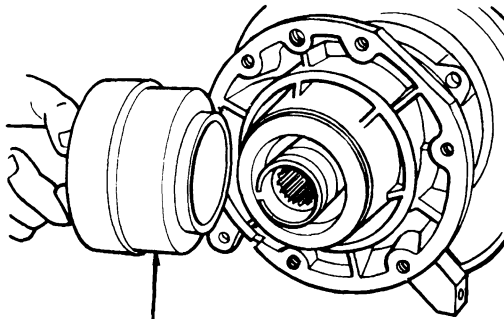
23. Mount a dial indicator between the mainshaft and the case to check end play. Use Dial Indicator with Bracketry TOOL-4201-C.



H6000-1A

DISASSEMBLY AND ASSEMBLY (Continued)

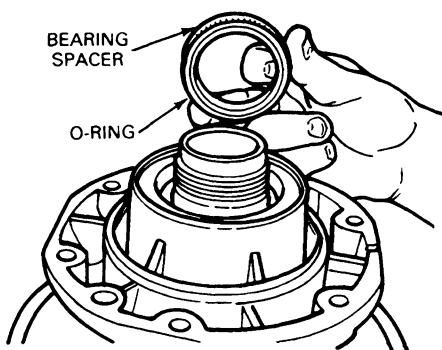
24. While rotating the case assembly on the mainshaft to center the bearings. Apply pressure up and down while taking an end play reading. A reading of 0.0483-0.0991 mm (0.0019-0.0039 inches) is required. If the reading is not to specification, a thicker or thinner shim must be used.
25. Remove the locknut and the bearing spacer from the shaft.
26. If required, remove the inner bearing cone and add the necessary shim to obtain the specified end play.
27. Install the inner bearing cone on the shaft.
28. Using Seal Replacer T88T-2598-B, install the seal until it seats inside the bore. The sealing lip of the seal must face inward.



SEAL INSTALLER
TOOL-T88T-2598-B

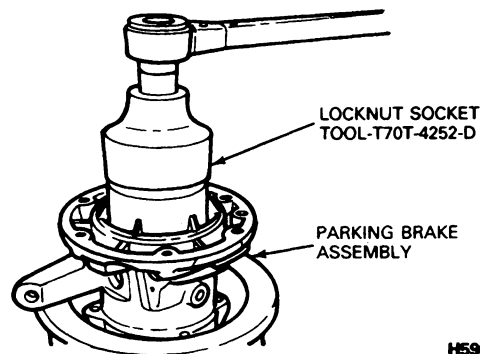
H6251-B

29. Install a new O-ring in the notch of the bearing spacer and install both parts onto the mainshaft until the spacer butts against the shoulder of the input bearing.



H6252-1A

30. Install a new locknut on the shaft, and tighten to 288-292 N·m (212-216 ft·lb).
31. Upset the outer lip of the locknut into the slot in the shaft, using 65mm Locknut Wrench T70T-4252-D.



H5985-1C

NOTE: Vent must be clean and free of oil residue.

32. Screw the vent into the case, and tighten it to 11-16 N·m (8-12 ft·lb).
33. Remove the parking brake assembly from the vise.
34. With the parking brake installed, fill the case with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid, XT-2 QDX or -DDX E4AZ-19582-B (ESP-M2C 166-H) or equivalent through the filler hole. Fill to the bottom of the filler hole.
35. Install and tighten the fill plug to 35-40 N·m (25-30 ft·lb).
36. Install the parking brake assembly as outlined in this section.

ADJUSTMENTS**Cable Actuated Rear Wheel Parking Brake**

E-150-250-350, F-150-250-350 and Bronco with Foot Operated Parking Brake Control

The parking brake systems used on these vehicles are self-adjusting and require no adjustment.

Cable Actuated Transmission-Mounted Parking Brake

F-Super Duty Chassis Cab, Motorhome Chassis Vehicles

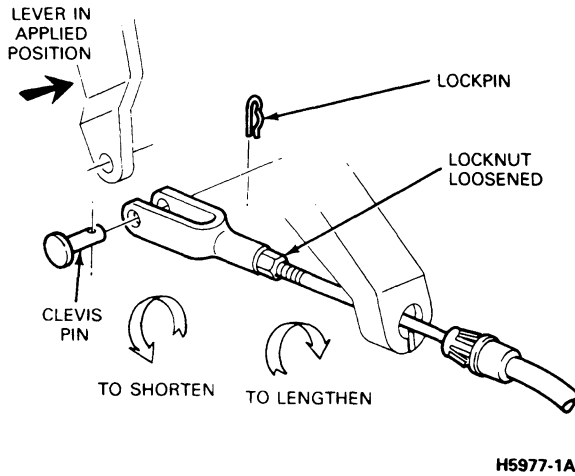
Field Adjustment, Foot Actuated Lever

Use this adjustment to correct excessive parking brake control travel.

1. Place the transmission in neutral, and release the parking brake.
2. Raise the vehicle on a twin post hoist and install safety stands.

ADJUSTMENTS (Continued)

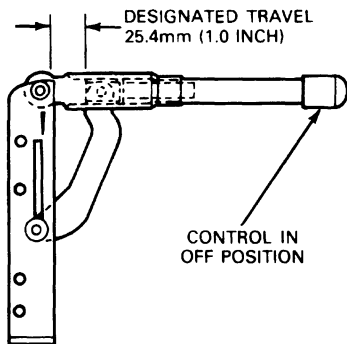
3. Loosen the parking brake adjusting clevis jam nut several turns. Spray the adjusting nut, threaded rod and the clevis with penetrating oil to ease adjustment.



4. Remove the locking pin and the clevis pin from the adjusting clevis.
5. Hold lever in applied position.
6. Screw clevis onto threaded end of cable until lever hole and clevis holes line up.
7. Loosen clevis about 10 turns [12.7mm (1/2 inch)].
8. Position clevis over lever. Install clevis pin and lockpin.
9. Rotate driveshaft to make sure brake shoes are not dragging against drum.
10. Remove the safety stands and lower the vehicle down off the hoist.
11. Place transmission in park; apply parking brake to check operation.

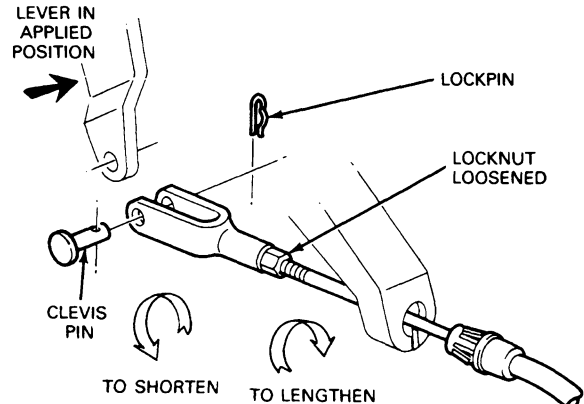
Field Adjustment, Orscheln Lever, F-Super Duty Commercial Chassis Vehicles

1. Turn Orscheln parking brake handle adjustment knob to obtain the designated travel 25.4mm (1.0 inch) and position handle to the OFF position.



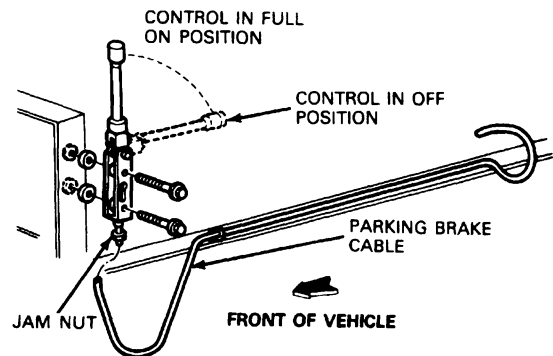
H7408-1A

2. Place transmission in NEUTRAL, raise vehicle on twin post hoist and position suitable safety stands under vehicle.
3. Loosen the jam nut at the parking brake cable clevis.
4. Install the parking brake cable into the parking brake mounting bracket and snap into position.



H5977-1A

5. Hold parking brake actuating lever in the applied position and screw the adjusting clevis onto the cable until the clevis pin can be inserted through the actuating lever and the adjusting clevis while the cable is held tight.

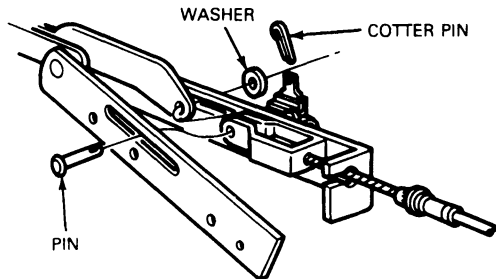


H7409-1A

6. Remove clevis pin and rotate clevis 10 full turns in a counterclockwise (loosening) direction about 12.7mm (1/2 inch). Tighten clevis jam nut to 14-20 ft-lbs.
7. Assemble cable to parking brake actuating arm.
8. Remove safety stands and lower vehicle.
9. Function check: Apply parking brake with a full stroke, then release. Repeat application and release. The control must latch and release both times.

ADJUSTMENTS (Continued)

10. Additional adjustment can be obtained by turning the adjustment knob on the orscheln parking brake lever.



H7410-B

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	Lb·Ft
Nuts, Control Assembly Mounting	17-23	13-17
Screw, Clip-to-Frame	24-30	18-22
Screw, Cable Retainer at Axle Housing	17-23	13-17
TRANSMISSION MOUNTED PARKING BRAKE		
Parking brake case to transmission bolts	34-58	25-43
Driveshaft to output flange	20-27	15-20
Brake backing plate to housing	118-123	87-91
Output yoke flange to brake drum	113-117	83-87
Mainshaft locknut	288-292	212-216
Vent to housing	11-16	8-12
Fill plug	35-40	25-30

SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
T77F-1102-A Bearing Cup Puller	 T77F-1102-A
T88T-2598-D Inner Bearing Cup Installer	 T88T-2598-D

(Continued)

Tool Number / Description	Illustration
T88T-2598-E Outer Bearing Cup Installer	 T88T-2598-E
T88T-2598-C Oil Seal Replacer	 T88T-2598-C
T88T-2598-F Bearing Replacer	 T88T-2598-F
TOOL-4201-C Dial Indicator with Bracketry	 TOOL-4201-C
T88T-2598-B Oil Seal Replacer	 T88T-2598-B

Tool Number	Description
D80L-1013-A	3-Jaw Puller
D80L-1002-L	2-Jaw Puller
D79L-4621-A	Bearing Cone Remover
D80L-630-6	Step Plate

SECTION 06-06 Brake Actuation, Hydraulic

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DISASSEMBLY AND ASSEMBLY	
Brake Pedal Linkage Adjustment, F-Super Duty		Master Cylinder	06-06-15
Motorhome Chassis	06-06-17	REMOVAL AND INSTALLATION	
DESCRIPTION AND OPERATION		Brake Pedal Assembly	06-06-7
Height Sensing Brake Proportioning Valve	06-06-4	Height Sensing Brake Proportioning	
Master Cylinder	06-06-1	Valve	06-06-13
Plastic Reservoir with Fluid Level		Master Cylinder Reservoir	06-06-15
Indicator	06-06-3	Master Cylinder, All Except F-Super Duty	06-06-4
Proportioning Valve	06-06-4	SPECIFICATIONS	06-06-18
DIAGNOSIS AND TESTING	06-06-4	VEHICLE APPLICATION	06-06-1

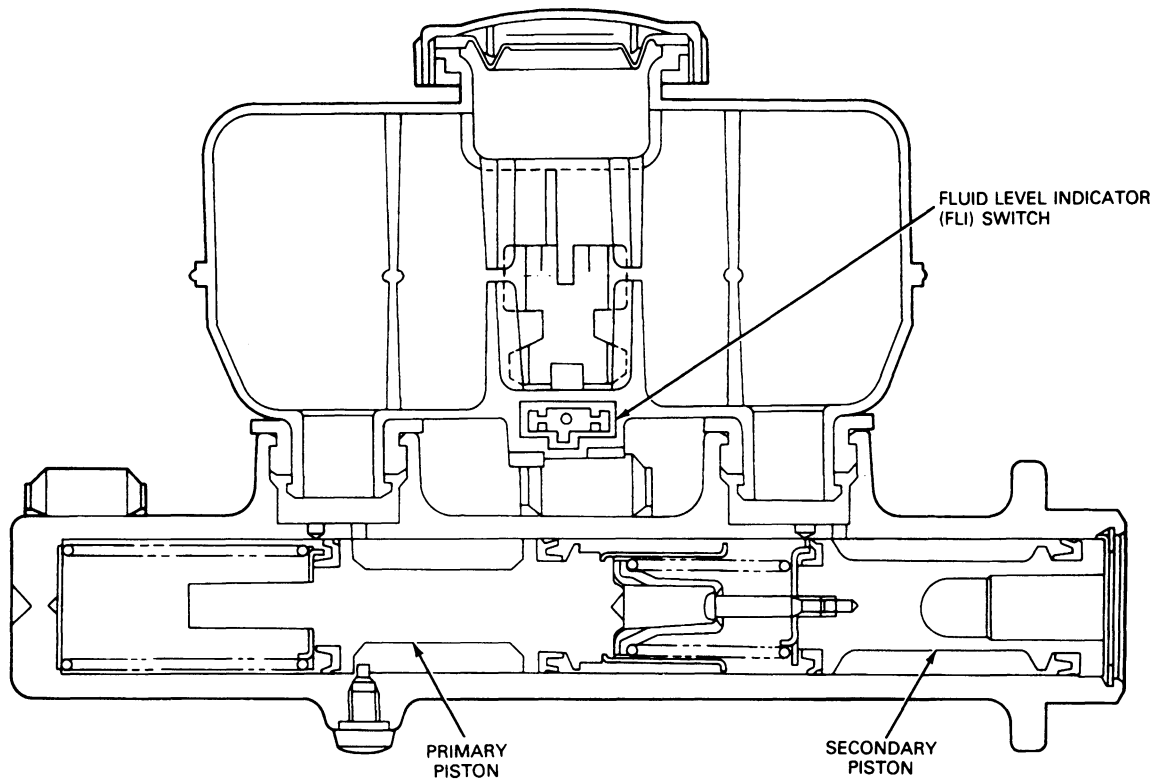
VEHICLE APPLICATION

E-150-250-350, E-350 Motorhome Chassis,
F-150-250-350, Bronco and F-Super Duty Vehicles

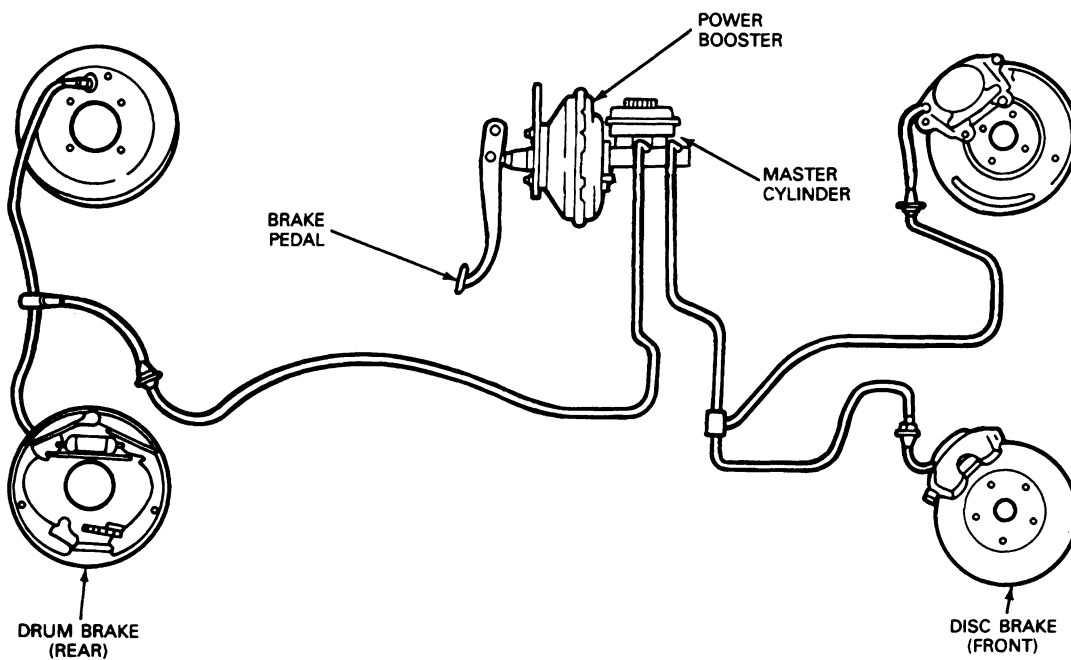
DESCRIPTION AND OPERATION

Master Cylinder

The dual master cylinder contains a plastic "see-through" fluid reservoir with a Fluid Level Indicator (FLI) and primary and secondary hydraulic pistons. Some vehicles have an integral proportioning valve.

DESCRIPTION AND OPERATION (Continued)**Master Cylinder, Cutaway View**

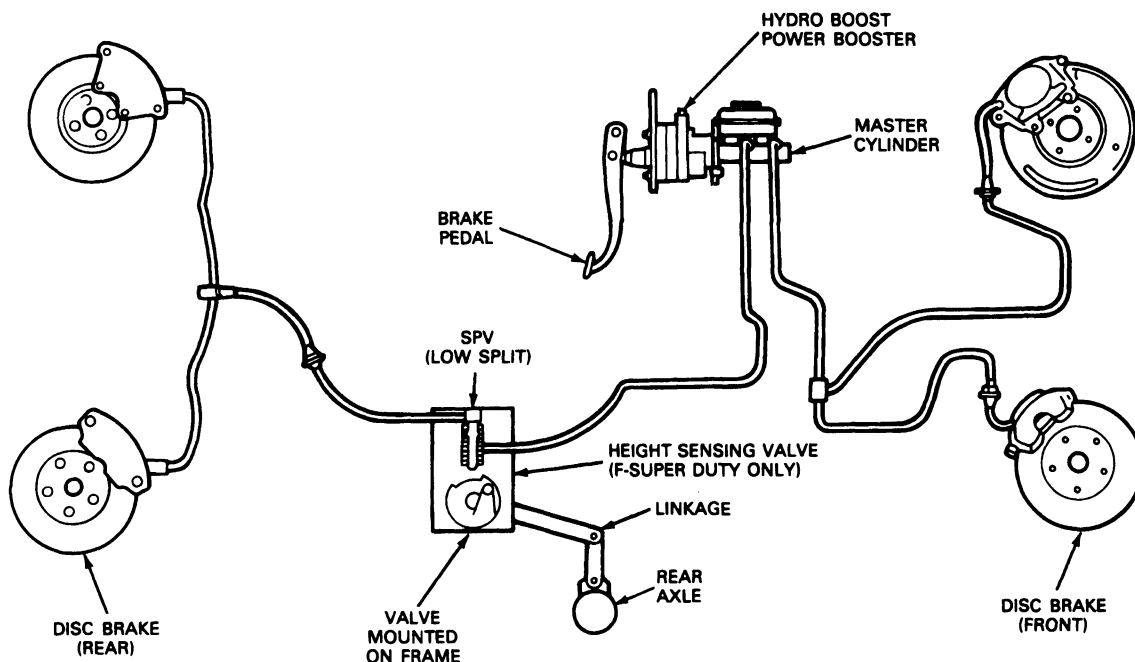
H5613-2A

Master Cylinder Operation, F-150-250-350, E-150-250-350

H4880-2C

DESCRIPTION AND OPERATION (Continued)

On all vehicles (except F-Super Duty) the master cylinder is assisted by a vacuum booster. On F-Super Duty a Bendix Hydro-boost is used. Information about the vacuum booster is in Section 06-07C. Information on the Bendix Hydro-boost is in Section 06-07A.

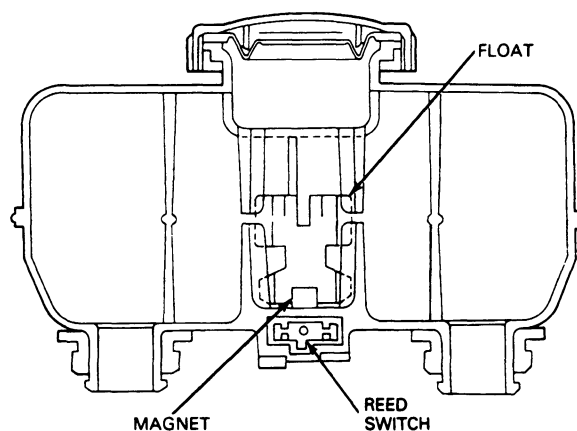
Master Cylinder Operation, F-Super Duty Chassis Cab

H6272-B

Plastic Reservoir with Fluid Level Indicator

The fluid level indicator is an integral part of the fluid reservoir. It is serviced as a part of the plastic reservoir assembly. It consists of a float containing a magnet and a reed switch. When the fluid in the reservoir gets to a predetermined level, the magnet actuates the reed switch, causing the warning lamp to light. Loss of fluid from either the primary (front) or secondary (rear) system will cause this system to actuate.

If the fluid level indicator is inoperative, the plastic reservoir must be replaced.

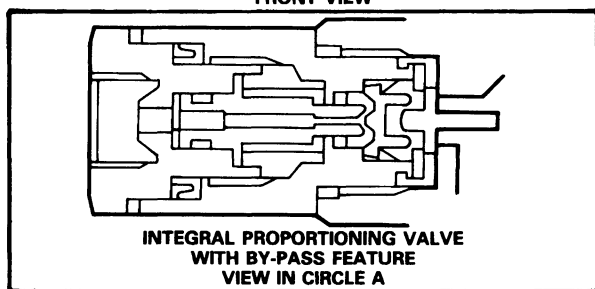
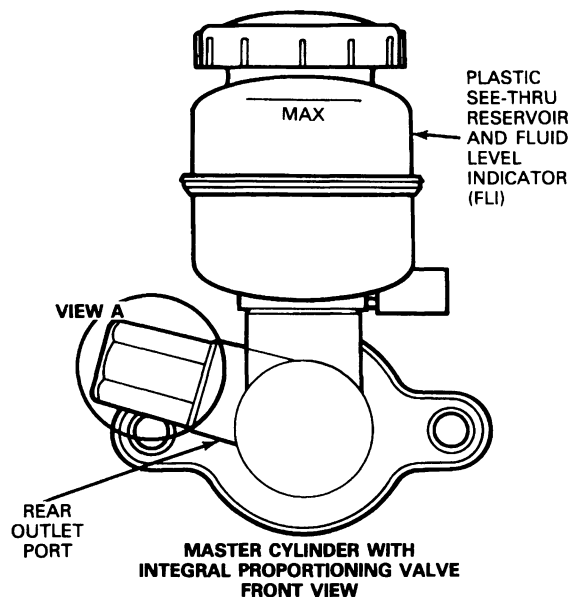
Plastic Reservoir with Fluid Level Indicator

H5608-1A

DESCRIPTION AND OPERATION (Continued)

Proportioning Valve

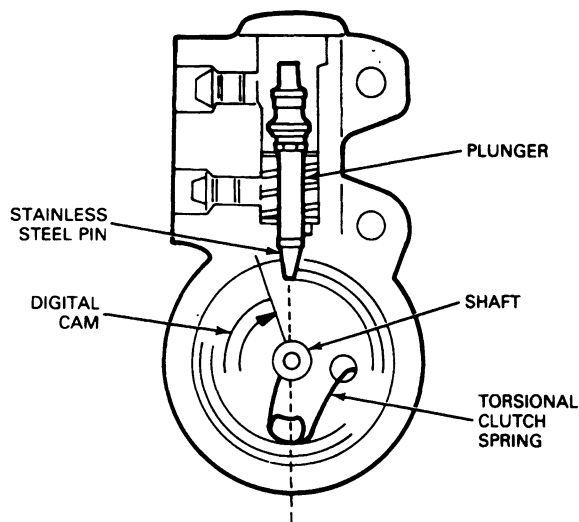
All E-series, F-series (except F-Super Duty) and Bronco vehicles are equipped with a proportioning valve. The proportioning valve is integral to the master cylinder. The valve functions to restrict rear brake system hydraulic pressure. A plug and tube seat is pressed into the outlet port of the master cylinder. A hole through the center of the plug and tube seat directs the hydraulic fluid down the valve to the rear brake system outlet port. In case of the front brake system malfunction, the proportioning valve with a bypass feature allows full hydraulic pressure to the rear brake system.



H5609-C

Height Sensing Brake Proportioning Valve

The Height Sensing Brake Proportioning Valve is used on F-Super Duty vehicles only. The height sensing valve regulates rear brake hydraulic pressure when the vehicle is in the lightly loaded condition and allows full braking pressure to the rear brakes when the vehicle is carrying a full load.



H4881-1A

DIAGNOSIS AND TESTING

Refer to Section 06-00.

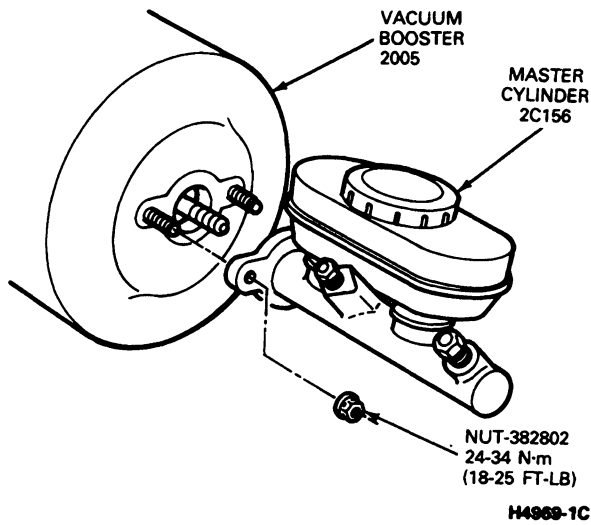
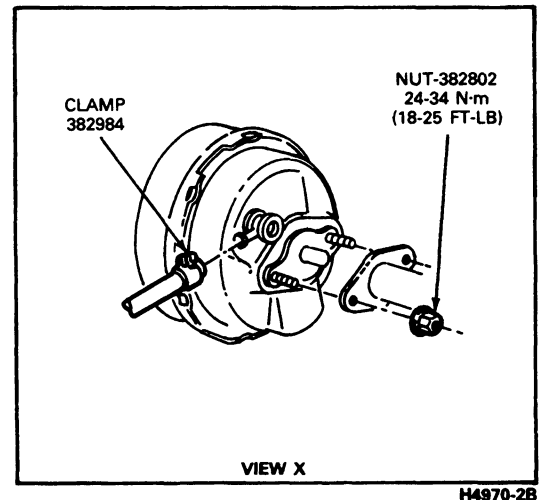
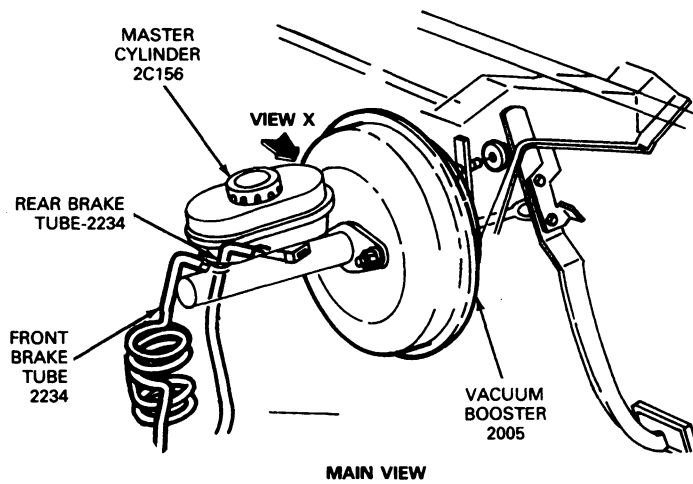
REMOVAL AND INSTALLATION

Master Cylinder, All Except F-Super Duty

CAUTION: F-Super Duty Series vehicles are equipped with a hydraulic brake booster. Refer to Section 06-07C for hydraulic brake booster removal and installation procedures.

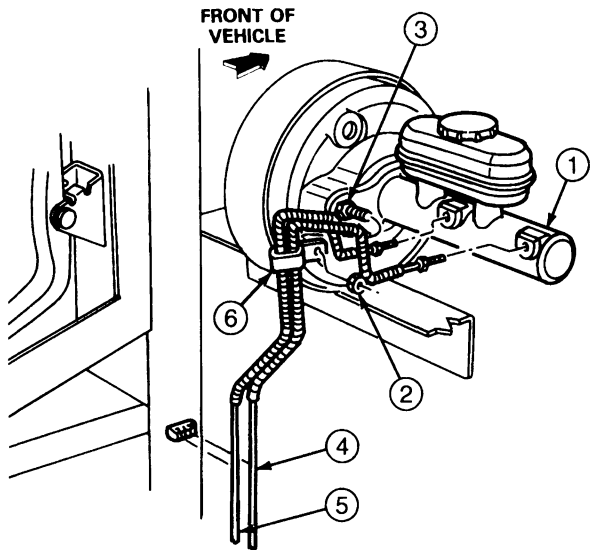
Removal

1. With the engine turned off, push the brake pedal down to expel vacuum from the brake booster system.
2. Disconnect fluid level indicator switch connector from the master cylinder.
3. Disconnect the hydraulic lines from the brake master cylinder.
4. Remove the brake booster-to-master cylinder retaining nuts. Remove the master cylinder from the brake booster.

REMOVAL AND INSTALLATION (Continued)**Master Cylinder Installation, F-150-250-350 and Bronco****Master Cylinder Installation, E-150-250-350**

REMOVAL AND INSTALLATION (Continued)

Master Cylinder Installation, E-350 Motorhome

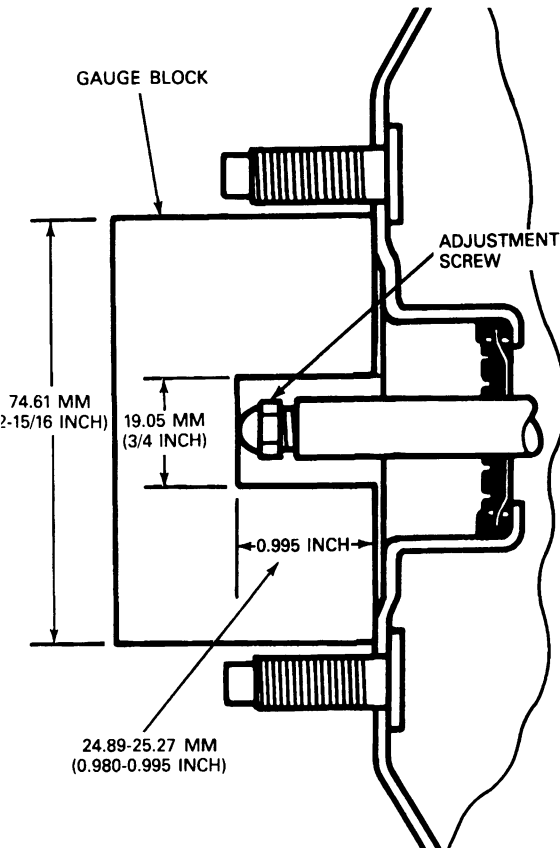


H8286-A

Item	Part Number	Description
1	2C156	Master Cylinder Assembly
2	382802-S2	Nut 3/8-16 30-40 N·m (22-30 Ft-Lb)
3	382802-S2	Nut 3/8-16 30-40 N·m (22-30 Ft-Lb)
4	2B253	Tube Assembly, Brake Master Cylinder, Rear
5	2A040	Tube Assembly, Brake Master Cylinder, Front
6	2B229	Clip, Brake Tube

Installation

- Before installing the master cylinder, check the distance from the outer end of the booster assembly push rod, to the front face of the brake booster assembly. Turn the push rod adjusting screw in or out as required to obtain the specified length.
- Position the master cylinder assembly over the booster push rod and onto the two studs on the booster assembly.
- Install the attaching nuts and tighten to specifications.
- Loosely connect the hydraulic brake system lines to the master cylinder.
- Tighten the attaching nut to specifications.
- Connect fluid level indicator switch.
- Bleed the master cylinder as described in Section 06-00.
- Fill the plastic reservoir of the master cylinder with Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent to the fluid fill line.



H1330-K

REMOVAL AND INSTALLATION (Continued)

9. Install gasket and bleed the hydraulic brake system as described in Section 06-00.

WARNING: BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

Brake Pedal Assembly

Bronco, F-150-250-350 and F-Super Duty Chassis Cab

Removal

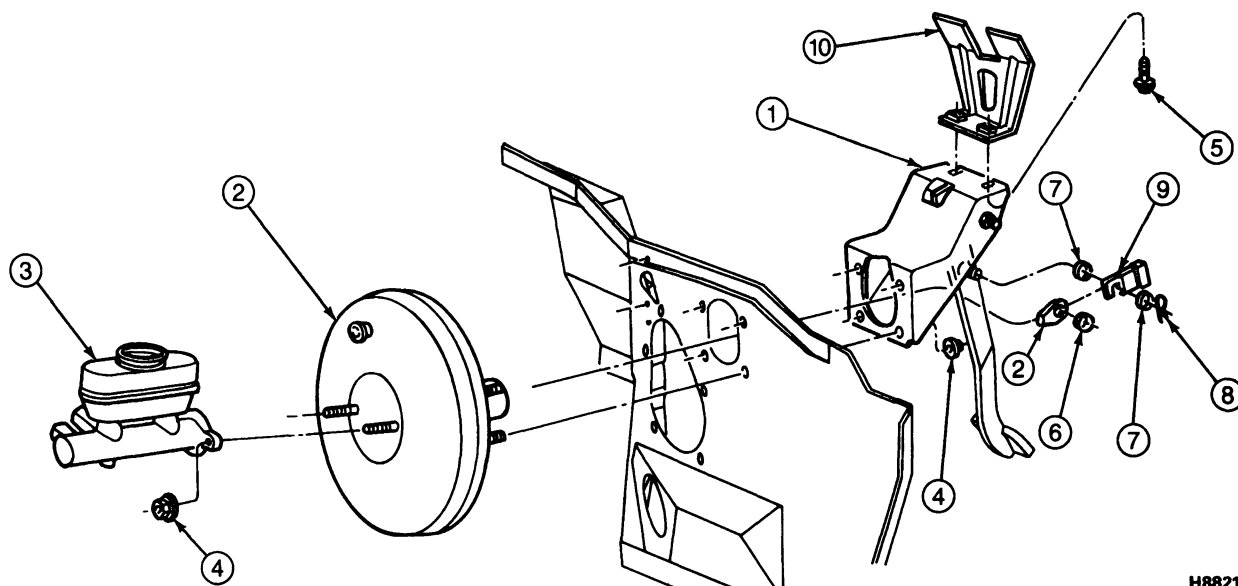
1. Disconnect the wires from the stoplamp switch located below instrument panel.
2. Remove the pin and spacer connecting the brake pedal assembly, stoplamp switch assembly and master cylinder push rod together.
3. Remove stoplamp switch, master cylinder push rod and inner spacer from pin on brake pedal. If vehicle is equipped with speed control, leave speed control bracket in place.
4. On vehicles equipped with manual transmissions, disconnect the clutch pedal retracting spring.
 - Remove the nut on the clutch rod lever located near brake pedal.

- Remove the lever, washer spring, and bushing.
- Push the clutch pedal assembly to the side enough for the brake pedal assembly to come off the shaft.
- Take off the brake pedal bushings.

NOTE: Some vehicles may have an "E-clip" type retainer instead of a "hair pin clip" type retainer.

5. On vehicles equipped with automatic transmission, remove one spring retainer and bushing from the brake pedal shaft. From the other end, pull out the shaft and remove the brake pedal assembly. Remove the bushings and washer spring from the brake pedal.
6. Remove the stoplamp switch from the bracket on the brake pedal.
7. Remove the pedal pad, if required.

Brake Pedal Installation, F-150-250-350, F-Super Duty and Bronco



H8821-A

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	2450	Brake Pedal and Bracket Assembly
2	2005	Booster Assembly
3	2C 156	Master Cylinder
4	382802-S2	Nut, 3/8-16 18-34 N·m (13-25 Ft-Lb)

(Continued)

Item	Part Number	Description
5	N606687-S2	Screw and Washer, M8-1.25 x 16 20-27 N·m (15-20 Ft-Lb)
6	2A309	Bushing
7	2B129	Spacer
8	380699-S 100	Self-Locking Pin
9	13480	Stoplamp Switch
10	—	Y-Brace

Installation

1. Install the pedal pad on the brake pedal assembly, if required.
2. Install the stoplamp switch on the brake pedal bracket.
3. Place bushings and washer spring in position on the brake pedal assembly.
4. **Manual transmissions:**
 - Move the pedal assembly into the bracket.
 - Slide the clutch pedal assembly so the clutch shaft goes through the hub of the brake pedal assembly.
 - Install the bushing and clutch rod and lever onto the clutch shaft.
 - Position the nut holding the clutch lever to clutch shaft and tighten.
 - Connect the clutch pedal retracting spring.

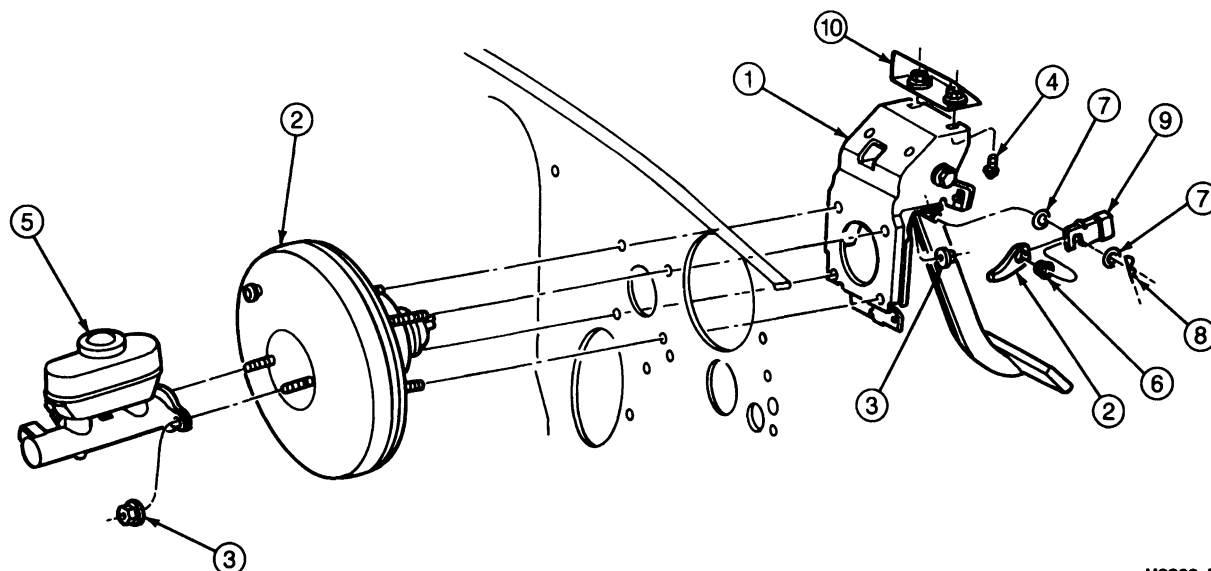
Automatic transmission:

- Move the brake pedal assembly into the bracket.

- Slide the brake pedal shaft through the bracket and hub on the brake pedal.
 - Install bushings and spring retainers on the shaft.
5. Place the bushing spacer stoplamp switch assembly and master cylinder push rod onto the pin on the brake pedal. Install the spacer and cotter pin.
 6. Connect wires to stop lamp switch. Check unit for correct operation.

E-150-250-350**Removal**

1. Remove pin and spacer which connect stoplight switch and power brake booster push rod to pedal.
2. Remove stoplight switch, bushing, and brake booster push rod from pedal.
3. Remove nut from long bolt.
4. Slide bolt out far enough to take out brake pedal, bushing, and spring washer.
5. Take spacer out of brake pedal.

Brake Pedal Installation, E-150-250-350

H8822-A

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	2450	Brake Pedal and Bracket Assembly
2	2005	Booster Assembly
3	382802-S2	Nut 3/8-16 18-34 N-m (13-25 Ft-Lb)
4	56340-S2	Bolt, 3/8-16 x 1 18-34 N-m (13-25 Ft-Lb)

(Continued)

Item	Part Number	Description
5	2C156	Master Cylinder
6	2A309	Bushing
7	2B129	Spacer
8	380699-S100	Self-Locking Pin
9	13480	Stoplamp Switch
10	—	Top Cowl

Installation

1. Put spacer inside brake pedal.
2. Put spring washer and bushings into brake pedal and hold.
3. Position brake pedal and assembled parts up into support bracket.
4. Push bolt through bracket and brake pedal.
5. Install nut on long bolt.
6. Install stoplamp switch, bushing, and brake booster push rod onto pin on brake pedal.
7. Install spacer and pin retaining stoplamp switch on pedal.

F-Super Duty Motorhome and Commercial Chassis**Removal**

1. **On commercial vehicles:** Working inside the vehicle below the instrument panel disconnect the wires from the stoplamp switch. Remove the pin and spacer connecting the brake pedal assembly, stoplamp switch assembly and master cylinder push rod together. Remove stoplamp switch, master cylinder push rod, bushing and inner spacer from pin on brake pedal.

On motorhome vehicles: Working inside the vehicle below the instrument panel disconnect the wires from the stoplamp switch. Remove the locking pin and washer. Remove the clevis pin connecting the bell crank rod to the pedal assembly.

2. Remove the nut and bolt holding the brake pedal to the brake pedal bracket.
3. Remove the brake pedal.
4. Remove the stoplamp switch from the pedal.

5. On motorhome vehicles, remove the speed control switch.
6. Remove the bushings and spacer from the panel.
7. Remove the pedal pad, if required.

Installation

1. Install the pedal pad on the brake pedal assembly, if required.
2. Install the stoplamp switch on the brake pedal bracket.
3. On motorhome vehicles, install the speed control switch.
4. Place spacer inside brake pedal.
5. Place bushings inside brake pedal and hold in place.
6. Position brake pedal and assembled parts up into the support bracket.
7. Push long bolt through the bracket and pedal assembly. Install nut and tighten to 50-67 N-m (37-50 ft-lb).
8. **On commercial vehicles:** Install the pin and spacer connecting the brake pedal assembly, stoplamp switch assembly and master cylinder push rod together.

On motorhome vehicles: Install the pin, spacer and self-locking pin to connect the brake pedal assembly to the brake pedal to the bellcrank rod.

On commercial vehicles: Place the bushing, spacer, stoplamp switch assembly and master cylinder push rod onto the pin on the brake pedal. Install the spacer and pin.

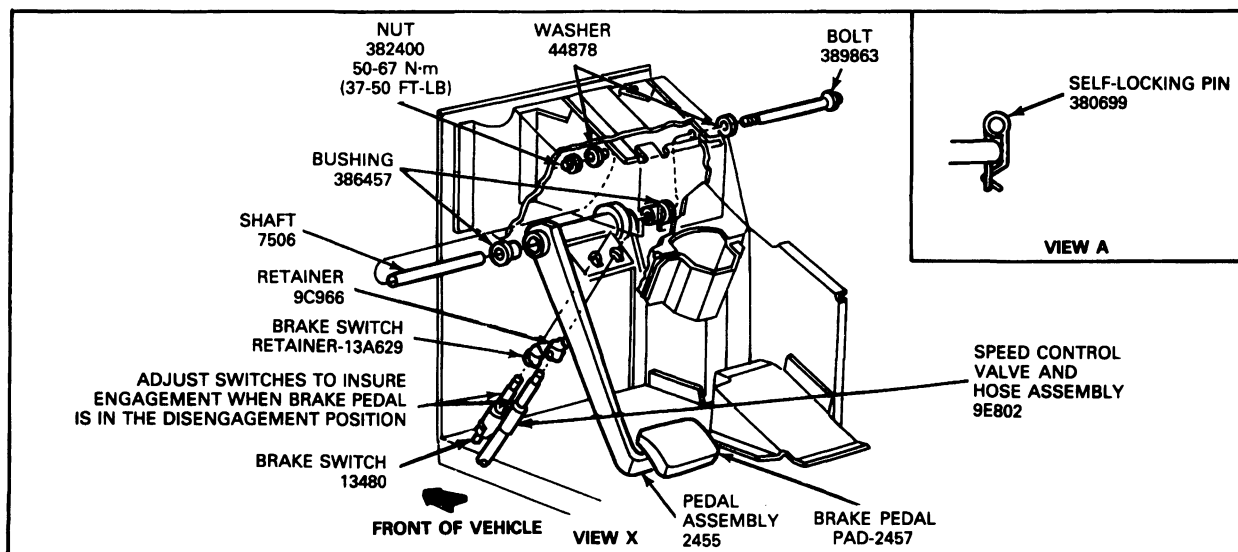
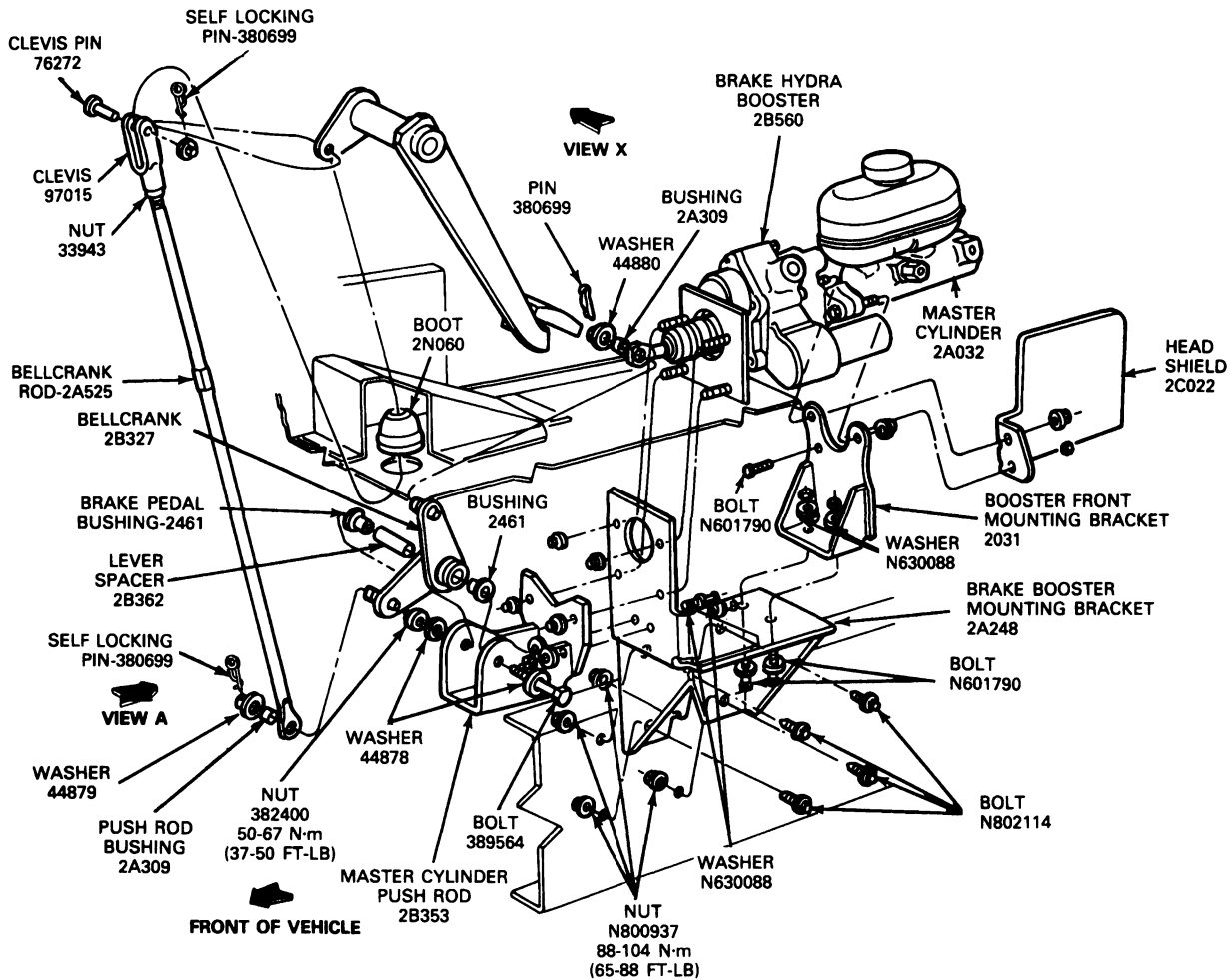
Connect wires to stoplamp switch. Check unit for correct operation.

REMOVAL AND INSTALLATION (Continued)

9. **On motorhome vehicles:** adjust brake pedal to bellcrank rod as follows:
 - a. Attach clevis, clevis pin and self-locking pin to brake pedal assembly.
 - b. Hold brake pedal against rubber stop.
 - c. Make sure jam nut is loose.
 - d. Turn brake rod into clevis until lower hole lines up with pin on bellcrank.
 - e. Slide brake rod and bushing onto pin of bellcrank and assemble washer and self-locking pin.
 - f. Tighten jam nut to 50-67 N·m (37-50 ft·lb).

REMOVAL AND INSTALLATION (Continued)

Brake Pedal Installation, F-Super Duty Motorhome Chassis



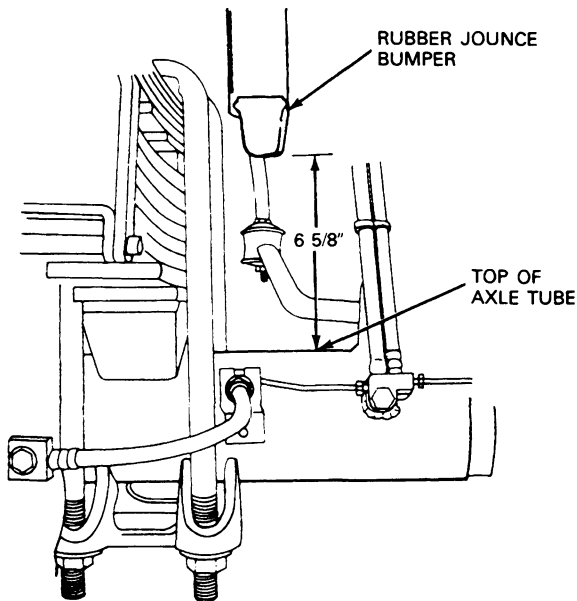
H5064-B

REMOVAL AND INSTALLATION (Continued)**Height Sensing Brake Proportioning Valve****F-Super Duty Chassis Cab Only**

CAUTION: If the linkage is disconnected from the height sensing valve, the proper indexing will be lost and a new sensing valve must be installed. The new sensing valve assembly will have the shaft preset and secured internally. If the valve shaft of the valve turns freely, **DO NOT USE**. The height/load sensing brake proportioning valve is not to be repaired or disassembled. It must be replaced as a complete assembly. If the linkage is damaged or broken and requires replacement, a new sensing valve must also be installed.

Removal

1. With the rear wheels on the ground, lift the frame to obtain a 168mm (6-5/8-inch) clearance between the bottom edge of the rubber jounce bumper and the top of the axle tube (both sides). The suspension is now in the correct position for installing the pre-indexed height sensing valve.

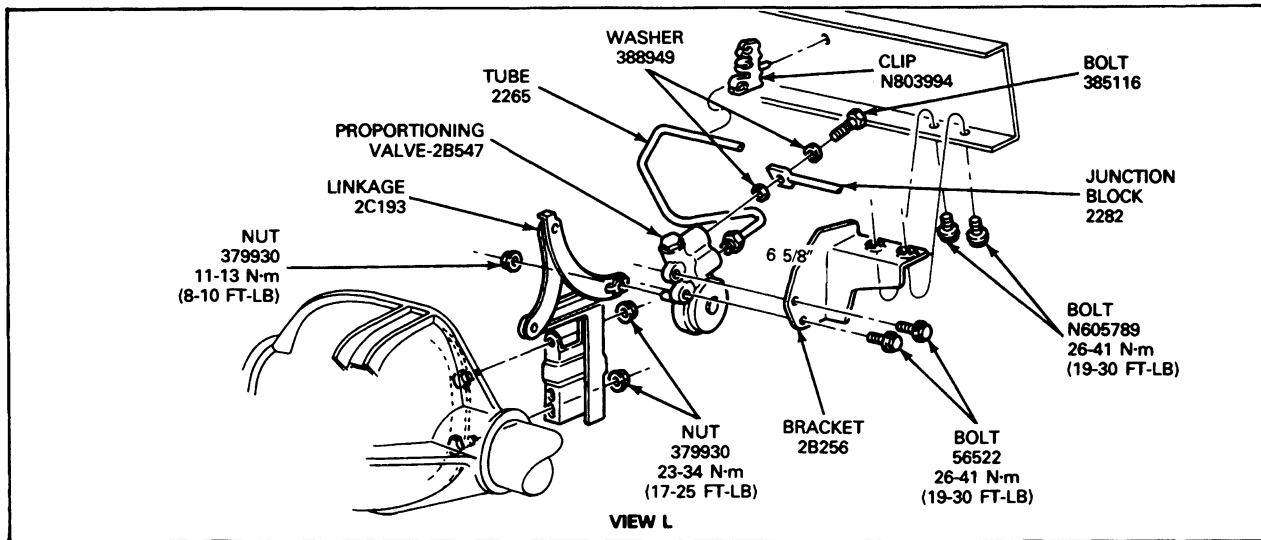
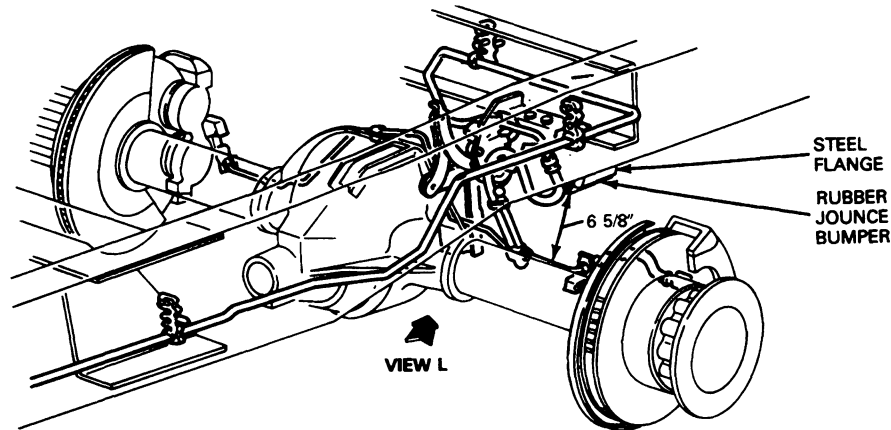
Obtain Correct Clearance Prior to Removing Proportioning Valve (F-Super Duty)

H7071-1A

2. Remove the nut holding the linkage arm to the height sensing valve and disconnect the linkage arm.
3. Remove the flow bolt holding the flexible brake hose to the valve.
4. Disconnect the brake line from the valve.
5. Remove the two (2) bolts securing the height sensing valve to mounting bracket, remove the valve.

REMOVAL AND INSTALLATION (Continued)

Height Sensing Brake Proportioning Valve, F-Super Duty Chassis Cab



H7072-2A

Installation

1. Place the height sensing valve on its mounting bracket. Install the two (2) mounting bolts and tighten to 17-24 N-m (12-18 ft-lb).
2. Install the flexible brake hose using new copper gaskets. Tighten the flow bolt to 37-46 N-m (28-34 ft-lb).
3. Install the brake line to the lower port on the valve and tighten securely.
4. Position the linkage arm on the height sensing valve and tighten the retaining nut to 11-14 N-m (8-10 ft-lb).

5. Bleed the brakes as described in Section 06-00. Check for proper brake operation.

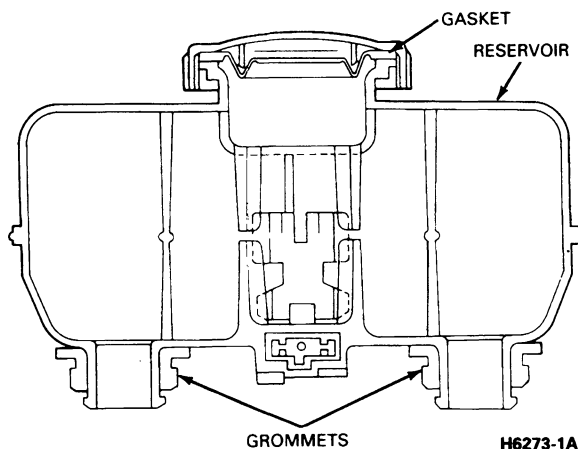
NOTE: When servicing other rear suspension components, (axle assembly, rear springs, fuel tank, etc.), remove the two (2) nuts attaching the sensing valve linkage to the rear axle cover plate. This will eliminate the need to replace the brake valve.

NOTE: Any change to the vehicle rear suspension which alters "curb" ride height or spring deflection rate (increased capacity leaf springs, addition of spacers, etc.) may change the function of the height sensing valve and alter the system braking performance.

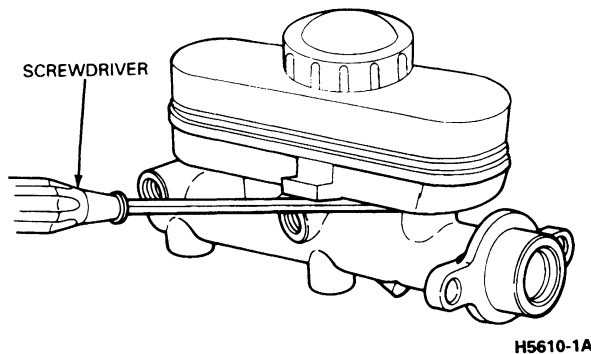
REMOVAL AND INSTALLATION (Continued)**Master Cylinder Reservoir****Removal**

1. Disconnect the brake warning lamp indicator wire from the plastic reservoir fluid level indicator socket. Using a suitable suction device, drain the brake fluid from the master cylinder assembly.

WARNING: BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.



2. Using a large screwdriver, pry between the reservoir and the master cylinder body and remove the reservoir.

**Installation**

1. Lubricate the two grommets included in Service Kit 2K478 with Heavy Duty Brake Fluid C6AZ-19542-AA or -BB (ESA-M6C25-A) or equivalent. Insert the grommets into the master cylinder body.

NOTE: Whenever replacing the master cylinder plastic reservoir, replace the grommets.

2. Press the plastic reservoir into the grommets with the fluid level indicator socket facing outboard. The reservoir should snap in place.
3. Connect the brake warning lamp indicator wire to the fluid level indicator socket.
4. Fill the reservoir with Heavy Duty Brake Fluid C6AZ-19542-AA or -BB (ESA-M6C25-A) or equivalent. Bleed the system as outlined in this section.
5. After bleeding, fill master cylinder to 3.17 mm (1/8-inch) from the top of the reservoir with Heavy Duty Brake Fluid C6AZ-19542-AA or -BB (ESA-M6C25-A) or equivalent.

DISASSEMBLY AND ASSEMBLY**Master Cylinder**

Remove the master cylinder from the vehicle for overhaul. Refer to the Removal and Installation portion of this section.

Disassembly

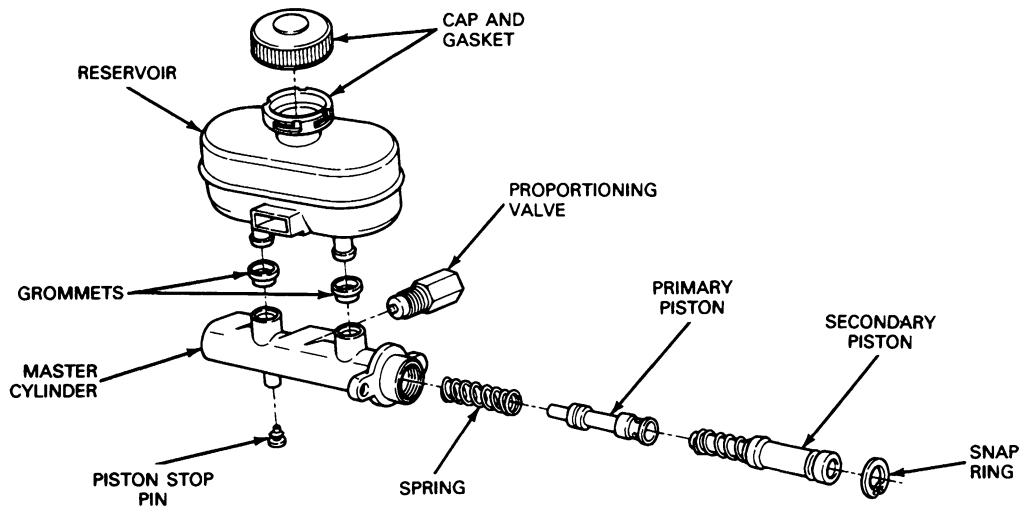
1. Clean the outside of the master cylinder. Remove the plastic cap and gasket. Drain and discard any brake fluid that remains in the cylinder.

WARNING: BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

2. If equipped, remove the proportioning valve from the master cylinder.
3. Remove stop-bolt from the bottom of the master cylinder assembly.

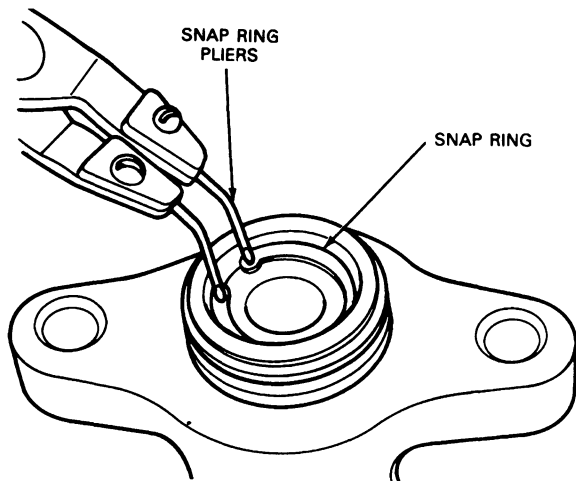
DISASSEMBLY AND ASSEMBLY (Continued)

Master Cylinder



H5844-2A

4. Depress the secondary piston and remove snap ring from retaining groove at the rear of the master cylinder bore.



H5401-1A

5. Remove secondary piston assembly from the master cylinder bore. Inspect for seal damage or twisting. Discard assembly.
6. Remove the primary piston assembly by directing compressed air into the outlet port at the blind end of the bore while plugging the other outlet port. Inspect for seal damage or twisting. Discard assembly.
7. Inspect the master cylinder bore for signs of etching, pitting, scoring or other damage.
 - a. If bore is damaged, discard and replace with new master cylinder assembly. Do not attempt to hone bore.

- b. If bore is not damaged, rebuild master cylinder assembly using the proper repair kit and the procedure outlined below.

Assembly

1. Clean the master cylinder body with clean isopropyl alcohol to remove any contamination.
2. Dip the repair kit piston assemblies in clean Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent to lubricate seals.
3. Carefully insert the complete primary piston assembly in the master cylinder bore.
4. Carefully insert the secondary piston assembly in the master cylinder bore.
5. Depress the secondary piston and install the snap ring in the cylinder bore groove.
6. Install the stop-bolt into the bottom of the master cylinder.
7. If equipped, install the proportioning valve assembly into the master cylinder.
8. Install the plastic cap on the master cylinder.

Bleeding the Master Cylinder

1. Support the master cylinder body in a vise, and fill both fluid reservoirs with Heavy Duty Brake Fluid C6AZ-19542-AA or -BA (ESA-M6C25-A) or equivalent.

WARNING: BRAKE FLUID CONTAINS POLYGLYCOL ETHERS AND POLYGLYCOLS. AVOID CONTACT WITH EYES. WASH HANDS THOROUGHLY AFTER HANDLING. IF BRAKE FLUID CONTACTS EYES, FLUSH EYES WITH RUNNING WATER FOR 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. IF TAKEN INTERNALLY, DRINK WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

DISASSEMBLY AND ASSEMBLY (Continued)

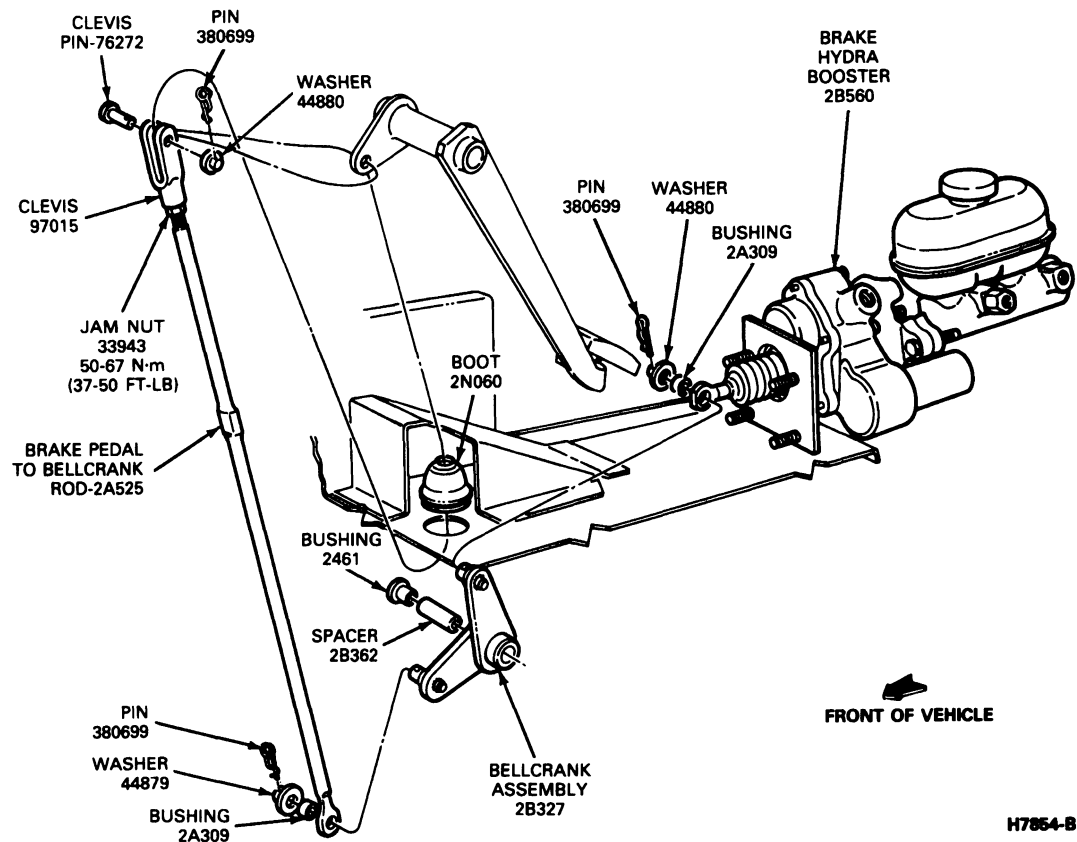
- | | |
|--|---|
| <ol style="list-style-type: none"> 2. Install plugs in the front and rear brake outlet ports. Bleed the front brake system first. 3. Loosen the plug in the front brake outlet port. Depress the secondary piston slowly to force the air out of the master cylinder. 4. Tighten plug while piston is depressed or air will enter the master cylinder. 5. Repeat this procedure until air ceases to exit at the outlet port. | <ol style="list-style-type: none"> 6. Repeat Steps 3, 4 and 5, for the rear brake outlet port with the front brake outlet plugged. 7. Tighten the plugs and try to depress the piston. The piston will not depress if all air bubbles are out of the brake system. 8. Install the plastic cap. 9. Install the master cylinder in the vehicle and bleed the hydraulic system as outlined in Section 06-00. |
|--|---|

ADJUSTMENTS

Refer to Section 06-00 for master cylinder and brake system bleeding procedures.

Brake Pedal Linkage Adjustment, F-Super Duty Motorhome Chassis

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Attach clevis, clevis pin and locking pin to brake pedal assembly. 2. Hold brake pedal against rubber stop. | <ol style="list-style-type: none"> 3. Make sure jam nut is loose. 4. Turn brake rod into clevis until lower hole lines up with pin on bellcrank. 5. Slide brake rod and bushing onto pin of bellcrank and attach washer and spring clip. 6. Tighten jam nut to 50-67 N-m (37-50 ft-lb). |
|---|---|

Brake Pedal

H7854-B

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	Lb·Ft
Master Cylinder-to-Vacuum Booster Nut (all except E-350 Motorhome, F-Super Duty with Hydro-Boost)	18-34	13-25
Vacuum Booster-to-Firewall and Pedal Support Nut (all except E-350 Motorhome, F-Super Duty with Hydro-Boost)	18-34	13-25
Master Cylinder to Hydro-boost — F-Super Duty	22-30	16-22
Hydro-boost to Mounting Brackets — F-Super Duty	22-30	16-22
Brake Rod Jam Nut	50-67	37-50
Brake Tube Clip Nut, E-350 Motorhome	30-40	22-30
Master Cylinder-to-Booster Nut, E-350 Motorhome	30-40	22-30
Screw, Pedal and Bracket Assembly-to-Y-Brace, F-Series and Bronco	20-27	15-20

(Continued)

TORQUE SPECIFICATIONS (Cont'd)

Description	N·m	Lb·Ft
Nut, Bellcrank Pivot Bolt, F-Super Duty Commercial Chassis	48-67	35-50
Nut, Bracket-to-Dash Panel, F-Super Duty Commercial Chassis	20-27	15-20
Nut, Booster Mounting Bracket-to-Frame, F-Super Duty Motorhome Chassis	88-104	65-88
Pedal Shaft Nut, F-Super Duty Motorhome Chassis	50-67	37-50
Nut, Bellcrank Pivot Bolt, F-Super Duty Motorhome Chassis	50-67	37-50
Height Sensing Proportioning Valve Mounting Bolts	17-29	12-18
Flow Bolt, Height Sensing Proportioning Valve	37-46	28-34
Nut, Height Sensing Proportioning Valve Linkage Arm	11-14	8-10

SECTION 06-07A Brake, Power, Vacuum, Single and Tandem Diaphragm

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Push Rod Adjustment.....	06-07A-7	E-150-250-350, F-150-250-350 and	
DESCRIPTION AND OPERATION	06-07A-1	Bronco	06-07A-2
DIAGNOSIS AND TESTING.....	06-07A-2	Econoline RV Chassis.....	06-07A-5
REMOVAL AND INSTALLATION		SPECIFICATIONS.....	06-07A-8
Vacuum Booster	06-07A-2	VEHICLE APPLICATION	06-07A-1

VEHICLE APPLICATION

F-150-250-350, E-150-250-350, E-350 RV and Commercial Chassis and Bronco Vehicles

DESCRIPTION AND OPERATION

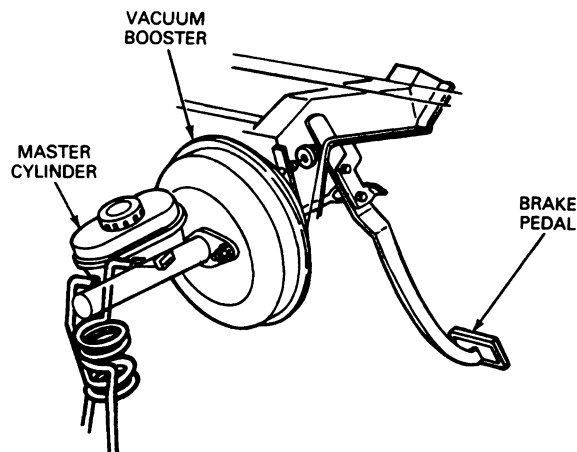
Service information for only the vacuum boosters (single and tandem) is given in this Section. Adjustments and repairs for the hydraulic brake systems are given in Sections 06-00, 06-02 and 06-03.

The vacuum booster is a self-contained vacuum booster providing assist to depress the master cylinder push rod.

On gasoline engine vehicles, engine vacuum is used to power the vacuum booster brake.

As diesel engines have no manifold vacuum, a pump is required to provide vacuum to the brake booster. Refer to Section 06-07B for vacuum pump service procedures.

NOTE: The only serviceable components of the power booster are the booster check valve, the adjustable push rod and the rubber reaction disc. The rubber reaction disc can only be repositioned if the master cylinder push rod is removed or accidentally pulled out. If the reaction disc cannot be properly installed and aligned, or if it cannot be located within the booster itself, the booster must be replaced as an assembly.



H4974-1A

BRAKE BOOSTER APPLICATION

Vehicle Series	Bronco, E-150, F-150 (5500 GVWR), F-250	F-250 H.D. (Over 7000 GVWR) and F-350	E-150 (Over 6000 GVWR) and E-250/350
Part Number	2005	2005	2005
Type	Single Diaphragm	Dual Diaphragm	Dual Diaphragm
Make	Bendix	Bendix	Bendix
O/S Diameter mm (in.)	298(11.72)	277(10.92)	277(10.92)
Effective Diameter mm (in.)	270(10.63)	342(13.46)	342(13.46)

DIAGNOSIS AND TESTING

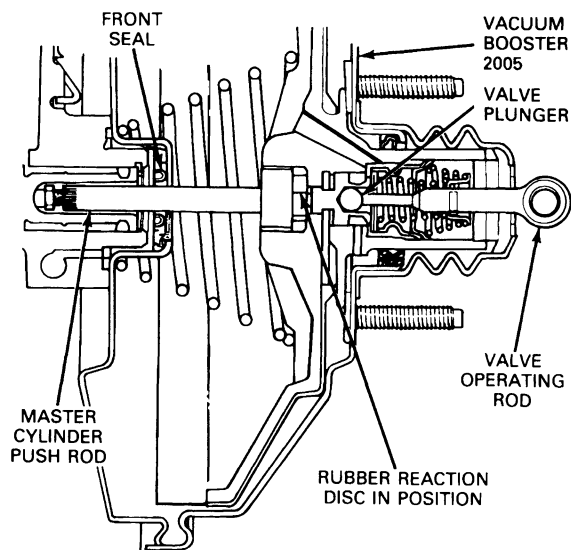
Refer to Section 06-00 for diagnostic and testing procedures.

REMOVAL AND INSTALLATION

Vacuum Booster

E-150-250-350, F-150-250-350 and Bronco

CAUTION: Make sure the booster rubber reaction disc is properly installed as shown in the illustration. If the master cylinder push rod is removed or accidentally pulled out, it may dislodge the rubber reaction disc from its seat in the booster. Symptoms of a dislodged disc are excessive pedal travel and extreme power brake sensitivity. If the master cylinder push rod is removed, remove the booster front seal and look into the booster to where the push rod seats. The disc is black rubber. If the disc is dislodged, a silver colored plunger will be exposed. If the rubber reaction disc cannot be located, installed and aligned, then the booster unit must be replaced.



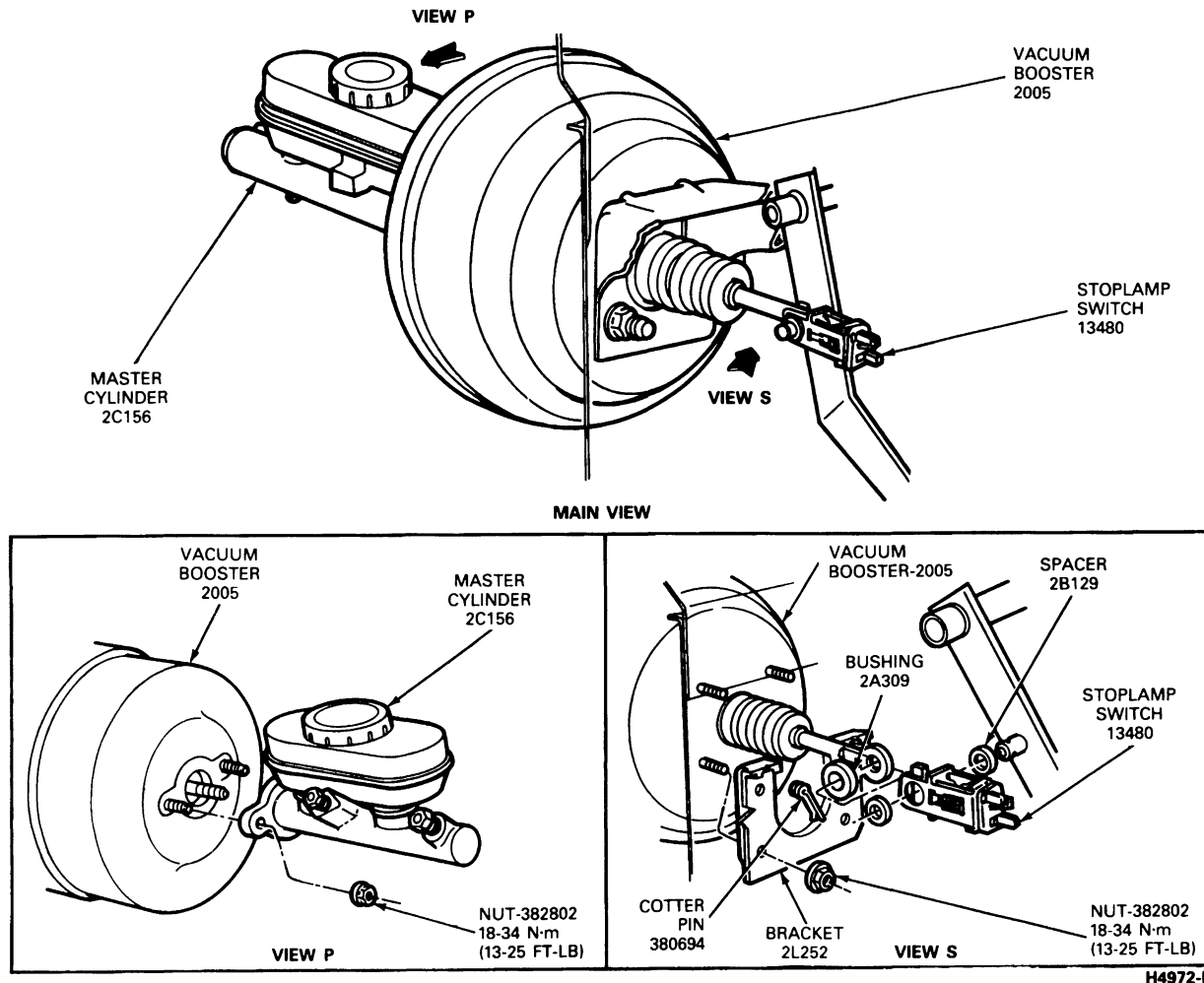
H2511-C

Removal

1. Disconnect the stop lamp switch wiring to prevent running the battery down.
2. Support the master cylinder from the underside with a prop.
3. Loosen the clamp that secures the vacuum hose to the booster check valve, and remove the hose. Remove the booster check valve.
4. Remove the wrap-around clip (securing brake lines) from booster inboard stud.
5. Remove the master cylinder-to-booster retaining nuts.
6. Pull the master cylinder off the booster and leave it supported by the prop, far enough away to allow removal of the booster assembly.
7. From inside the cab, remove the cotter pin and slide the stoplamp switch, spacers and bushing off the brake pedal arm.
8. From inside the cab, remove the nuts retaining the booster to the dash. Remove the booster from the engine compartment.

REMOVAL AND INSTALLATION (Continued)

Brake Booster Installation, F-150-250-350 and Bronco



H4972-B

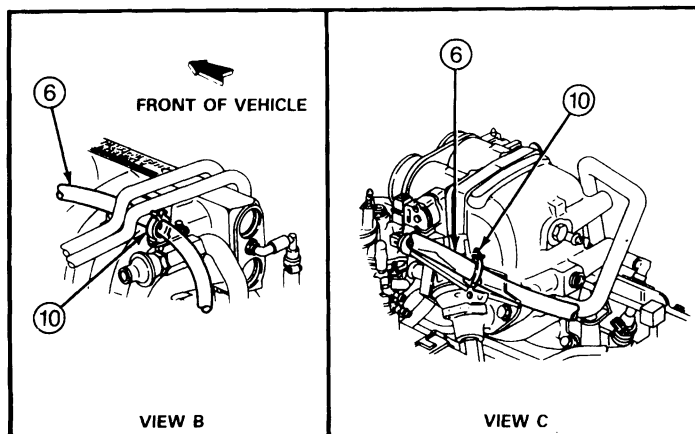
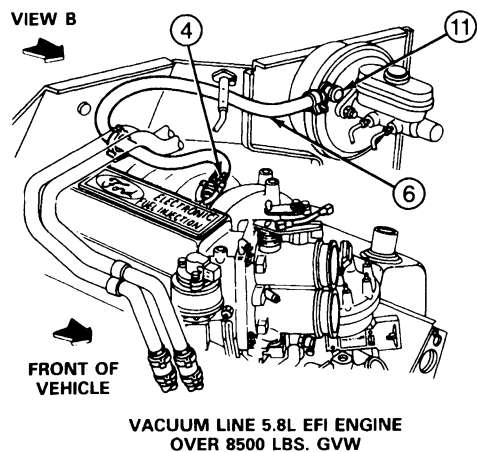
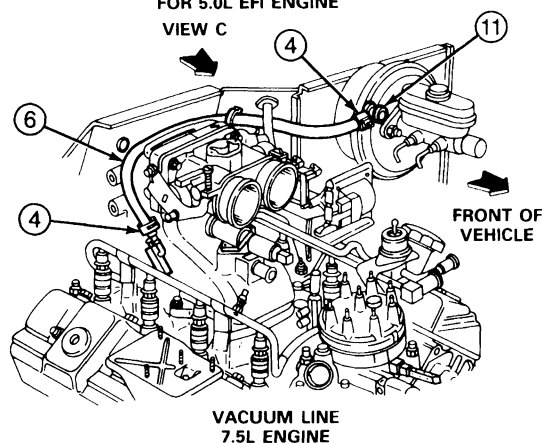
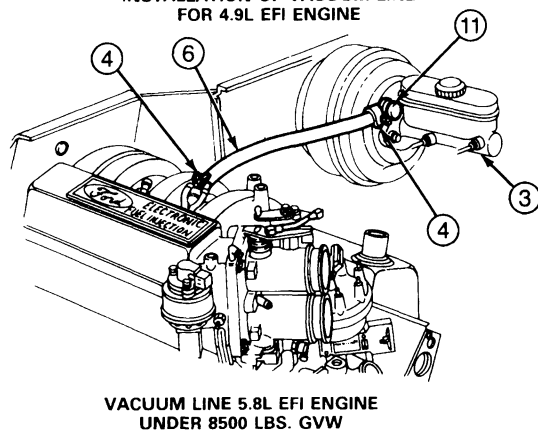
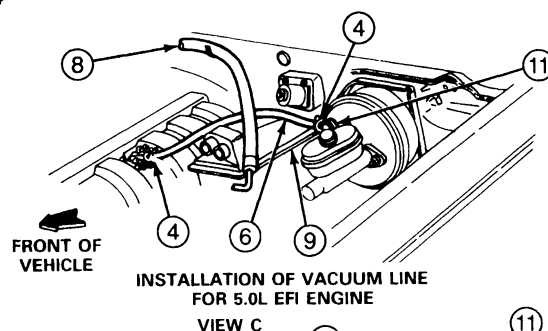
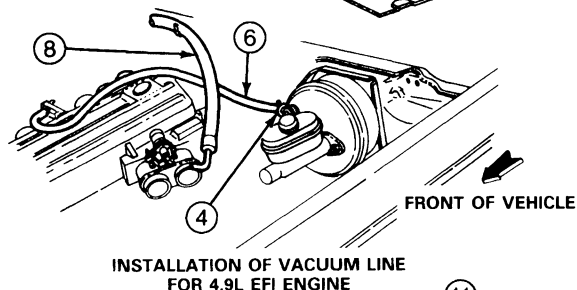
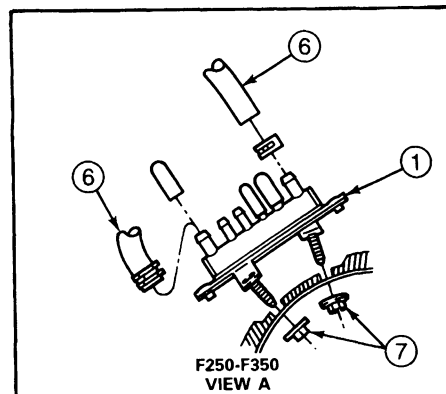
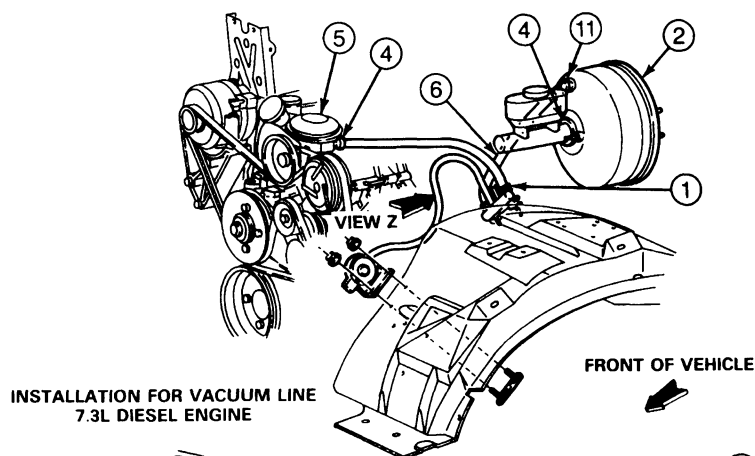
Installation

1. Mount the booster assembly on the engine side of the dash panel by sliding the bracket mounting bolts and valve operating rod in through the holes in the dash panel.
NOTE: Make certain that the booster push rod is positioned on the correct side of the brake pedal to install onto the push pin prior to tightening the booster assembly to the dash.
2. From inside the cab, install the booster mounting bracket-to-dash panel retaining nuts. Tighten nuts to 18-34 N·m (13-25 ft-lb).
3. Position the master cylinder on the booster assembly, install the retaining nuts, and remove the prop from underneath the master cylinder. Tighten nuts to 18-34 N·m (13-25 ft-lb).

4. Install the wrap-around clip on the booster inboard stud on F-150-250-350 and Bronco.
5. Install the booster check valve. Connect the manifold vacuum hose to the booster check valve and secure with the clamp. Make sure the vacuum hose is routed as shown.
6. From inside the cab, install the bushing and position the switch on the end of the push rod. Then install the switch and rod on the pedal pin, along with spacers on each side, and secure with the cotter pin.
7. Connect the stoplamp switch wiring.
8. Start the engine and check brake operation.

REMOVAL AND INSTALLATION (Continued)

Brake Booster Vacuum Hose Routing, F-150-250-350 and Bronco



H4973-G

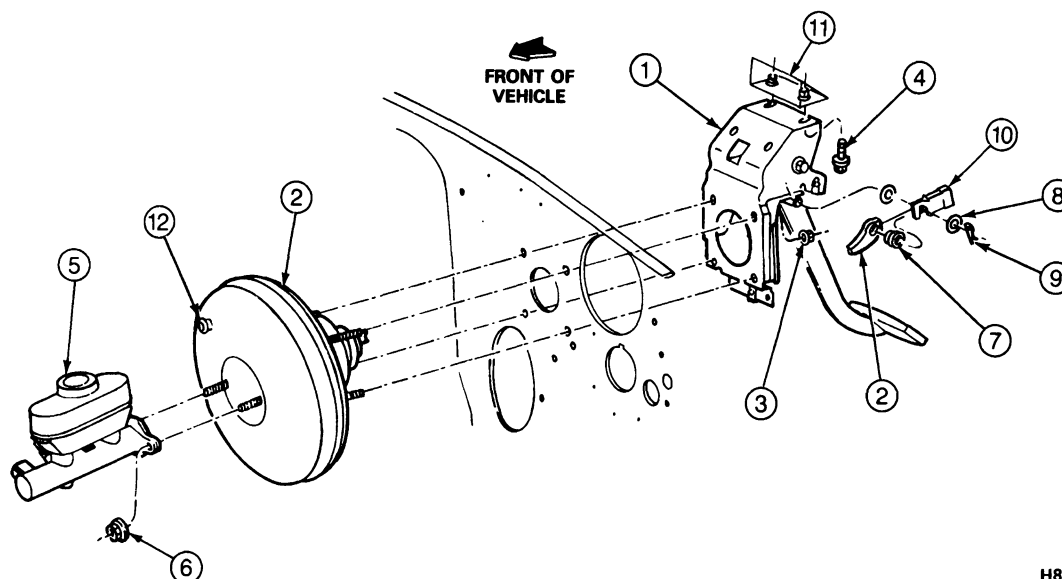
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	9C490	Vacuum Manifold
2	2005	Booster Assembly
3	2A032	Master Cylinder
4	382984	Clamp
5	—	Vacuum Pump
6	381298	Vacuum Hose

(Continued)

Item	Part Number	Description
7	N803300-S2	Nut and Washer M6 x 1.0 Hex 5-7 N·m (44-62 In-Lb)
8	—	Air Conditioning Hose (Reference)
9	—	Air Cleaner (Reference)
10	—	Guide
11	—	Vacuum Check Valve

Brake Booster Installation, E-150-250-350



H8156-B

Item	Part Number	Description
1	2450	Pedal and Bracket Assembly, Brake
2	2005	Booster Assembly, Brake
3	382802-S2	Nut 3/8-16 17.5-34 N·m (13-25 Ft-Lb)
4	56740-S2	Bolt 3/8-16 x 1 Hex Flange 30-41 N·m (22-30 Ft-Lb)
5	2C156	Master Cylinder

(Continued)

Item	Part Number	Description
6	382802-S2	Nut 3/8-16 17.5-34 N·m (13-25 Ft-Lb)
7	2A309	Bushing
8	2B129	Spacer
9	380699-S100	Pin
10	13480	Switch, Stoplamp
11	—	Cowl, Top (Reference)
12	—	Valve, Vacuum Check

TH8156A

Econoline RV Chassis

Removal

1. Support the master cylinder from the underside with a prop.
2. Loosen the clamp that secures the vacuum hose to the booster check valve and remove the hose. Remove the booster check valve.
3. Remove the master cylinder to booster retaining nuts.

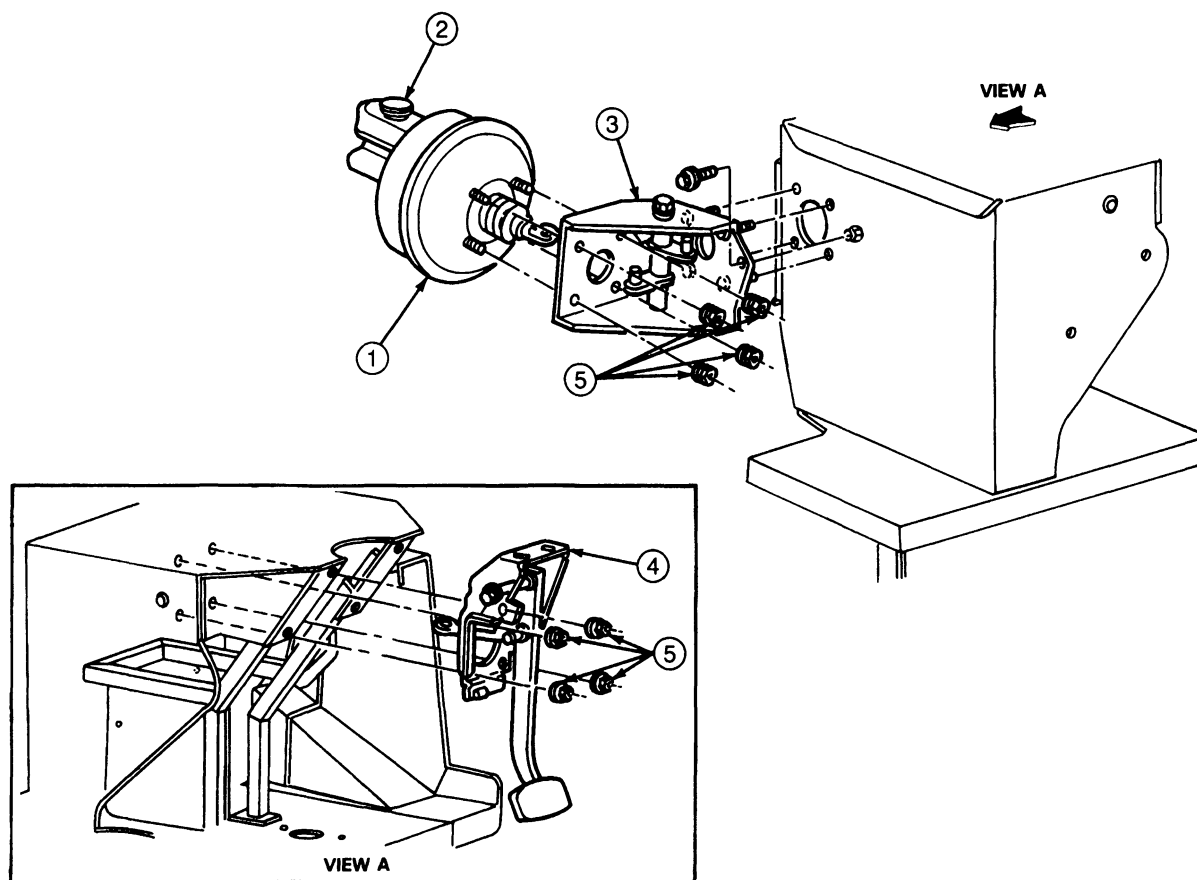
4. Pull the master cylinder off the booster and leave it supported by the prop, far enough away to allow removal of the booster.
5. Remove the four retaining nuts that secure the booster to the bell crank assembly. Remove the booster from the bell crank assembly.

Installation

1. Position the booster assembly to the bell crank assembly, making sure push rod engages bell crank arm.

REMOVAL AND INSTALLATION (Continued)

2. Install the four retainer nuts and tighten to 17.5-34 N·m (13-25 ft·lb).
3. Position the master cylinder onto the booster assembly and install the retaining nuts. Tighten nuts to 17.5-34 N·m (13-25 ft·lb).
4. Install the booster check valve. Connect the hose and secure with a clamp. Make sure the vacuum hose is routed properly.

Brake Booster Installation, Econoline RV Chassis

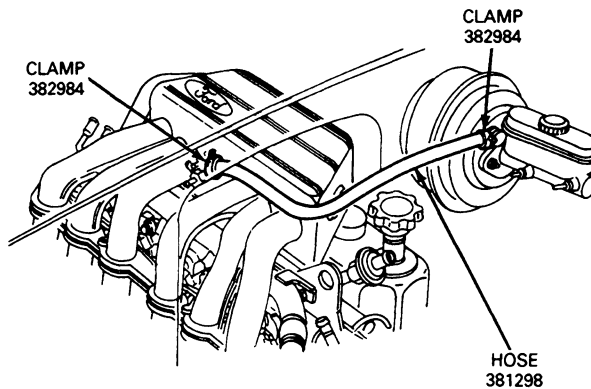
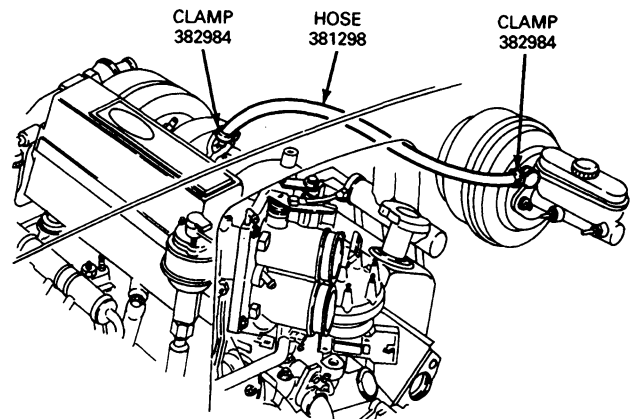
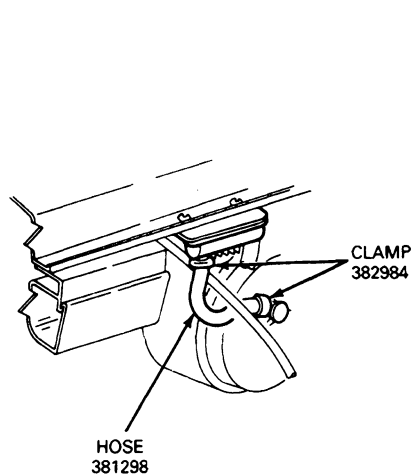
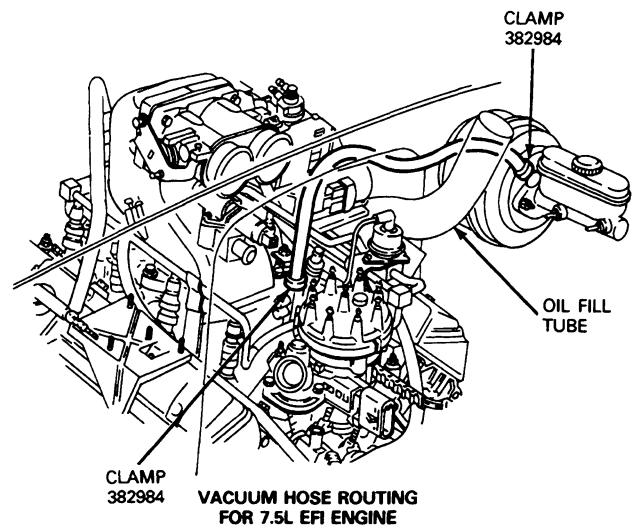
H8284-A

Item	Part Number	Description
1	2005	Booster, Brake
2	2A032	Master Cylinder, Brake
3	2A520	Bell Crank Assembly, Brake

(Continued)

Item	Part Number	Description
4	2450	Pedal Assembly, Brake
5	382802-S2	Nut 17.5-34 N·m (13-25 Ft-Lb)

TH8284A

REMOVAL AND INSTALLATION (Continued)**Brake Booster Vacuum Hose Routing, E-150-250-350****VACUUM HOSE ROUTING
FOR 4.9L EFI ENGINE****VACUUM HOSE ROUTING
FOR 5.0L EFI AND 5.8L EFI ENGINES****VACUUM HOSE ROUTING
FOR 7.3L DIESEL ENGINE****VACUUM HOSE ROUTING
FOR 7.5L EFI ENGINE**

H6814-2A

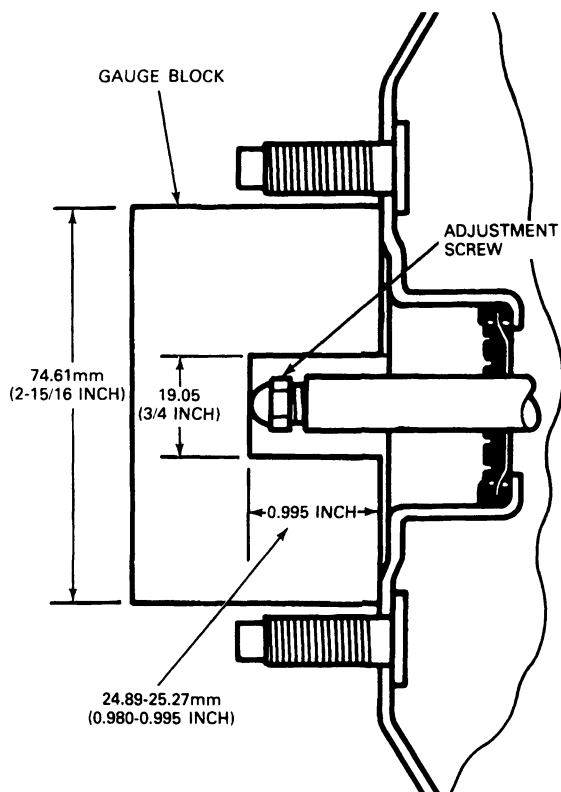
5. From inside the cab, install the bushing and position the switch on the end of the push rod. Then install the switch and rod on the pedal arm along with spacers on each side and secure the assembly with the cotter pin.
6. Connect the stoplamp switch.
7. Start the engine and check brake operation.

ADJUSTMENTS**Push Rod Adjustment**

The push rod has an adjustment screw to maintain the correct relationship between the booster control valve plunger and the master cylinder piston. If the plunger is too long, it will prevent the master cylinder piston from completely releasing hydraulic pressure, causing the brakes to drag. If the plunger is too short, it will cause excessive pedal travel and an undesirable clunk in the booster area. Remove the master cylinder for access to the booster push rod.

ADJUSTMENTS (Continued)

To check the adjustment of the screw, fabricate a gauge and place it against the master cylinder mounting surface of the booster body as shown. Adjust the push rod screw by turning it until the end of the screw just touches the inner edge of the slot in the gauge.

Booster Push Rod Gauge Dimensions and Adjustment**SPECIFICATIONS****TORQUE SPECIFICATIONS**

Description	N·m	Lb·Ft
Master Cylinder-to-Booster— E-150-250-350, Econoline RV Chassis	17.5-34	13-25
Master Cylinder-to-Booster— F-150, F-250, F-350, Bronco	18-33	13-25
Booster-to-Brake Pedal and Bracket Assembly— E-150-250-350	17.5-34	13-25
Booster-to-Dash Panel—F-150, F-250, F-350, Bronco	18-33	13-25
Vacuum Manifold-to-Inner Fender— F-Super Duty, F-250, F-350, 7.3L Diesel	2-3	18-27 (In-Lb)

SECTION 06-07B Brake, Power, Vacuum Pump, 7.3L Diesel

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS.....	06-07B-7	REMOVAL AND INSTALLATION (Cont'd.)	
DESCRIPTION AND OPERATION	06-07B-1	Vacuum Pump.....	06-07B-6
DIAGNOSIS AND TESTING.....	06-07B-3	SPECIAL SERVICE TOOLS / EQUIPMENT	06-07B-7
REMOVAL AND INSTALLATION		SPECIFICATIONS.....	06-07B-7
Low Vacuum Indicator Switch	06-07B-6	VEHICLE APPLICATION	06-07B-1

VEHICLE APPLICATION

E-250-350 and F-250-350 Vehicles Equipped with 7.3L Diesel Engine

DESCRIPTION AND OPERATION

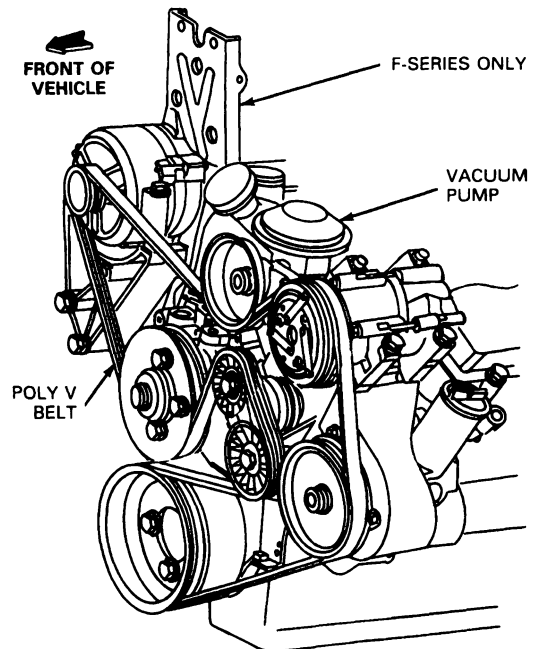
On diesel engine vehicles, vacuum is supplied from a pump located on the top left side of the engine. The diesel engine vacuum pump is driven by a poly-V belt that drives all accessories.

Diesel engine equipped vehicles employ the use of a low-vacuum indicator switch.

The low-vacuum indicator switch for E-250-350 models is mounted to the left side fender panel. On F-250-350 models the indicator switch is located on the right side of the engine compartment adjacent to the vacuum pump.

The vacuum pump, low-vacuum indicator switch and connecting hoses are shown in the following illustrations.

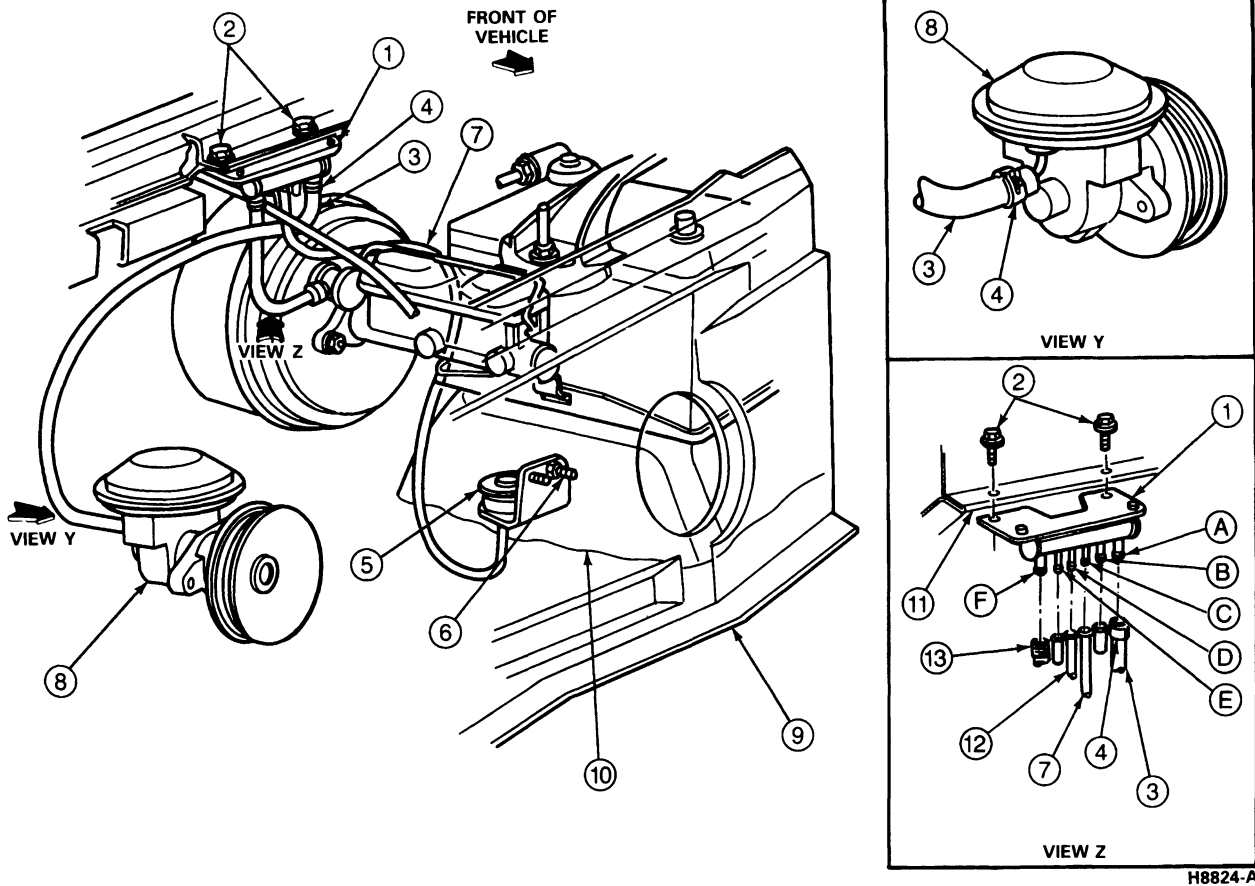
NOTE: Gasoline engine vehicles use engine vacuum to power the vacuum booster brake. Refer to Section 06-07.



H8823-A

DESCRIPTION AND OPERATION (Continued)

Brake Booster Vacuum Hose Routing, E-250-350



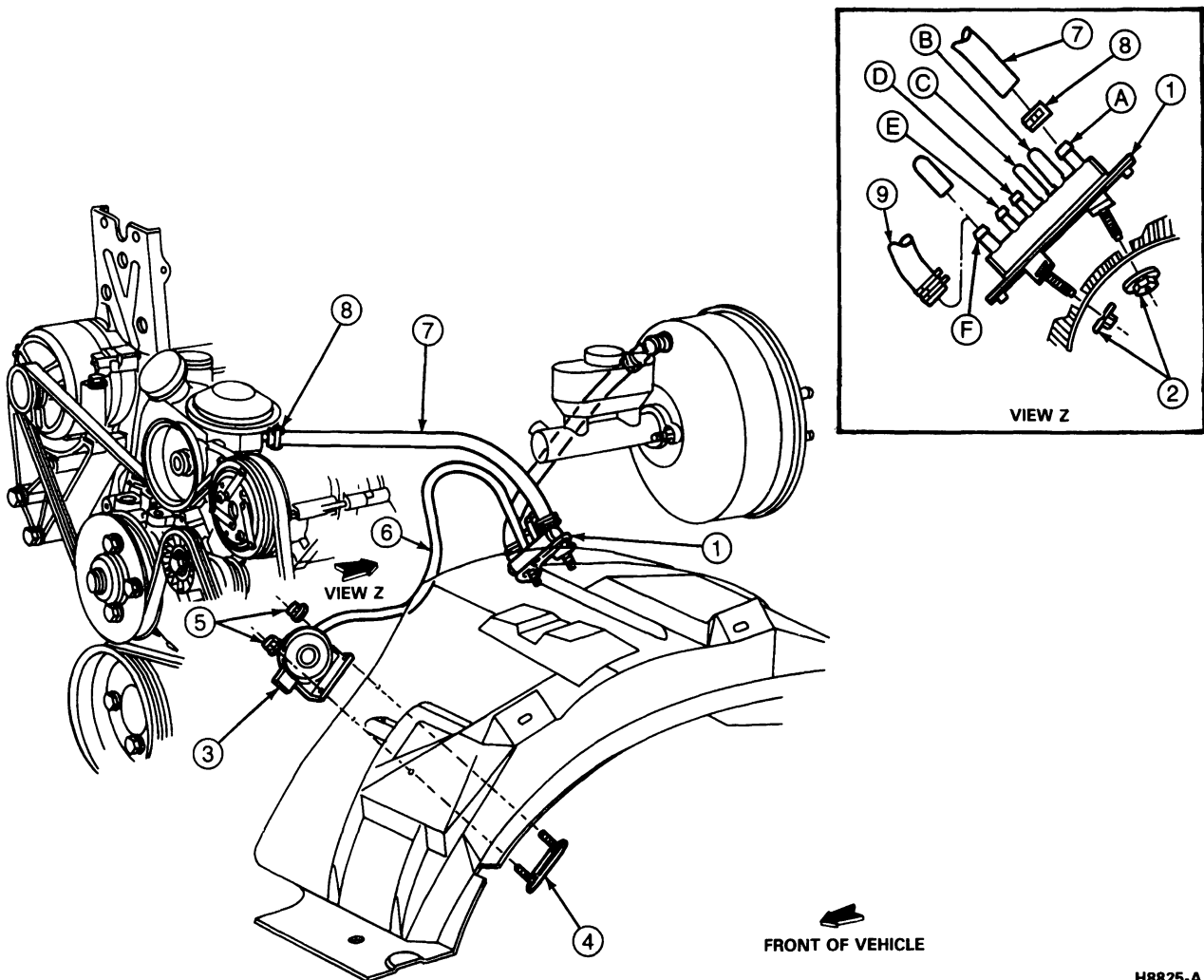
Item	Part Number	Description
1	9C490	Vacuum Outlet Manifold Assembly
2	40927-S2	Screw, 1/4-20 x 1/2 10-14 N·m (89-124 In·Lb)
3	381298-SX38A	Hose
4	382984-S100	Hose Clamp
5	12A182	Switch Assembly, Distributor Module Valve
6	N610957-S36	Screw, 6.3 x 18 8-11 N·m (71-97 In·Lb)
7	381377-S300A	Vacuum Hose
8	2A451	Vacuum Pump
9	Ref.	Radiator Support
10	Ref.	Fender Apron, Left

(Continued)

Item	Part Number	Description
11	Ref.	Cowl Inner Panel
12	—	Vacuum Line, Climate Control
13	381298	Vacuum Hose
A	—	3/8-Inch Port — Vacuum Pump
B	—	5/16-Inch Port — Spare
C	—	1/4-Inch Port — Low Vacuum Indicator
D	—	1/4-Inch Port — Climate Control
E	—	1/4-Inch Port — Regulator Valve
F	—	3/8-Inch Port — Brake Booster

DESCRIPTION AND OPERATION (Continued)

Brake Booster Vacuum Hose Routing, F-250-350 and F-Super Duty



H8825-A

Item	Part Number	Description
1	9C490	Vacuum Outlet Manifold Assembly
2	N803300-S2	Nut and Washer, M6 x 1.0 6-7 N·m (53-62 In·Lb)
3	12A182	Switch Assembly, Distributor Module Valve
4	9C809	Plate Assembly, Speed Control Bracket
5	N620480-S2	Nut, M6 x 1.0 8-11 N·m (71-97 In·Lb)
6	381377-S260A	Tube, 1/4 I.D.-7/16 O.D.
7	381298-SX05A	Hose

(Continued)

Item	Part Number	Description
8	382984-S100	Clamp
9	—	Hose to Brake Booster
A	—	3/8-Inch Port — Vacuum Pump
B	—	5/16-Inch Port — Spare
C	—	1/4-Inch Port — Spare
D	—	1/4-Inch Port — Climate Control
E	—	1/4-Inch Port — Low Vacuum Indicator
F	—	3/8-Inch Port — Spare (If Vehicle Equipped With Hydro Boost)

DIAGNOSIS AND TESTING

Refer to Section 06-00 for diagnostic and testing procedures other than those listed in the chart.

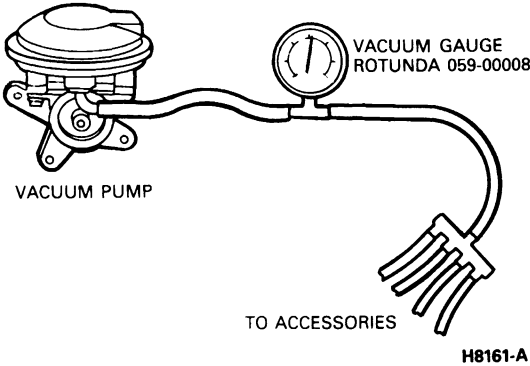
DIAGNOSIS AND TESTING (Continued)

VACUUM PUMP DIAGNOSIS — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	CONDITION ISOLATION		
	<ul style="list-style-type: none"> Block the wheels and apply the parking brake. Place the transmission in PARK or NEUTRAL. Key ON, engine running. Disconnect the low-vacuum switch. Run engine at normal idle speed. Apply brakes. 	Brake warning light illuminates Brake warning light doesn't illuminate	Condition related to the hydraulic system. REFER to Section 06-03. Condition related to the vacuum pump. GO to A2 .
A2	VACUUM PUMP OUTPUT		
	<ul style="list-style-type: none"> Disconnect the vacuum pump hose from the brake booster and insert a vacuum gauge. Rotunda Model 059-00008 or equivalent, in the hose end. Run the engine at normal curb idle and check vacuum. Gauge should read 70 kPa (21 inches Hg) at sea level within 30 seconds (refer to graph below for vacuum at other elevations). <p>MINIMUM ACCEPTABLE VACUUM VS. ALTITUDE</p> <p style="text-align: right;">H8160-A</p>	Vacuum at or above specified level Vacuum below specified level or fluctuating gauge reading	GO to A4 . GO to A3 .
A3	SYSTEM INTEGRITY CHECK		
	<ul style="list-style-type: none"> Check gauge and connections for leaks. Check pulley fit-to-shaft. Check that engine curb idle rpm is at specifications. Repeat procedure in Step A2, Vacuum Pump Output Test. 	Vacuum at or above specified level Vacuum below specified level	GO to A4 . REPLACE vacuum pump.

DIAGNOSIS AND TESTING (Continued)

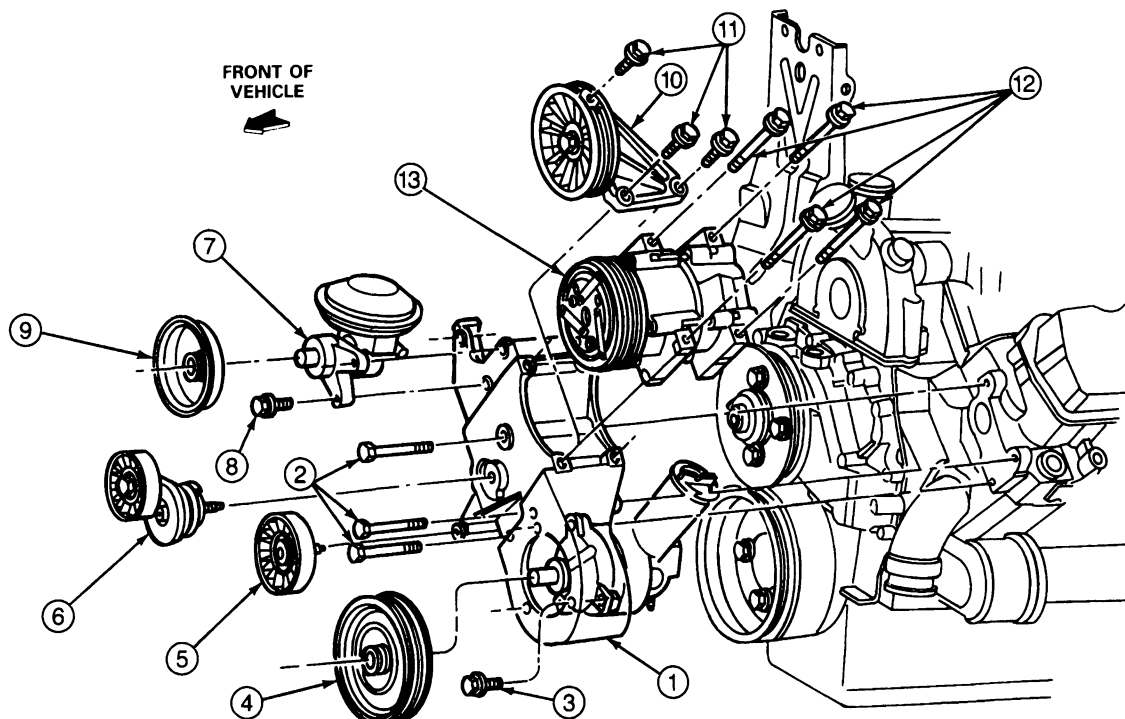
VACUUM PUMP DIAGNOSIS — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A4	VACUUM SYSTEM CHECK		
	<ul style="list-style-type: none"> Reconnect the vacuum hose with a T-fitting and connect vacuum gauge so gauge is located near pump inlet. Run engine at curb idle speed. The maximum allowable vacuum drop to be 10 kPa (3 inches Hg) from the specified level of vacuum described in Step A2, Vacuum Pump Outlet Test. <p>VACUUM SYSTEM CHECK</p>  <p>VACUUM PUMP</p> <p>VACUUM GAUGE ROTUNDA 059-00008</p> <p>TO ACCESSORIES</p> <p>H8161-A</p>	<p>Vacuum at or above specified level</p> <p>Vacuum below specified level</p>	<p>GO to A5.</p> <p>GO to A6.</p>
A5	BRAKE BOOSTER CHECK		
	<ul style="list-style-type: none"> Depress brake pedal and hold. Repeat Step A4, Vacuum System Check. 	<p>Vacuum at or above specified level</p> <p>Vacuum below specified level</p>	<p>CHECK Hydraulic System. REFER to Section 06-00.</p> <p>REPLACE brake booster.</p>
A6	LEAK CHECK		
	<ul style="list-style-type: none"> Check all attaching hoses for leaks. 	<p>Vacuum hoses leak</p> <p>Vacuum hoses do not leak</p>	<p>SERVICE as required.</p> <p>If vacuum is still low, CHECK all vacuum accessories for out-of-specification leaks. REPAIR or REPLACE as required. Refer to Section 06-00.</p>

TH4142D

DIAGNOSIS AND TESTING (Continued)

Vacuum Pump Installation, Disassembled View E-Series and F-Series



H8826-A

Item	Part Number	Description
1	19E708	Bracket, P / S-A / C-V / P
2	389706-S2	Screw, 3/8-16 x 5.50 41-54 N·m (30-40 Ft-Lb)
3	N800199-S8M	Screw, M10-1.5 x 33 41-54 N·m (30-40 Ft-Lb)
4	3D673	Power Steering Pulley
5	19A216	Idler Pulley
6	6B209	Belt Tensioner

(Continued)

Item	Part Number	Description
7	2A451	Vacuum Pump
8	N605790-S2	Bolt, M8-1.25 x 40 24-31 N·m (18-23 Ft-Lb)
9	2L487	Vacuum Pump Pulley
10	19A216	Idler Assembly
11	N605790-S2	Bolt, M8-1.25 x 40 24-31 N·m (18-23 Ft-Lb)
12	N806020-S2	Bolt, M8-1.25 x 123 24-31 N·m (18-23 Ft-Lb)
13	19D629	Air Conditioning Compressor

REMOVAL AND INSTALLATION

Low Vacuum Indicator Switch

Refer to illustration in the Description portion of this section.

NOTE: The low vacuum switch is mounted to the left side fender panel.

Removal

1. Disconnect vacuum hose from low-vacuum indicator switch.
2. Remove two attaching screws and remove switch and bracket assembly.

Installation

1. Position switch and bracket assembly to panel and secure with two screws. Tighten screws to 8-11 N·m (6-8 ft-lbs).

2. Connect vacuum hose to low vacuum indicator switch.

Vacuum Pump**Removal**

1. Loosen the hose clamp.
2. Remove the hose from the vacuum pump inlet fitting.
3. Remove drive belt by placing a 15mm box end wrench on the automatic belt tensioner pulley bolt and rotating it counterclockwise until belt can be removed.

REMOVAL AND INSTALLATION (Continued)

4. Remove vacuum pump retaining bolts and remove vacuum pump.

NOTE: The vacuum pump is not to be disassembled. It is only serviced as a unit. The pulley is serviced as a separate item.

Installation

- Position vacuum pump and install retaining bolt. Tighten bolts to 24-31 N·m (18-23 ft-lb).
- Connect the hose from the manifold vacuum outlet fitting to the pump and install the hose clamp.

3. Install belt by placing a 15mm box end wrench on the automatic belt tensioner pulley bolt and rotate the pulley counterclockwise. Position belt on pulley.

NOTE: the vacuum pump is driven by the back (flat) side of the belt.

NOTE: The BRAKE light will glow until vacuum builds up to the normal level.

NOTE: If new belt is installed, recheck belt tension after running engine for five minutes.

ADJUSTMENTS

Adjustments and repairs for the hydraulic brake system are given in Section 06-00.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	Lb-Ft
Low-Vacuum Indicator Switch Bracket Screws	8-11	6-8
Vacuum Pump-to-Bracket	24-31	18-23

VACUUM PUMP BELT TENSION SPECIFICATIONS — 7.3L DIESEL ENGINE

Belt	New Belt		Used Belt			
	Lbs	N	Minimum		Readjustment	
			Lbs	N	Lbs	N
Vacuum Pump Belt	90-130	400-578	60	266	65-85	290-378

TH4074A

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
059-00008	Vacuum / Pressure Tester

SECTION 06-07C Brake, Power, Hydro-Boost Booster

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DIAGNOSIS AND TESTING (Cont'd.)	
Bleeding the Hydro-Boost Unit.....	06-07C-16	Seal Leak Diagnosis	06-07C-9
Brake Pedal Rod, Motorhome	06-07C-16	DISASSEMBLY AND ASSEMBLY.....	06-07C-16
DESCRIPTION AND OPERATION	06-07C-1	REMOVAL AND INSTALLATION	
DIAGNOSIS AND TESTING		Hydro-Boost Booster.....	06-07C-9
Diagnosis Guides	06-07C-6	SPECIFICATIONS.....	06-07C-17
Hydro-Boost Normal Noise		VEHICLE APPLICATION	06-07C-1
Characteristics	06-07C-6		

VEHICLE APPLICATION

All F-Super Duty Chassis Cab, Commercial and Motorhome Chassis Vehicles

DESCRIPTION AND OPERATION

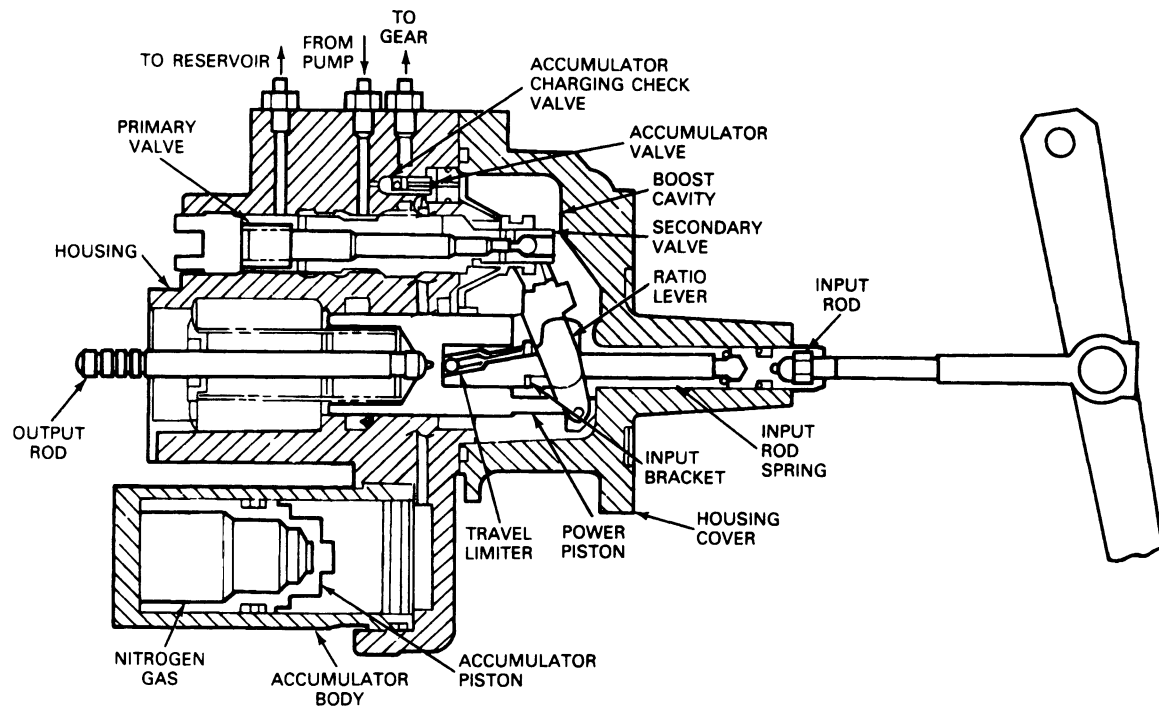
The Bendix Hydro-Boost brake booster is a hydraulically operated brake booster powered by the power steering pump. The power steering pump provides the fluid pressure to operate both the hydraulically-powered brake booster (hydro-boost) and the power steering gear.

A hydro-boost reserve system (compressed gas accumulator) stores sufficient fluid under pressure to provide at least two power assist brake applications in the event the power steering pump fluid flow is interrupted. The brakes can also be applied manually if the reserve system is depleted.

Hydro-Boost model identification is stamped into the booster housing near the inlet line.

DESCRIPTION AND OPERATION (Continued)

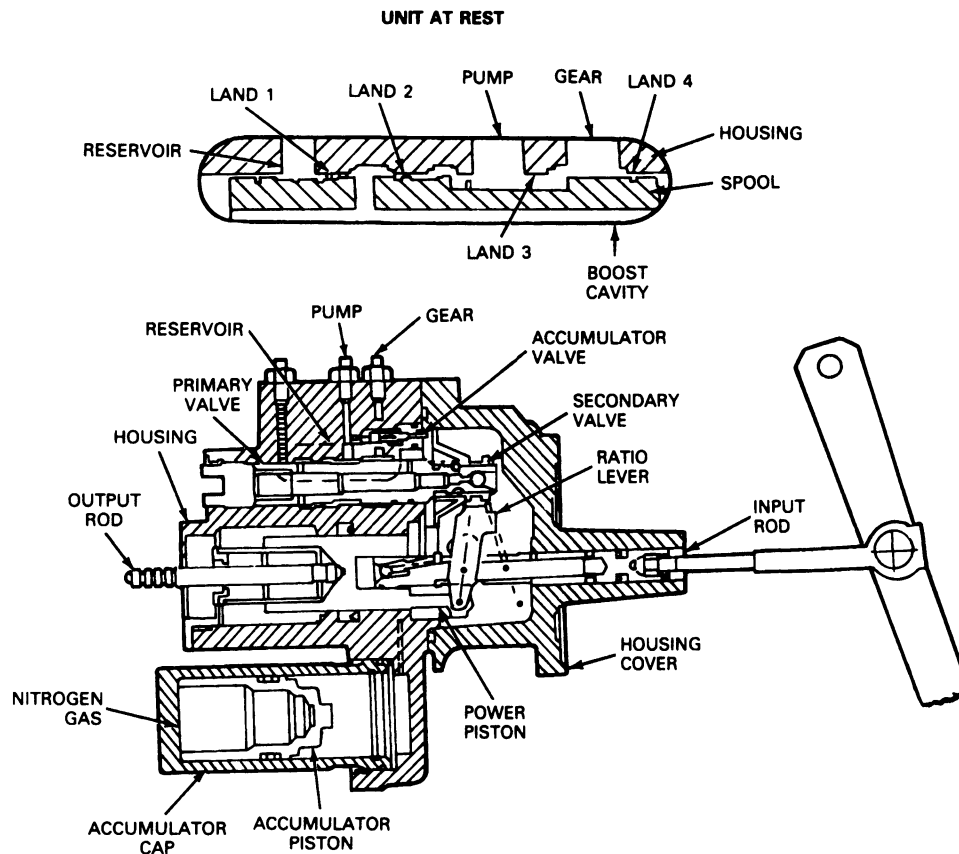
Hydro-Boost Booster



H6260-B

DESCRIPTION AND OPERATION (Continued)

With the Hydro-Boost at rest (engine on, brakes released) oil flows from the inlet (pump) port, across the number 3 land and out the gear port. In this position, steering pressure created by the steering gear and pump is isolated from the boost cavity by the spool valve. Lands 2 and 4 block this steering pressure avoiding activation of the unit. Any leakage goes directly back to the reservoir.

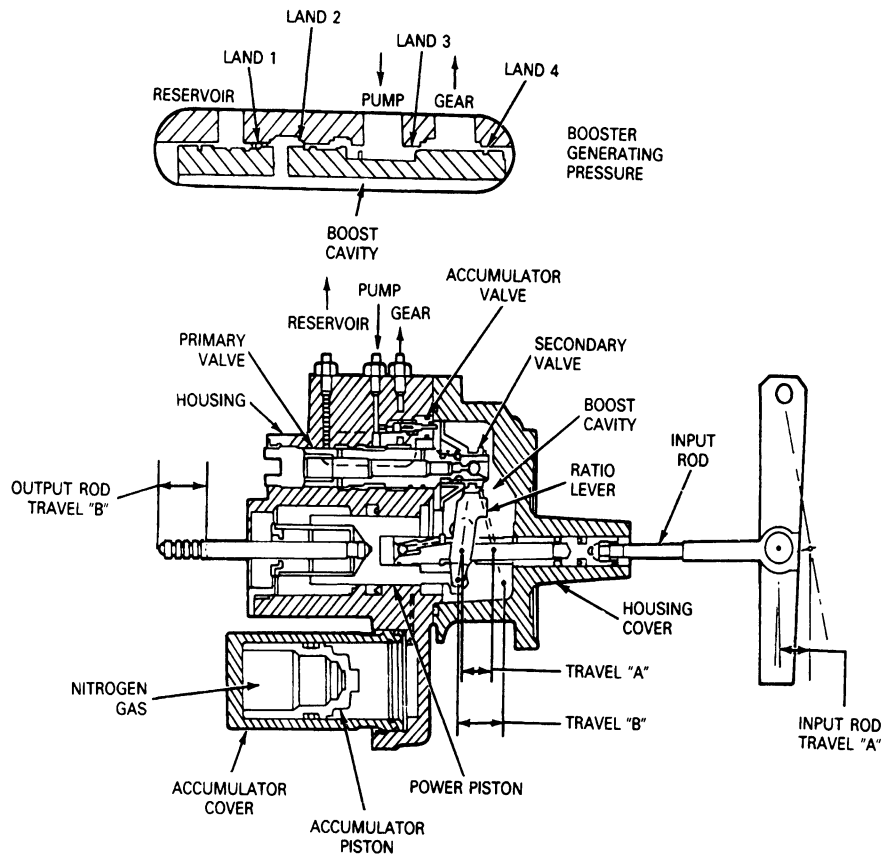


H6261-B

During normal power operation, the brake pedal is applied as shown by input rod travel A. The movement of the ratio lever operates the spool valve creating hydraulic pressure due to the restriction at land 3. Fluid traverses land 2 and flows through the center of the spool into the boost cavity. This pressure acts against the power piston to give the power assist and against the reaction rod to provide the effort level of the brake pedal.

DESCRIPTION AND OPERATION (Continued)

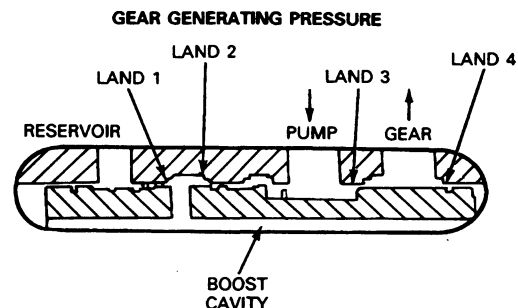
If, while braking, fluid pressure is required for steering, pump pressure will rise and the spool valve will shift in an open direction allowing more fluid to flow to the steering gear. Even under extremes of braking, the fluid flow to the steering gear is fully sufficient for steering the vehicle.



H6262-2A

The enlarged view of the spool valve shows the relationship of the valve lands during normal power operation. Land 1 is closed blocking the oil flow to the reservoir. Land 3 meters the flow of oil from the supply pump to the steering gear and generates the hydraulic pressure that is metered across land 2 to provide assist to the brakes.

The enlarged view of the valve shows the same operation except pressure is generated by the steering gear and is also being used for braking. During this mode of operation, the spool travel is slightly less than the first case.



H6263-1A

Reserve System

The reserve braking system consists of a charging valve, an accumulator valve and a compressed gas accumulator. The system is open to the pressure port of the hydro-boost.

DESCRIPTION AND OPERATION (Continued)

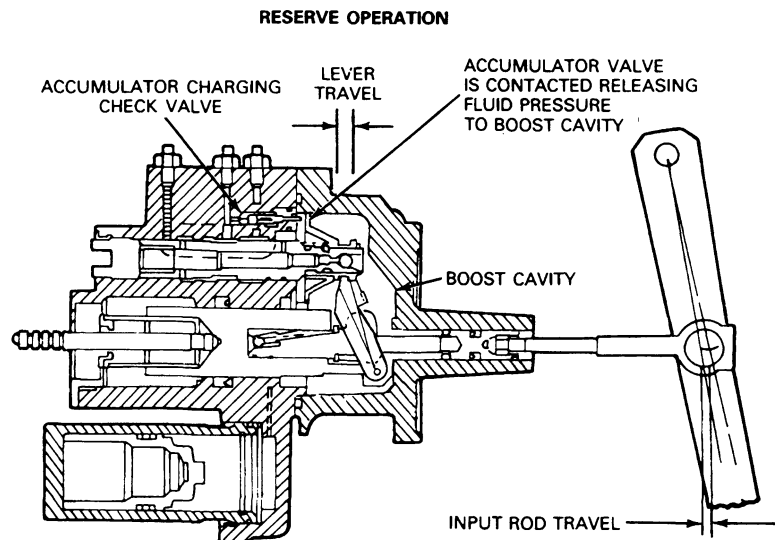
The accumulator is charged by the pump pressure during normal steering or braking operation through a check valve that communicates with the pump port.

The charging valve has an orifice and a check valve. Fluid from the pump passes around the check valve into the accumulator if the pump pressure exceeds the pressure in the accumulator. The charging rate is controlled by the orifice to minimize its effect on fluid flow to the steering gear. The check valve prevents reverse flow when the accumulator pressure is greater than pump pressure.

The accumulator valve is a small poppet-type valve held closed by the pressure stored in the accumulator. An actuator on the spool valve sleeve opens the accumulator valve when a stop with no pump pressure is made that requires use of the reserve system pressure.

Fluid pressure can also enter the accumulator from the boost chamber through the accumulator valve. This condition occurs whenever boost chamber pressure momentarily exceeds accumulator pressure.

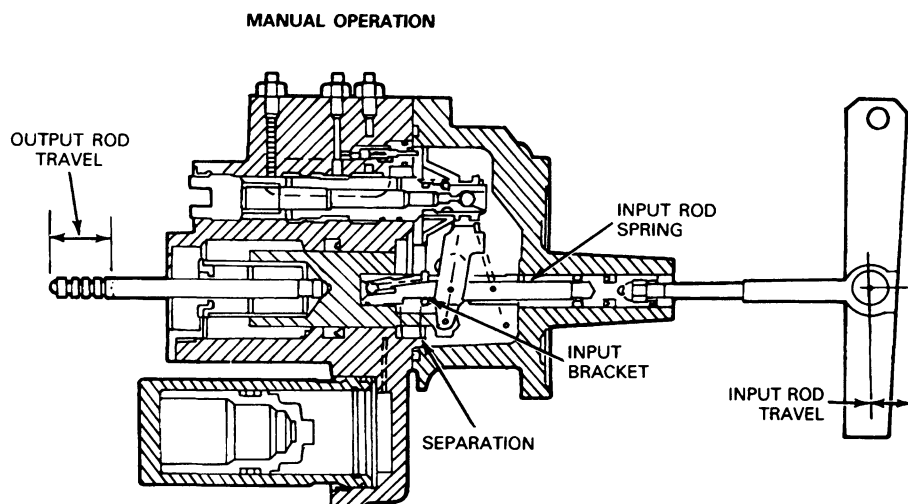
A pressure relief valve vents the accumulator to the pump pressure port whenever pressure in the accumulator exceeds approximately 9,652 kPa (1,400 psi).



H6264-2A

DESCRIPTION AND OPERATION (Continued)

When reserve power is depleted (manual operation) pressure on the brake pedal will cause the input bracket to separate from a shoulder on the input rod, compresses the input spring and allows a change of ratio between input and output rods. This ratio increase will cause the brake pedal to travel further and increases the mechanical force applied to the master cylinder.



H6265-2A

DIAGNOSIS AND TESTING**Hydro-Boost Normal Noise Characteristics**

Normal hydro-boost brake units will produce certain characteristic noises that current technology cannot correct. These noises occur, for the most part, when the brake pedal is manipulated in a manner not associated with the everyday braking habits. The general categories of normal operating noise are hissing noise and clunk, click and chatter noises.

The hydro-boost will emit normal hissing noises when above normal pedal efforts are applied. The hiss sounds are particularly noticeable with the vehicle motionless and will increase in intensity as pedal efforts increase and system operating temperatures increase. Loud hissing sounds at or below normal pedal effort (111-156 N [25-35 lb]) warrants investigation and possible correction.

Clunk, chatter or clicking noises will be heard when the brake pedal is quickly released from hard pedal efforts. Due to "quick release for hard application" requirement for the noises, they will most likely be heard with the vehicle motionless or during a fast stop-start condition.

Diagnosis Guides

Refer to the following diagnosis guides for aid in diagnosing Hydro-Boost conditions. Additional information is available in Section 11-00.

DIAGNOSIS AND TESTING (Continued)**NO POWER ASSIST — TEST A**

TEST STEP		RESULT	ACTION TO TAKE
A1	FLUID LEVEL		
	<ul style="list-style-type: none"> Check power steering pump fluid level. Is fluid level within specifications? 	Yes No	GO to A2 . CHECK Hydro-Boost leak points, ADD fluid as required.
A2	BELT CHECK		
	<ul style="list-style-type: none"> Check the power steering belt tension, and condition. Is belt OK? 	Yes No	GO to A3 . ADJUST belt tension as required. REFER to Section 03-05.
A3	CHECK POWER STEERING HOSES		
	<ul style="list-style-type: none"> Check the power steering hoses for cracks or leaks. Do hoses check OK? 	Yes No	GO to A4 . SERVICE or REPLACE as required. REFER to Section 11-00.
A4	CHECK BRAKE PEDAL LINKAGE		
	<ul style="list-style-type: none"> Check the brake pedal linkage for binding or sticking operation. Does linkage check OK? 	Yes No	GO to A5 . SERVICE or REPLACE as required. REFER to Section 06-06.
A5	PUMP SPEED		
	<ul style="list-style-type: none"> Check engine idle speed against specifications. Is engine idle speed OK? 	Yes No	GO to A6 . SET engine idle speed to specifications.
A6	PUMP FLOW AND RELIEF		
	<ul style="list-style-type: none"> Test the power steering pump for proper flow and relief pressure. Is pump operating properly? 	Yes No	REPLACE booster. REPAIR or REPLACE pump as required. REFER to Section 11-00.

TH6269D

HYDRO-BOOST, ERRATIC OPERATION, STICKS, BINDS OR GRABS — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	HOSE CHECK		
	<ul style="list-style-type: none"> Check for obstructed return line and connections between the Hydro-Boost unit and the pump reservoir. Are there any obstructions? 	Yes No	REPAIR or REPLACE as required. GO to B2 .
B2	BOOSTER OPERATION CHECK		
	<ul style="list-style-type: none"> Have an assistant check the brake fluid in the reservoir while rapidly applying the brake pedal approximately 1 inch. Does the fluid show any movement or spouting? 	Yes No	System is OK. REPLACE the Hydro-Boost unit.

TH6270C

DIAGNOSIS AND TESTING (Continued)

BRAKE SYSTEM AND HYDRO-BOOST OPERATIONAL CHECK — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	BASIC CHECK		
	<ul style="list-style-type: none"> ● Key OFF. ● Depress and release brake pedal several times to deplete all hydraulic pressure from the Hydro-Boost unit. ● Depress and hold the brake pedal with light pressure. ● Key ON, engine running. ● Does the pedal fall slightly and then hold, and is less pressure now required to hold the pedal at this position? 	Yes No	Hydro-boost is OK. GO to C2.
C2	BRAKE HYDRAULIC LEAK CHECK		
	<ul style="list-style-type: none"> ● Depress and release the brake pedal several times. ● Hold the brake pedal down with medium pressure of 111-156 N (25-35 lb). ● Does the pedal fall away? 	Yes No	GO to C3. GO to C5.
C3	EXTERNAL LEAK CHECK		
	<ul style="list-style-type: none"> ● Check for leaks at disc brake calipers, brake lines, master cylinder and hoses. ● Do components check OK? 	Yes No	SERVICE or REPAIR the master cylinder internal leak as required. REFER to Section 06-00. REPAIR or REPLACE as required. REFER to Section 06-06.
C4	HYDRO-BOOST HOSE CONNECTIONS LEAK CHECK		
	<ul style="list-style-type: none"> ● Clean the Hydro-Boost unit, all hoses and connections. ● Key ON, engine running at idle speed. ● Check the Hydro-Boost hose connections for leaking. ● Do the hose connections check OK? 	Yes No	GO to A5. SERVICE or REPLACE hoses and connections as required.
C5	HYDRO-BOOST LEAK CHECK		
	<ul style="list-style-type: none"> ● Key ON, engine running at idle speed. ● Apply the brakes with approximately 444 N (100 lb) of pressure at the pedal and hold. <p>CAUTION: Do not hold the brake pedal at 444 N (100 lb) for more than 5 seconds at a time.</p> <ul style="list-style-type: none"> ● Check the Hydro-Boost hoses for leaks. ● Do the hoses check OK? 	Yes No	GO to C6. REPLACE the Hydro-Boost unit.
C6	RESERVE RETENTION CHECK		
	<ul style="list-style-type: none"> ● Key ON, engine running at idle speed. ● Charge system pressure by holding the steering on the stop, or by pressing down on the brake pedal with approximately 444 N (100 lb). ● Key OFF. ● Wait 8 to 12 hours. ● Depress the brake pedal. ● Is there any power reserve? 	Yes No	Hydro-Boost unit is OK. REPLACE the Hydro-Boost unit.

TH8545A

CONDITION	POSSIBLE SOURCE	ACTION
Slow brake pedal return.	<ul style="list-style-type: none"> ● Excessive seal friction in booster. ● Flared reaction end. ● Broken piston return spring. ● Restriction in return line from booster to pump reservoir. ● Return line incorrectly connected. ● Broken spool return spring. ● Heavy brake pedal. 	<ul style="list-style-type: none"> ● Replace booster. Refer to Section 06-06. ● Replace booster. ● Replace booster. ● Clear or replace line. ● Correct plumbing. ● Replace booster. ● Reposition pedal or add retracting spring. Refer to Section 06-06.

DIAGNOSIS AND TESTING (Continued)

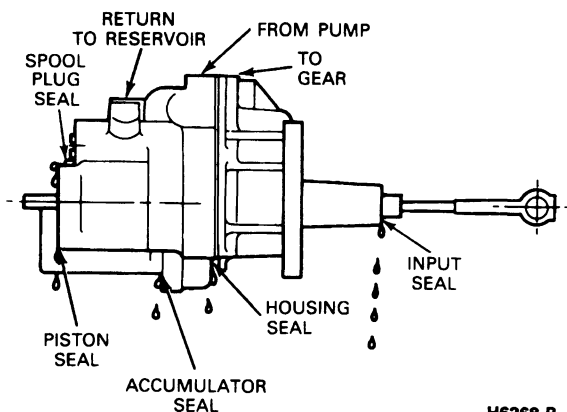
CONDITION	POSSIBLE SOURCE	ACTION
Grabbing brakes.	<ul style="list-style-type: none"> Broken spool return spring. Faulty spool action due to contamination. Low pump flow. 	<ul style="list-style-type: none"> Replace booster. Flush steering while pumping brake pedal. Refer to Section 11-00. Tighten belt. Refer to Section 03-05.
Booster chatter, pedal vibration.	<ul style="list-style-type: none"> Slipping pump belt. Low fluid level in pump. 	<ul style="list-style-type: none"> Tighten belt. Refer to Section 03-05. Fill reservoir. Check for external leaks.
Accumulator leaks down. Reserve system does not hold charge.	<ul style="list-style-type: none"> Two-function valve is faulty. Accumulator seal is faulty. Pneumatic accumulator is faulty. 	<ul style="list-style-type: none"> Replace booster. Replace booster. Replace booster.
Excessive brake pedal efforts.	<ul style="list-style-type: none"> Loose, glazed or broken pump belt. No fluid in pump reservoir. Leaks in system hoses. Leaks at tube fittings and connections. Leakage at pneumatic accumulator seal. Leakage at piston seal. Leakage at input seal. Leakage at cover-to-housing seal. Leakage at spool plug seal. Leakage at ball plug. 	<ul style="list-style-type: none"> Tighten or replace belt. Refer to Section 03-05. Fill reservoir and check for external leaks. Refer to Section 06-06. Replace faulty parts. Tighten fittings or replace tube seats or O-rings. Replace booster. Replace booster. Replace booster. Replace booster. Replace booster. Replace booster.
Unit self-applies.	<ul style="list-style-type: none"> Restriction in booster return line. Return line incorrectly connected. Dump valve faulty. 	<ul style="list-style-type: none"> Clear or replace line. Correct plumbing. Replace booster.

TH6266C

Seal Leak Diagnosis

Possible sources of leakage from the Hydro-Boost unit are:

- Input seal
- Piston seal
- Housing seal
- Spool plug seal
- Accumulator cap seal
- Return port fitting seal



REMOVAL AND INSTALLATION

Hydro-Boost Booster

WARNING: THE BOOSTER SHOULD NOT BE CARRIED BY THE ACCUMULATOR, NOR SHOULD IT EVER BE DROPPED ON THE ACCUMULATOR. THE SNAP RING ON THE ACCUMULATOR SHOULD BE CHECKED FOR PROPER SEATING BEFORE THE BOOSTER IS USED. THE ACCUMULATOR CONTAINS HIGH PRESSURE NITROGEN GAS AND CAN BE DANGEROUS IF MISHANDLED.

WARNING: IF THE ACCUMULATOR IS TO BE DISPOSED OF, IT MUST NOT BE EXPOSED TO EXCESSIVE HEAT, FIRE OR INCINERATION. BEFORE DISCARDING THE ACCUMULATOR, DRILL A 1.6MM (1/16 INCH) DIAMETER HOLE IN THE END OF THE ACCUMULATOR CAN TO RELIEVE THE GAS PRESSURE. ALWAYS WEAR SAFETY GLASSES WHEN PERFORMING THIS OPERATION.

Removal

- With the engine off, depress the brake pedal several times to discharge the accumulator.
- Remove the master cylinder from the Hydro-Boost unit. Prop the master cylinder up and out of the way.

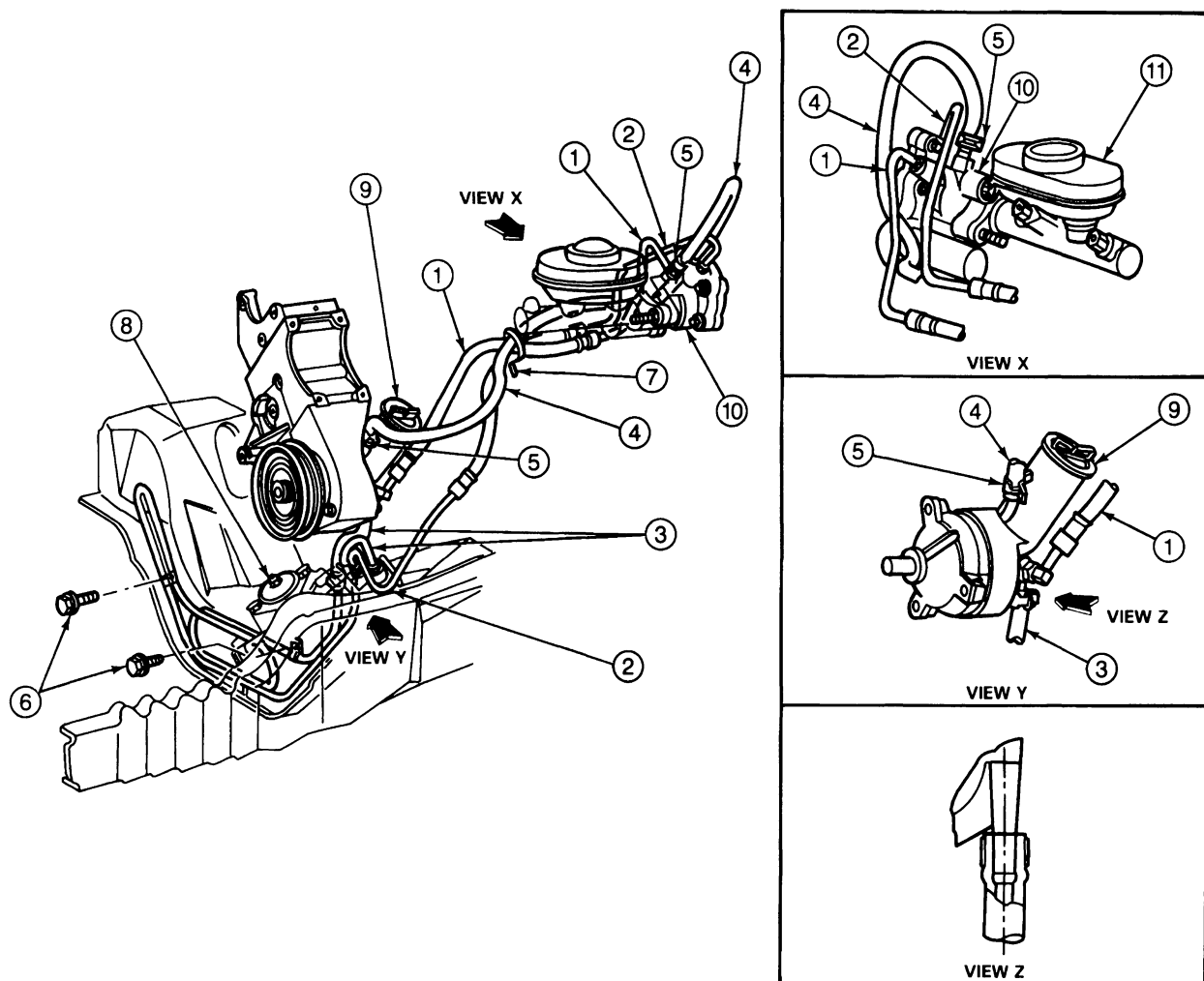
CAUTION: Do not apply the booster with the master cylinder removed.

REMOVAL AND INSTALLATION (Continued)

3. Disconnect all three hydraulic lines from the booster.
4. Disconnect the input push rod from the brake pedal bellcrank assembly.
5. Remove the booster mounting nuts, and remove the booster from the vehicle.

Installation

1. Install the booster in the vehicle and tighten the mounting nuts to 22-30 N·m (16-22 ft·lb).

Hydro-Boost Booster, F-Super Duty Chassis Cab

Item	Part Number	Description
1	3F523	Power Steering Pressure Line Hose Assembly (Pump-to-Booster) 30-40 N·m (22-30 Ft-Lb)
2	3F524	Power Steering Pressure Line Hose Assembly (Booster-to-Gear) 30-40 N·m (22-30 Ft-Lb)

(Continued)

2. Connect the input push rod to the brake pedal bellcrank assembly or pedal to push rod linkage.
3. Position the master cylinder against the booster and tighten the mounting nuts to 22-30 N·m (16-22 ft·lb).
4. Connect the hoses to the Hydro-Boost unit. Refill the system and bleed as required.

Item	Part Number	Description
3	3A713	Power Steering Return Line Hose Assembly (Gear-to-Pump) 30-40 N·m (22-30 Ft-Lb)
4	3A005	Power Steering Return Line Hose (Booster-to-Pump)

(Continued)

REMOVAL AND INSTALLATION (Continued)

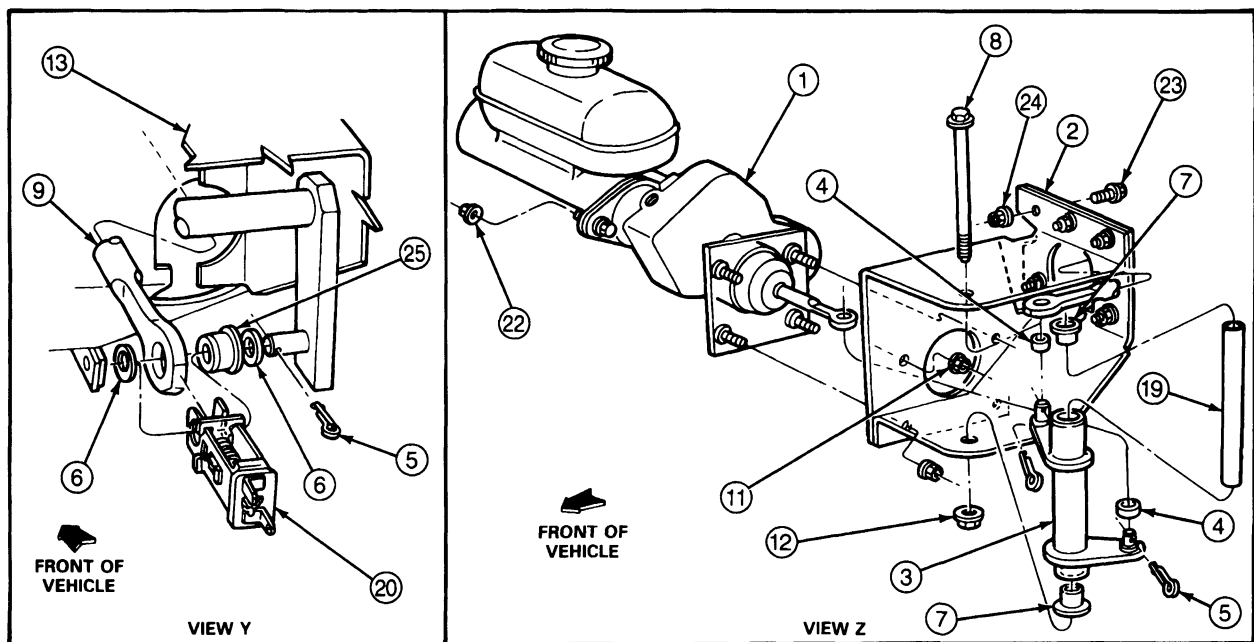
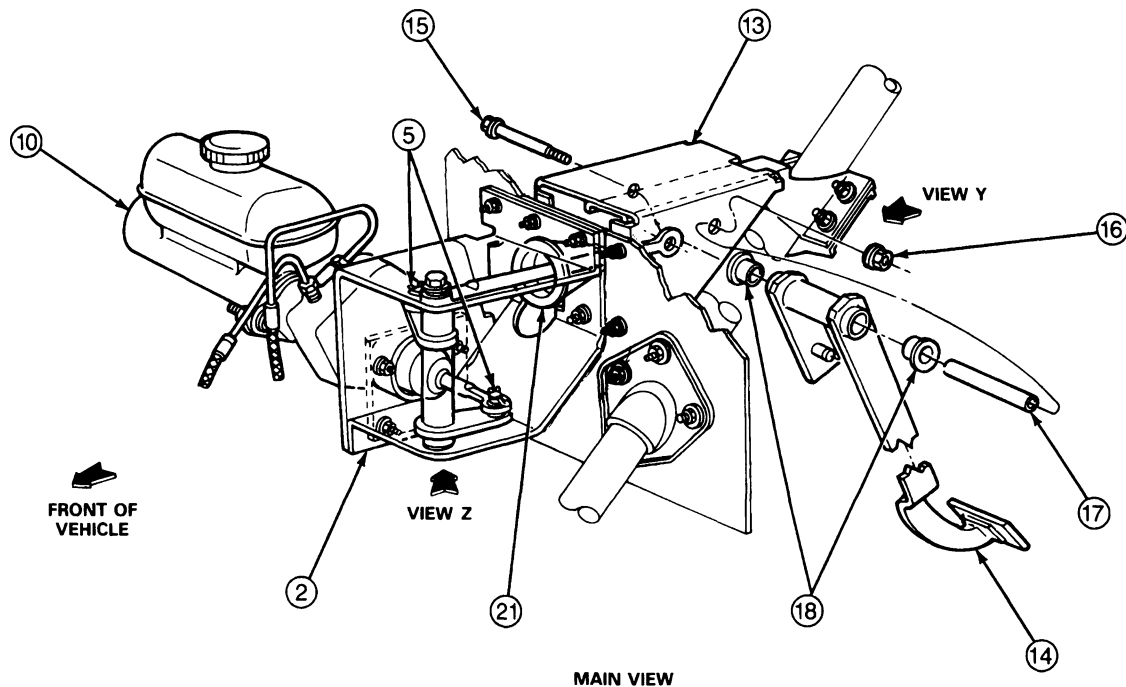
Item	Part Number	Description
5	3C750	17mm Hose Clamp (Attaches 3A713 and 3A005 to Pump and Booster)
6	40949-S2	Hex Washer Head Tap Screw 15-20 N·m (11-15 Ft-Lb)

(Continued)

Item	Part Number	Description
7	95873-S	Bundling Strap
8	3504	Power Steering Gear
9	3A674	Power Steering Pump
10	2B560	Hydraulic Booster
11	2A032	Brake Master Cylinder

REMOVAL AND INSTALLATION (Continued)

Hydro-Boost Booster, F-Super Duty Commercial Chassis



H6807-E

Item	Part Number	Description
1	2B560	Hydraulic Brake Booster Assembly
2	2A248	Master Cylinder Push Rod Bellcrank Bracket

(Continued)

Item	Part Number	Description
3	2B327	Bellcrank Assembly
4	2A309	Push Rod Bushing
5	380699-S100	Self-Locking Pin
6	2B129	Push Rod Spacer

(Continued)

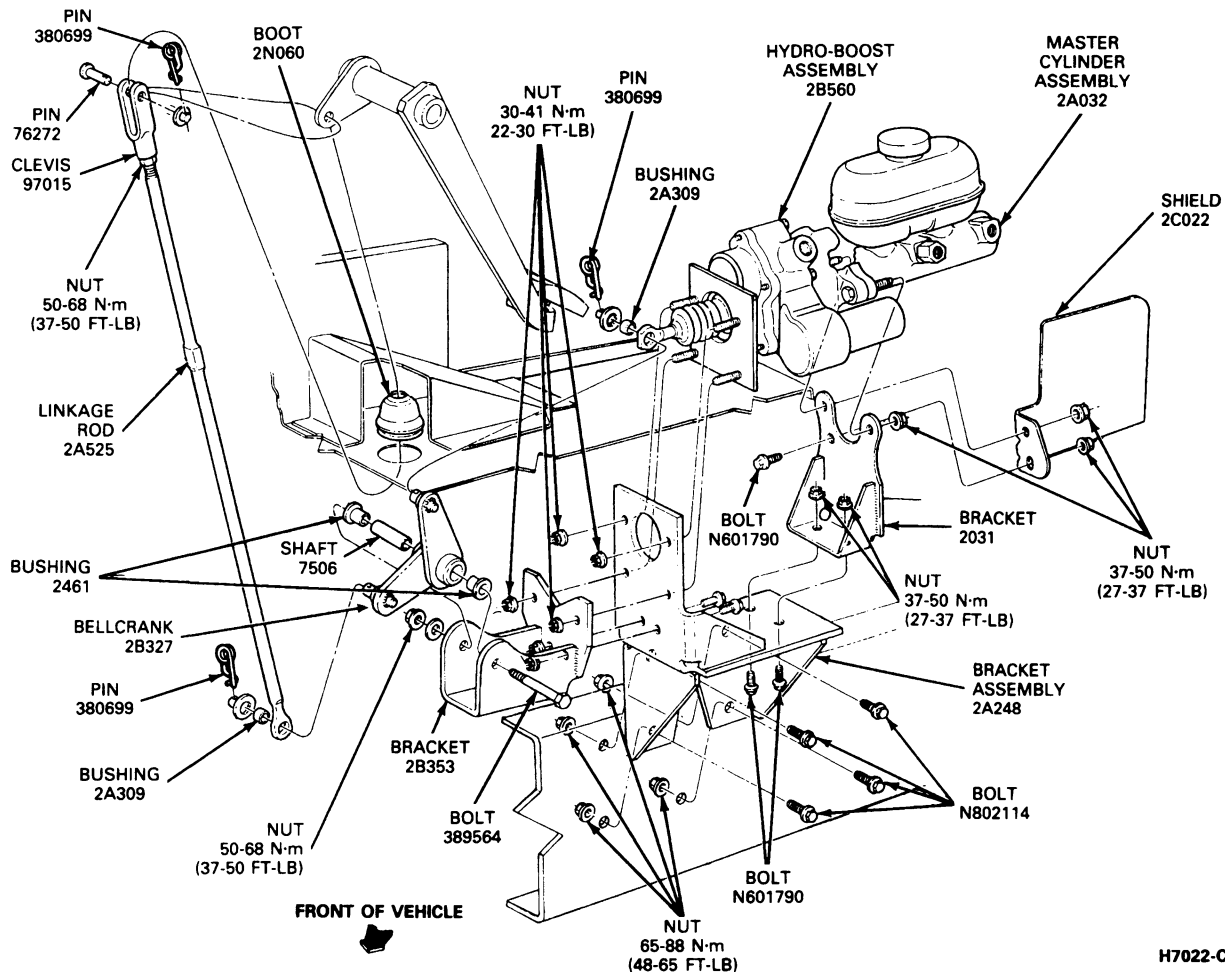
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
7	2461	Bellcrank Bushing
8	381004-S2	Bolt 7 / 16- 14 x 6.8
9	2A525	Rod Assembly
10	2A032	Brake Master Cylinder Assembly
11	382802-S2	Nut, 3 / 8- 16 22-30 N-m (16-22 Ft-Lb)
12	382400-S2	Nut, 7 / 16- 14, Lock 47-68 N-m (35-50 Ft-Lb)
13	2467	Pedal Bracket Assembly
14	2455	Brake Pedal Assembly
15	381004-S2	Bolt, 7 / 16 14 x 6.8

(Continued)

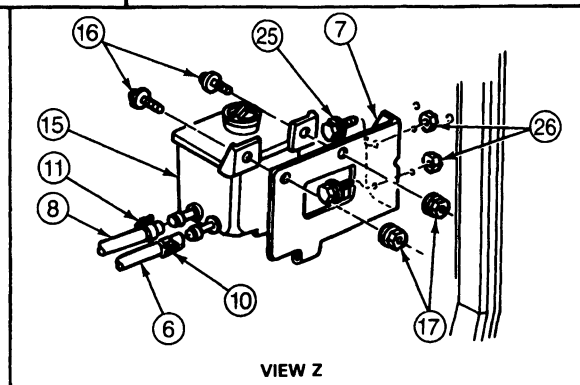
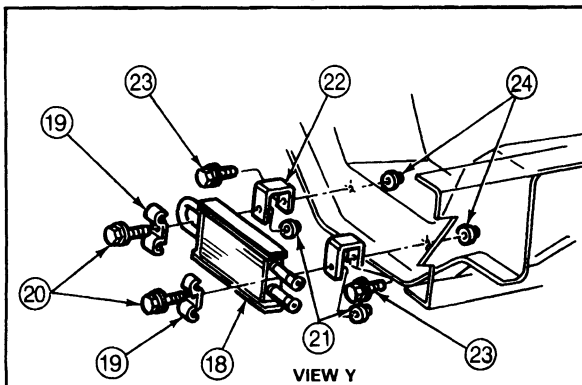
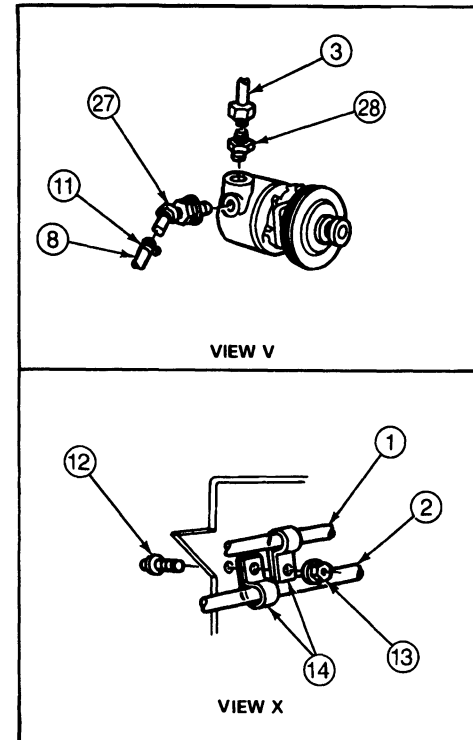
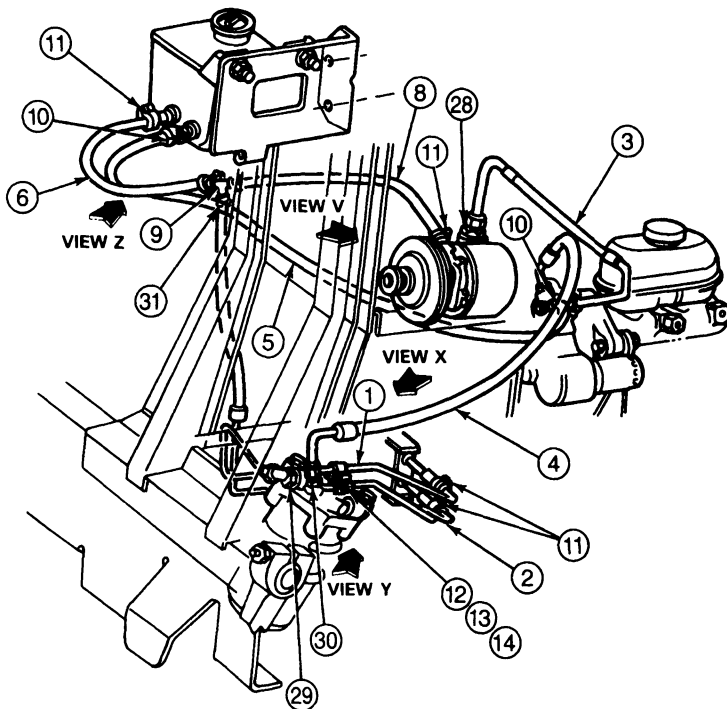
Item	Part Number	Description
16	382400-S2	Nut, 7 / 16- 14 47-68 N-m (35-50 Ft-Lb)
17	7506	Brake Pedal Spacer
18	386457-S101	Brake Pedal Bushing
19	2B362	Spacer
20	13480	Brake On-Off Switch
21	2N060	Boot
22	382802-S2	Nut, 3 / 8- 16 22-30 N-m (16-22 Ft-Lb)
23	N605907-S2	Bolt, M8-1.25 x 30
24	N620481-S2	Nut, M8-1.25 21-27 N-m (15-20 Ft-Lb)
25	2A309	Push Rod Bushing

Hydro-Boost Booster, F-Super Duty Motorhome Chassis



REMOVAL AND INSTALLATION (Continued)

Power Steering and Hydro-Boost Plumbing, Motorhome



H8820-A

Item	Part Number	Description
1	3A713	Power Steering Return Line Tube Assembly 27-41 N-m (20-30 Ft-Lb)
2	3A713	Power Steering Return Line Tube Assembly 27-41 N-m (20-30 Ft-Lb)
3	3F523	Power Steering Pressure Line Hose Assembly, Right-Hand 27-41 N-m (20-30 Ft-Lb)
4	3F524	Power Steering Pressure Line Hose Assembly, Left Hand
5	3A005	Power Steering Return Line Hose Assembly

(Continued)

Item	Part Number	Description
6	3691	Power Steering Return Line Hose Assembly
7	3A530	Power Steering Pump Reservoir Bracket Assembly
8	3691	Power Steering Hose (Reservoir-to-Pump)
9	3R608	Power Steering Return Line Connector
10	390462-S100	Clamp 0.62, 1-2 N-m (10-18 In-Lb)
11	97241-S8	Clamp 0.88, 1-2 N-m (10-18 In-Lb)
12	N605787-S2	Bolt, M8-1.25 x 25

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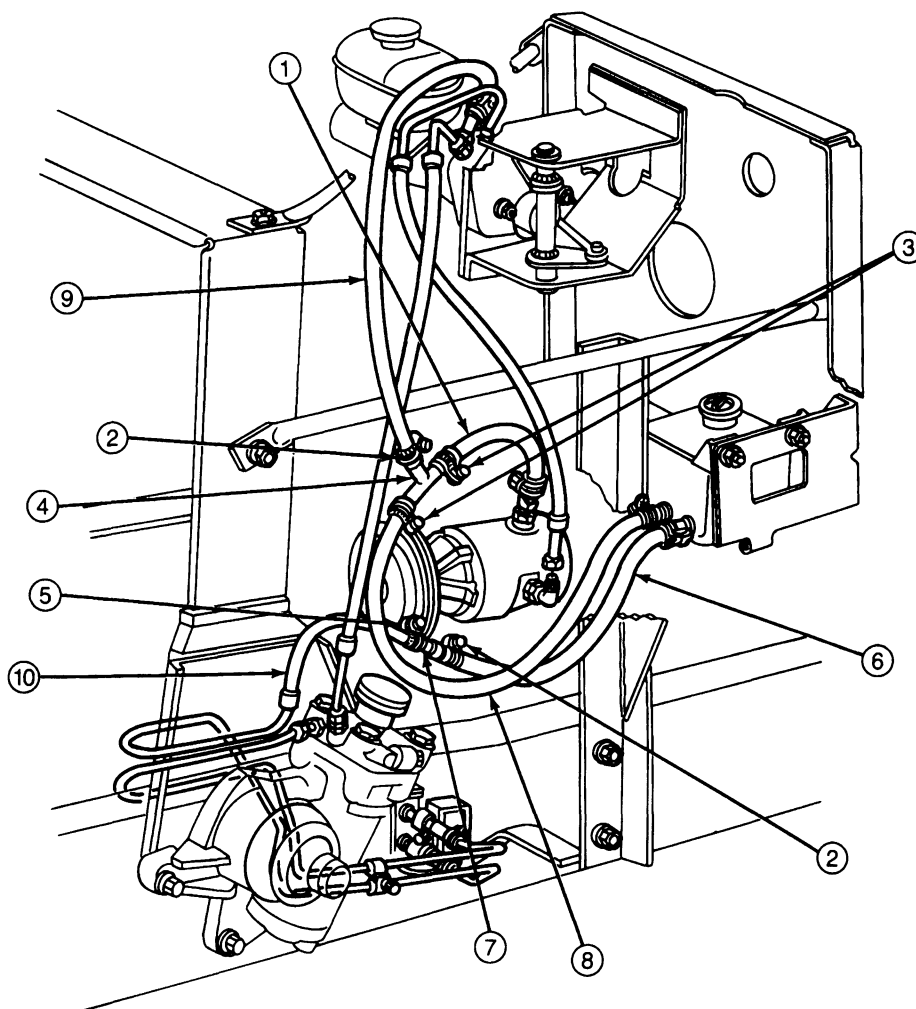
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
13	N620481-S2	Nut, M8-1.25 21-32 N-m (15-24 Ft-Lb)
14	359928-S100	1/2 Wraparound Clip
15	3531	Power Steering Pump Reservoir Assembly
16	N606676-S2	Screw and washer M6-1.0 x 20
17	N620480-S2	Nut, M6-1.0 9-13 N-m (80-115 In-Lb)
18	3D746	Power Steering Cooler Assembly
19	3B749	Power Steering Cooling Tube Clamp
20	N605787-S2	Bolt, M8-1.25 x 25
22	3D744	Power Steering Oil Cooler Bracket

Item	Part Number	Description
23	N605921-S2	Bolt, M10 x 1.5 x 35
24	N605482-S2	Nut, M10 x 1.5 40-64 N-m (30-47 Ft-Lb)
25	N605786-S2	Bolt, M8-1.25
26	N620481-S2	Nut, M8-1.25 21-32 N-m (15-24 Ft-Lb)
27	3E599	Power Steering Pump Elbow Assembly
28	390505-S7	Connector 27-39 N-m (20-24 Ft-Lb)
29	384285-S7	45° Elbow Connector 27-39 N-m (20-29 Ft-Lb)
30	390505-S7	Connector 27-39 N-m (20-29 Ft-Lb)
31	376240-S	Clamp 0.78 1-2 N-m (10-18 Ft-Lb)

(Continued)

Power Steering and Hydro-Boost Plumbing, Commercial



H8195-B

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	3691	Hose
2	390462-S100	Clamp
3	97241-S8	Clamp
4	389344-S100	Tee
5	376240-S	Clamp

(Continued)

Item	Part Number	Description
6	3A005	Hose
7	3A766	Connector
8	3691	Hose
9	3A005	Hose
10	3A713	Hose Assembly

TH8195A

DISASSEMBLY AND ASSEMBLY

The Hydro-Boost power brake booster is not to be disassembled and is to be serviced as a unit.

ADJUSTMENTS**Bleeding the Hydro-Boost Unit**

1. Fill the pump reservoir with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid E4AZ-19582-B XT-2-QDX or -DDX (ESP-M2C138-CJ) or equivalent. F-Super Duty Motorhome and Commercial Stripped Chassis uses a ZF pump and Motorcraft MERCON® lubricant only.
2. Disconnect coil wire (do not start the engine).
3. Crank the engine for several seconds.
4. Check the fluid level, and add if necessary. Reconnect coil wire.
5. Start the engine.
6. With the engine running, turn the wheels lock to lock two times. Turn the engine off.
7. Depress the brake pedal several times to discharge the accumulator.

8. Repeat Steps 5 and 6.
9. If foaming occurs, stop the engine and allow the foam to dissipate.
10. Repeat Steps 5 and 6 as required, until all the air is removed from the system.

NOTE: The Hydro-Boost is generally self-bleeding, and the above procedure will normally bleed the air from the booster. Normal operation of the vehicle will further remove any additional trapped air.

Brake Pedal Rod, Motorhome

1. Remove locking pin and washer from lower end of brake pedal rod.
2. Remove lower end of rod and bushing from bellcrank pin and loosen jam nut.
3. Hold brake pedal up against rubber stop and turn rod until lower hole lines up with bellcrank pin.
4. Slide rod and bushing onto bellcrank pin and reinstall washer and locking pin.
5. Tighten jam nut.

ADJUSTMENTS (Continued)

Brake Pedal Rod, Motorhome

FRONT OF VEHICLE

H5070-C

Item	Part Number	Description
1	2455	Brake Pedal
2	76272-S8	Clevis Pin 1/2 x 1.44
3	380699-S100	Self-Locking Pin
4	44880-S2	Flatwasher — 9/ 16 Inch
5	97015-S8	Clevis 1/2-20 x 3.00 Inch
6	33943-S2	Jam Nut — 1/2 x 20 Hex 50-68 N·m (37-50 Ft·Lb)

(Continued)

Item	Part Number	Description
7	2A525	Brake Pedal-to-Bellcrank Rod
8	44879-S2	Flatwasher — 1/2 x 1.06 x 0.010 Inch
9	2A309	Push Rod Bushing
10	2B327	Push Rod Bellcrank
11	2B362	Brake Booster Lever Spacer
12	2461	Brake Pedal Bushing
13	2N060	Brake Rod Seal Boot

SPECIFICATIONS

TORQUE SPECIFICATIONS		
Description	N·m	Lb·Ft
Booster Mounting Nuts	22-30	16-22
Booster Cover to Booster Body	30-32	22-24
Bracket to Booster Nut	149-155	110-114
Master Cylinder to Booster Nuts	22-30	16-22

SECTION 06-09A Brake, Rear, Anti-lock Control

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Component Location	06-09A-2	Pinpoint Test Code 8	06-09A-42
E-150-250-350	06-09A-2	Pinpoint Test Code 9	06-09A-44
F-150-250-350	06-09A-2	PSOM Signal Verification Procedure	06-09A-24
Operation	06-09A-1	System Pre-Check	06-09A-13
System Self-Check	06-09A-2	System Pre-Check Test A	06-09A-14
DIAGNOSIS AND TESTING		System Pre-Check Test B	06-09A-16
Diagnostic Procedure Flow System	06-09A-9	System Pre-Check Test C	06-09A-18
Drive Test — Code 16	06-09A-53	System Pre-Check Test D	06-09A-19
Drive Test — Code 4 Only	06-09A-55	System Pre-Check Test E	06-09A-21
Drive Test — Code 5 Only	06-09A-56	Wiring Diagram	06-09A-9
Drive Test — Code 6	06-09A-58	REMOVAL AND INSTALLATION	
Pinpoint Test Code 10	06-09A-46	Fuses	06-09A-61
Pinpoint Test Code 11	06-09A-49	RABS II Module	06-09A-61
Pinpoint Test Code 12	06-09A-51	E-150-250-350	06-09A-62
Pinpoint Test Code 13	06-09A-53	F-150-250-350	06-09A-61
Pinpoint Test Code 16	06-09A-53	RABS II Sensor	06-09A-63
Pinpoint Test Code 2	06-09A-26	RABS II Valve	06-09A-62
Pinpoint Test Code 3	06-09A-29	E-150-250-350	06-09A-63
Pinpoint Test Code 4	06-09A-32	F-150-250-350	06-09A-62
Pinpoint Test Code 5	06-09A-35	Speed Sensor Ring	06-09A-64
Pinpoint Test Code 6	06-09A-37	SPECIAL SERVICE TOOLS/EQUIPMENT	
Pinpoint Test Code 7	06-09A-40	VEHICLE APPLICATION	
		06-09A-1	

VEHICLE APPLICATION

F-150-250-350, E-150-250-350

DESCRIPTION AND OPERATION

Operation

The Rear Anti-lock Brake System (RABS II) continuously monitors rear wheel speed with a sensor mounted on the rear axle. When the teeth on a speed sensor ring, mounted on the ring gear, pass the sensor pole piece, an AC voltage is induced in the sensor circuit with a frequency proportional to the average rear wheel speed. In the event of an impending lockup condition during braking, at vehicle speeds above approximately 5 mph, the RABS II modulates hydraulic pressure to the rear brakes. This inhibits rear wheel lockup.

When the brake pedal is applied, the RABS II module senses the drop in rear wheel speed. If the rate of deceleration is too great, indicating that wheel lockup is going to occur, the RABS II module activates the electro-hydraulic valve causing the isolation valve to close. With the isolation valve closed, the rear wheel cylinders are isolated from the master cylinder and the rear brake pressure cannot increase. If the rate of deceleration is still too great, the RABS II module will energize the dump solenoid with a series of rapid pulses to bleed off rear wheel cylinder fluid into an accumulator built into the RABS II valve. This will reduce the rear wheel cylinder pressure and allow the rear wheels to spin back up to vehicle speed. Continuing under RABS II module control, the dump and isolation solenoids will be pulsed in a manner that will keep the rear wheels rotating while still maintaining high levels of deceleration during braking.

At the end of the stop, when the operator releases the brake pedal, the isolation valve de-energizes and any fluid in the accumulator is returned to the master cylinder. Normal brake operation is resumed.

DESCRIPTION AND OPERATION (Continued)**System Self-Check**

The RABS II module performs system tests and during start-up and normal operation. The RABS II valve assembly, sensor, and fluid level circuits are monitored for proper operation. If a concern is found, the RABS II will be deactivated and the REAR ABS will be light illuminated.

Most concerns will cause the light to stay illuminated until the ignition is turned off, at which time the module will retain the diagnostic trouble in memory (also referred to as Keep Alive Memory or KAM). At any time while the ignition is turned on a diagnostic trouble code (DTC) may be obtained. A special code of 16 indicates that the RABS II system is operating normally. However, there are certain concerns (those associated with loss of power to the module) which will cause the system to be deactivated and the REAR ABS light to be illuminated, but will not provide a diagnostic flashout code.

Component Location**F-150-250-350**

The RABS II consists of the following components:

- RABS II module located in the cab directly behind the glove box.
- RABS II valve (dual solenoid electro-hydraulic valve) located on the left frame rail just behind the No. 1 crossmember.
- RABS II speed sensor and speed sensor ring located in the rear axle carrier.
- Yellow REAR ABS warning light in the instrument cluster.

- RABS II diagnostic connector located in the cab and clipped on the main instrument panel wiring harness about three inches below and to the right of the RABS II module.
- Diode/resistor element located under the power distribution box.
- Sensor test connector with cap located under the hood on the left wheel well.

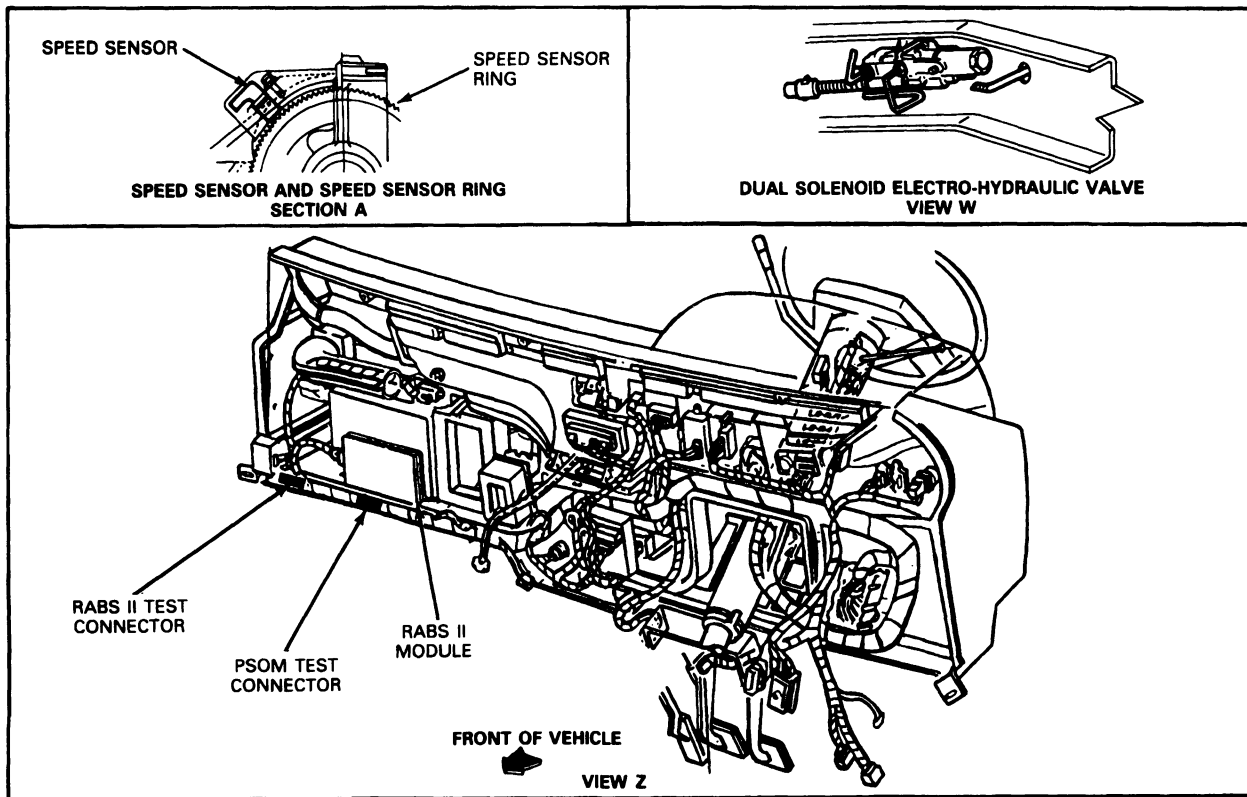
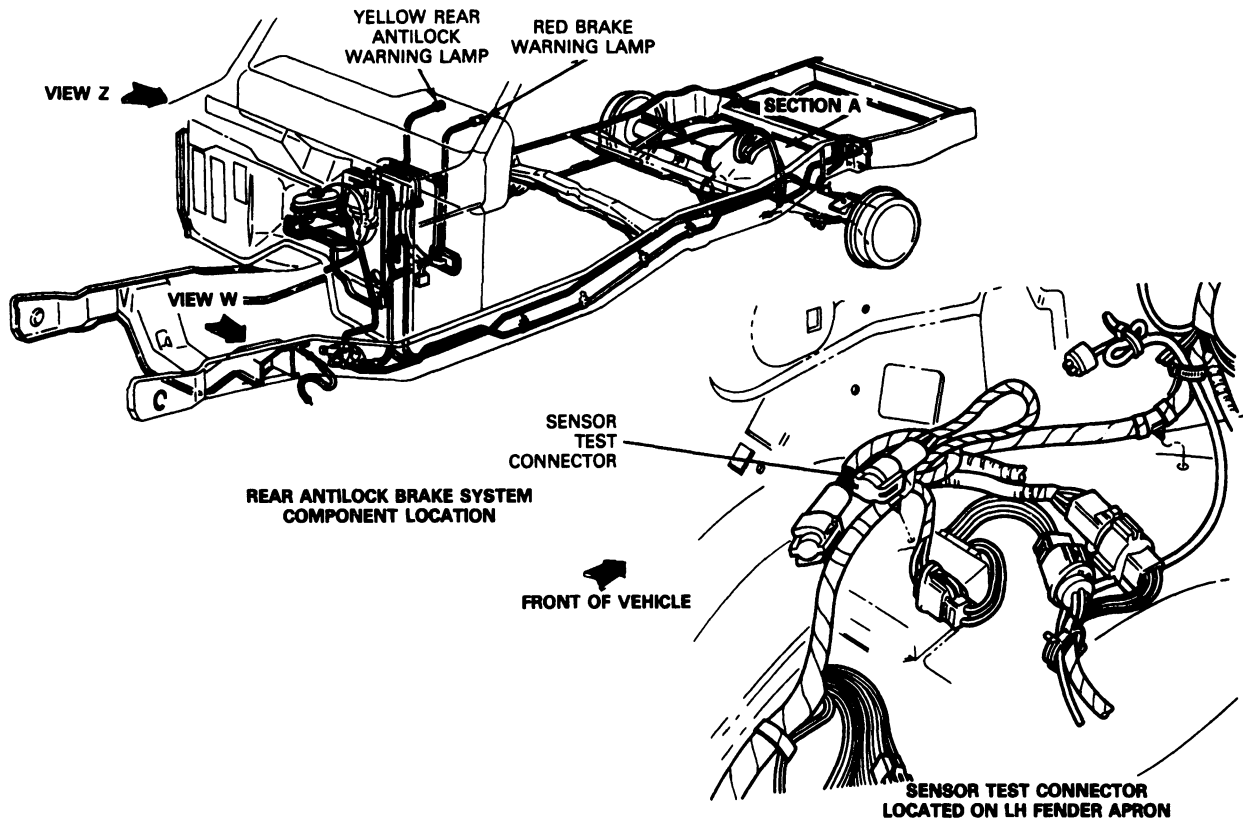
E-150-250-350

The RABS II consists of the following components:

- RABS II module located in the cab mounted to the instrument panel lower brace behind the passenger side trim cover.
- RABS II valve (dual solenoid electro-hydraulic) located on the left inside frame rail just behind the engine mount crossmember.
- RABS II speed sensor and speed sensor ring located in the rear axle carrier.
- Yellow REAR ABS warning light in the instrument cluster.
- RABS II diagnostic connector located behind trim panel at far right side of instrument panel, just below the instrument panel brace.
- Diode/resistor element located on the main trunk of the instrument panel wiring harness where the RABS II module connector pigtail intersects the main trunk.
- Sensor test connector with cap located under hood between the battery and the right side engine compartment wall.

DESCRIPTION AND OPERATION (Continued)

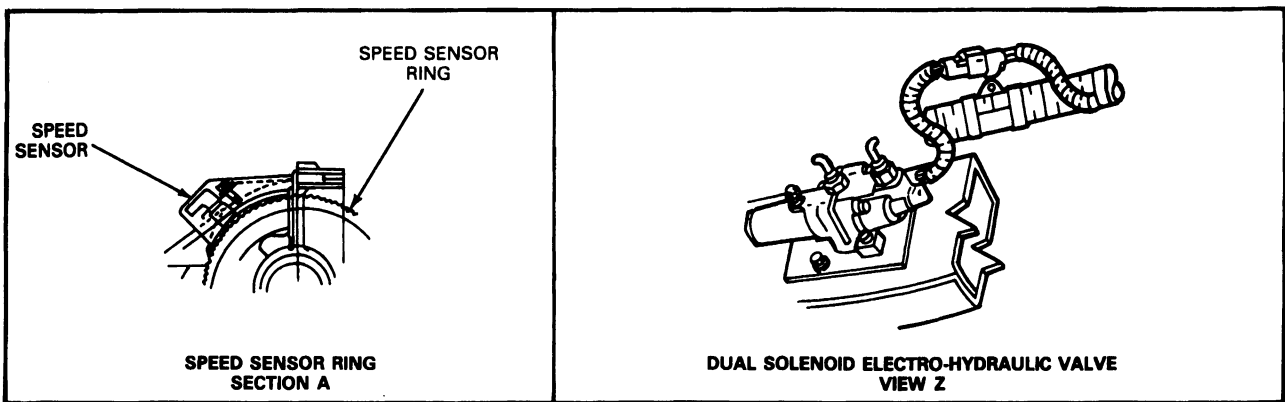
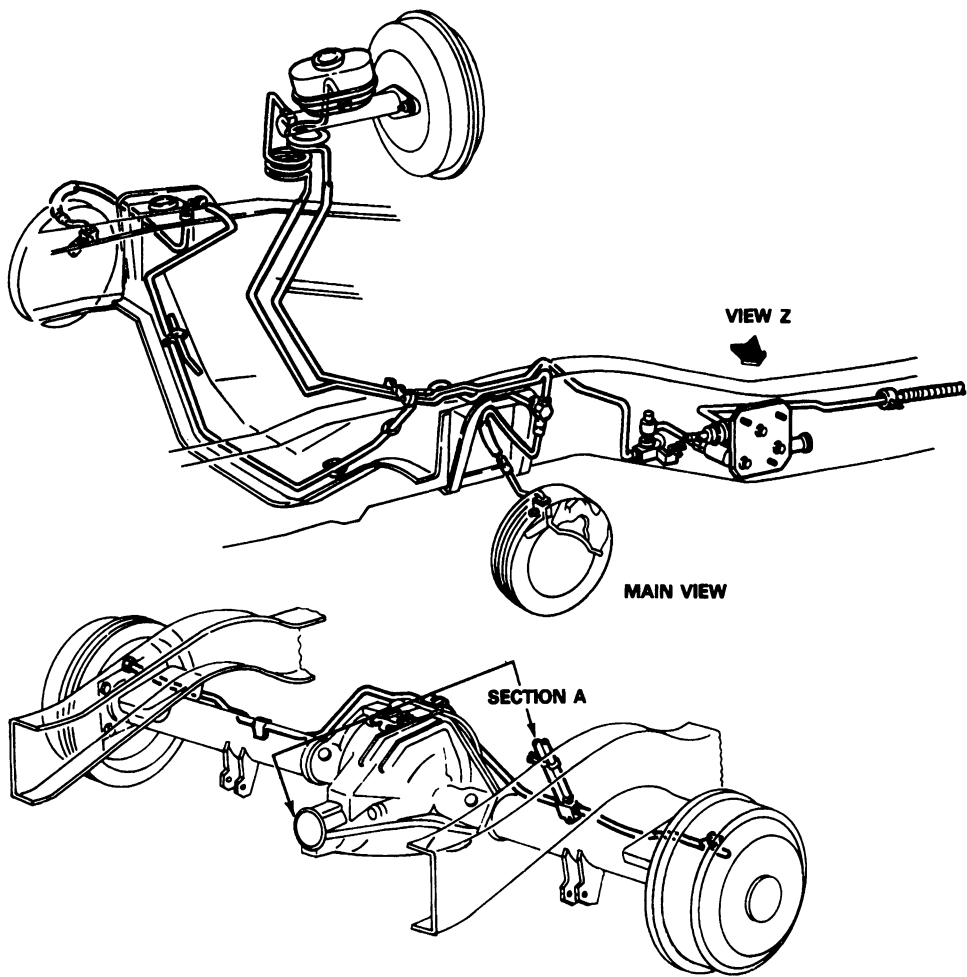
Component Location F-150-250-350



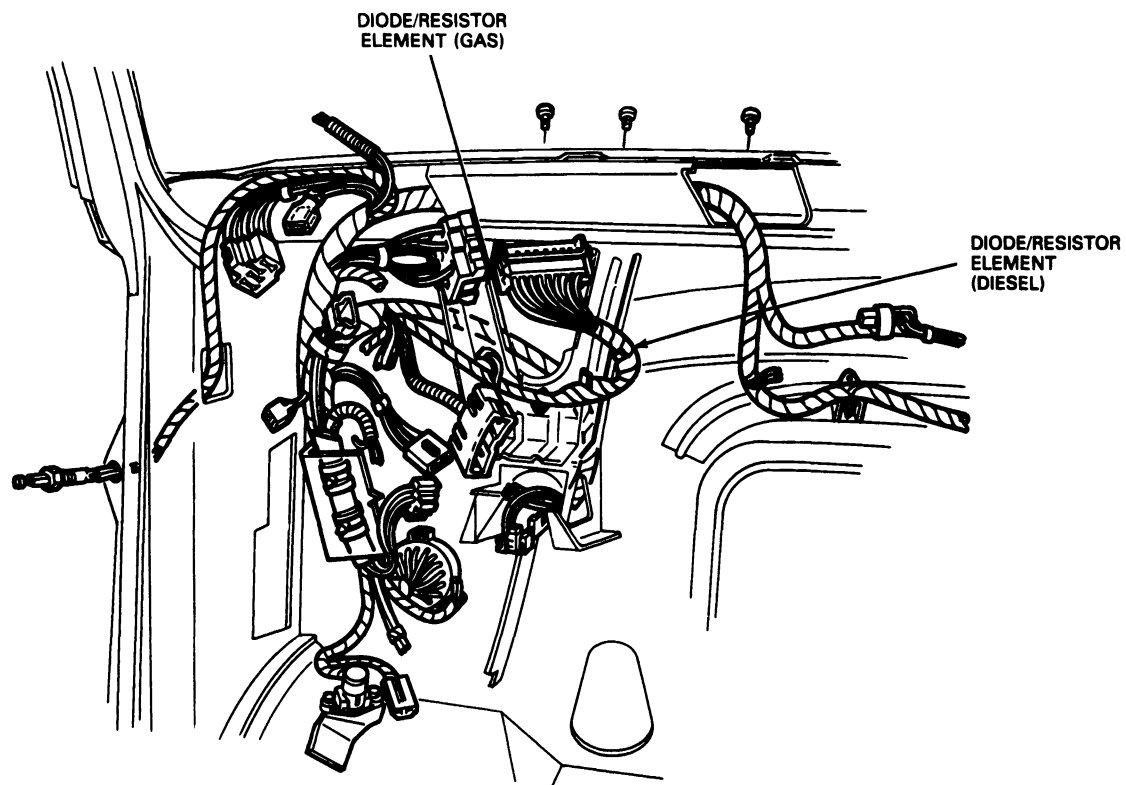
H6276-D

DESCRIPTION AND OPERATION (Continued)

Component Location, E-150-250-350

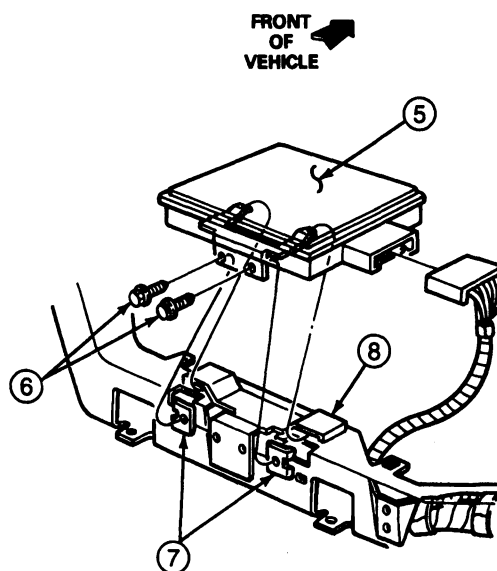
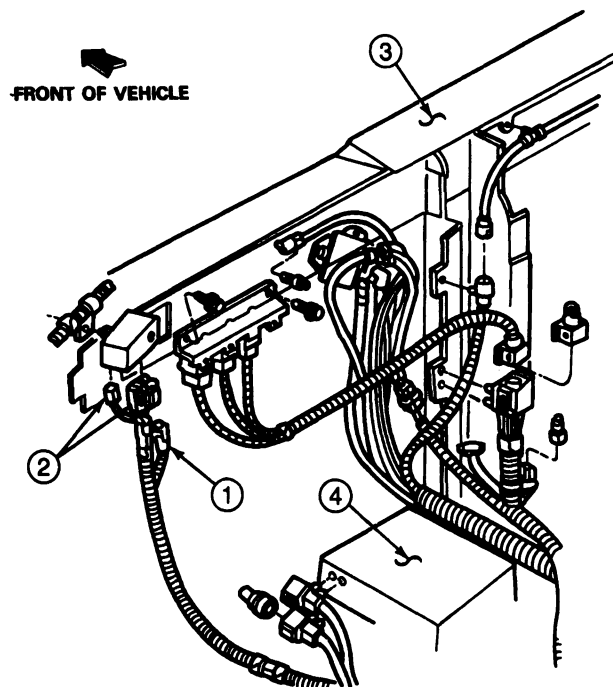


H7420-D

DESCRIPTION AND OPERATION (Continued)**Component Location, E-150-250-350 (Continued)****DIODE RESISTOR ELEMENT****H7453-B**

DESCRIPTION AND OPERATION (Continued)

RABS II Module and Test Connector Location



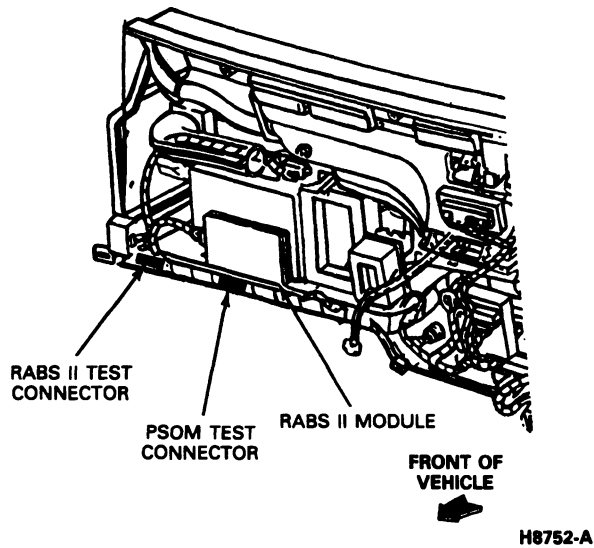
H8280-B

Item	Part Number	Description
1	—	RABS II Sensor Test Connector
2	—	EEC-IV Test Connector
3	—	Radiator Support (Upper)
4	—	Battery Tray, Left
5	2C018	Module Assembly, Rear Anti-Lock Brake

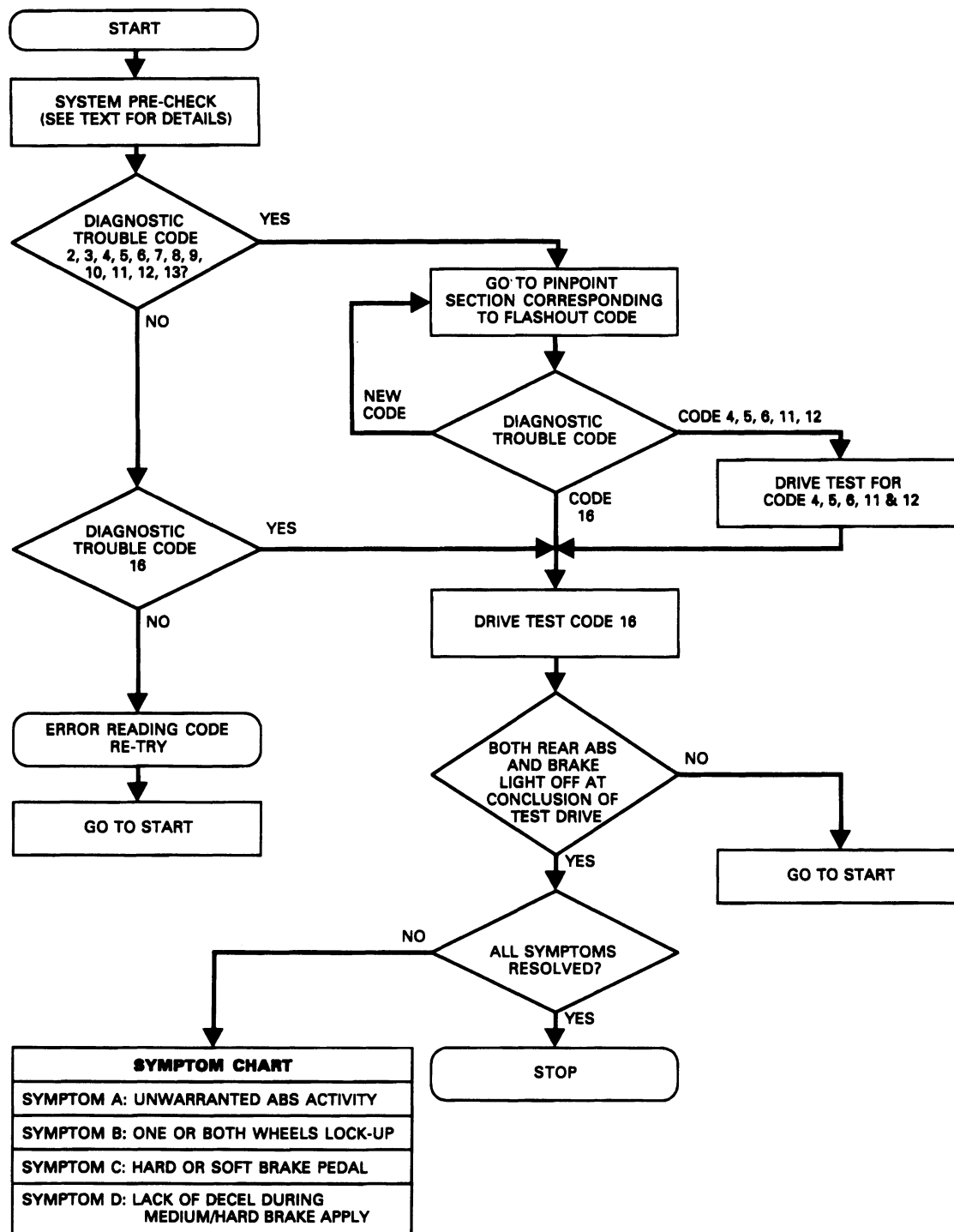
(Continued)

Item	Part Number	Description
6	N804234-S58	Screw and Washer (2 Req'd) 1.9 ± 0.2 N·m (16.8 ± 1.7 In-Lb)
7	N802650-S36	J-Nut
8	—	Front of Instrument Panel Steels. (Instrument Panel Brace)
9	—	RABS II Test Connector

TH8280A

DESCRIPTION AND OPERATION (Continued)**Component Location, F-150-250-350**

DESCRIPTION AND OPERATION (Continued)



CH8899-A

DIAGNOSIS AND TESTING

Wiring Diagram

A wiring diagram is provided which represents the RABS II electrical system. The diagram provides the wire circuit numbers, color codes, connectors, and connections to principal system components. If, after following a particular test procedure, the result is not as indicated, the problem may be located in the wiring itself. This diagram will assist in diagnosing these problems.

Diagnostic Procedure Flow System

System Pre-Check

The System Pre-Check is used to screen a vehicle for relatively simple diagnostic repairs such as loose connectors, blown fuses, etc.. However, the System Pre-Check is also used to prepare the vehicle for further diagnostics. In addition, warning light concerns are dealt with in this check.

NOTE: It is important that this procedure be performed first. Failure to do so may result in incorrect diagnosis of problem, wasted time, and improper replacement of components.

Red BRAKE Light Diagnosis

The red BRAKE warning light is constantly monitored by the RABS II module. If the red light illuminates, the module will disable the RABS II system. For this reason, diagnosing and resolving any base brake concerns illuminating the red BRAKE warning light will, in most cases, resolve a perceived RABS II concern.

Pinpoint Tests

Assuming the red BRAKE warning light diagnosis has been performed and passed, and the REAR ABS warning light is illuminated, the code retrieved is used to designate the appropriate pinpoint test. The pinpoint tests are relatively simple and will be effective in most situations. If resolution is not reached by the end of the pinpoint test, additional, more in-depth procedures are provided in the drive tests.

Drive Tests

The drive tests will aid in diagnosing more complex concerns, and in general, are more time consuming to perform than the pinpoint tests.

NOTE: Do not proceed to any pinpoint test unless directed to do so.

At times, running completely through both pinpoint and drive tests will not lead to concern resolution. Often, the concern is due to an intermittent connection, termination, or a damaged circuit. An attempt has been made to point out obvious sources for potential intermittents within the pinpoint tests. However, it should be noted that several circuits pass through one or more connections between components. These are also areas of potential concern and should be considered. Refer to the intermittent diagnosis procedure.

Symptom Chart

There are times when a customer concern will not cause the REAR ABS warning light to illuminate or a code to be stored.

The symptom chart is intended to give the technician a starting point in resolving these types of concerns.

Please note that both the red BRAKE warning light diagnosis procedure and test drive are required prior to entering this section. Failure to perform these procedures will greatly diminish the effectiveness of this method of diagnosis.

Intermittent Diagnosis Guidelines

As previously mentioned, intermittent concerns are the most difficult to diagnose.

An understanding of code storage and automatic code erasure is important.

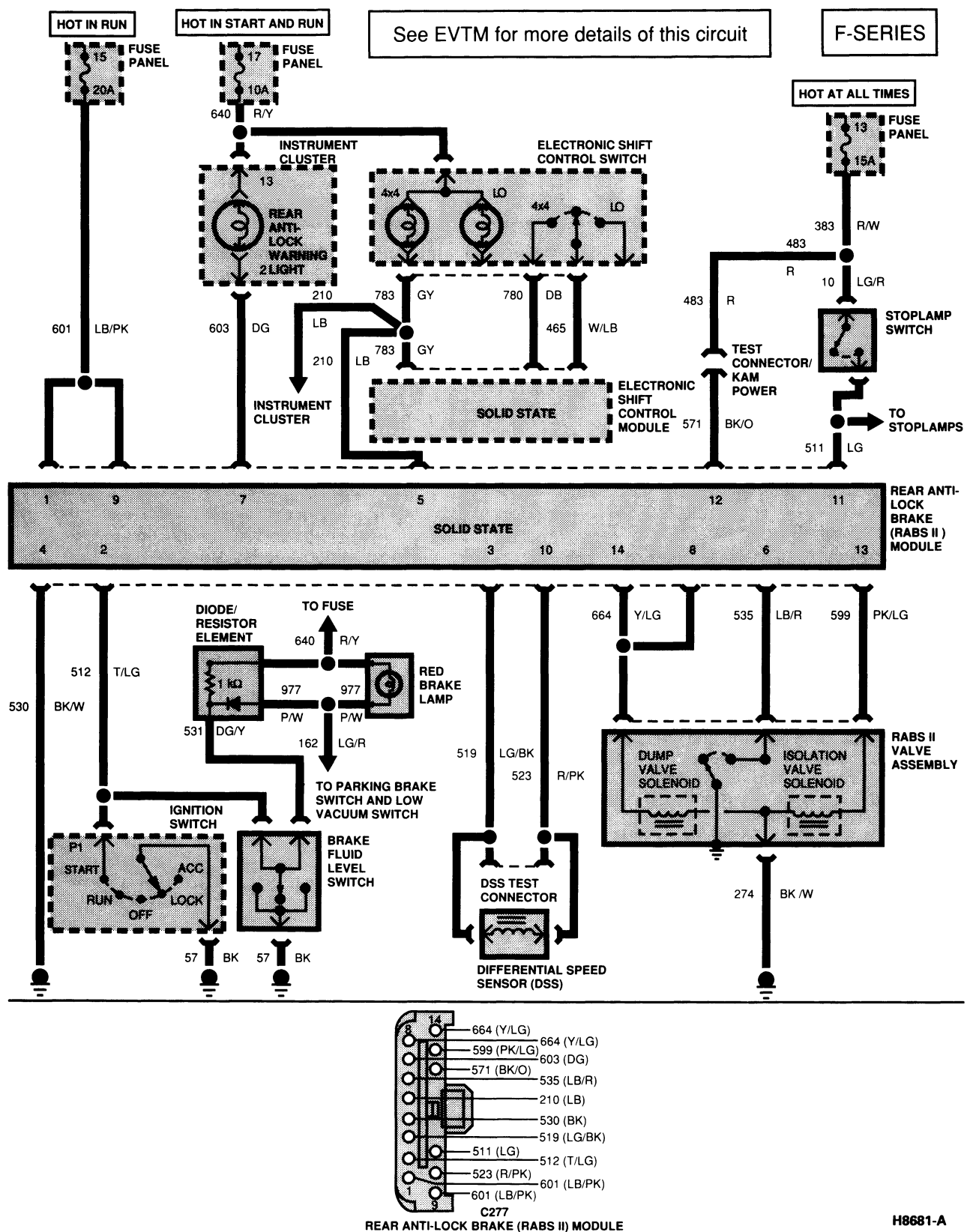
First, codes can only be stored if the RABS II module has power. The RABS II module gets primary power from the ignition feed into Pins 1 and 9. If this voltage is missing or less than 11V, the RABS II module will not initialize and therefore, a code cannot be stored. However, any code already in memory will be retained as long as the Keep Alive Memory power is available. Code 16 (system OK) is present whenever the module sees the required voltage (assuming no other diagnostic trouble codes are present).

However, any code already stored in memory will be retained as long as the Keep Alive Memory (KAM) power is available.

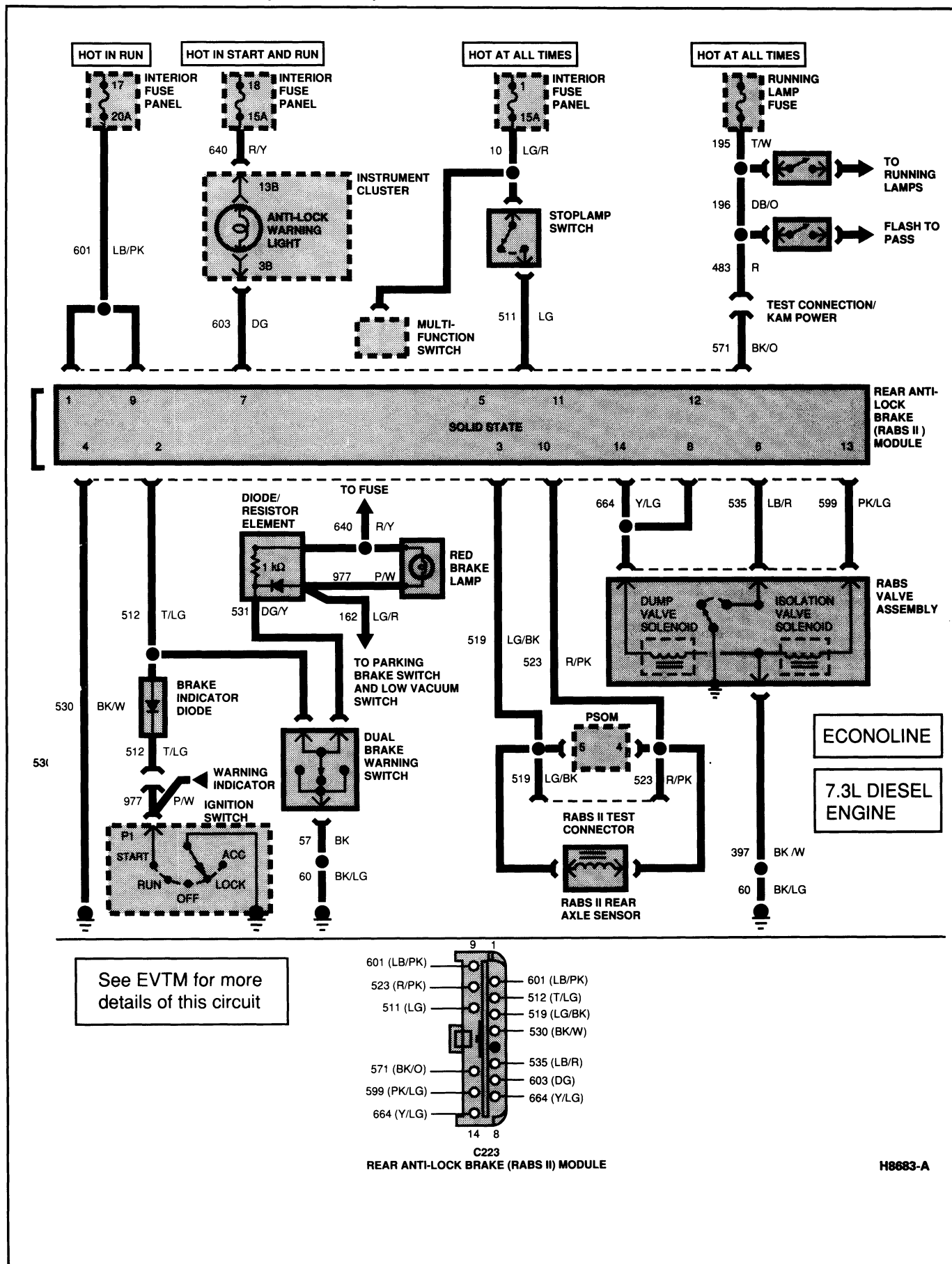
Therefore, some codes read out in the System Pre-Check may not result in any trouble found in the pinpoint test performed. More likely, this is an indication of an intermittent electrical concern.

To minimize misdiagnosis, refer to the intermittent diagnosis procedure if no resolution has been reached by the end of a particular pinpoint test.

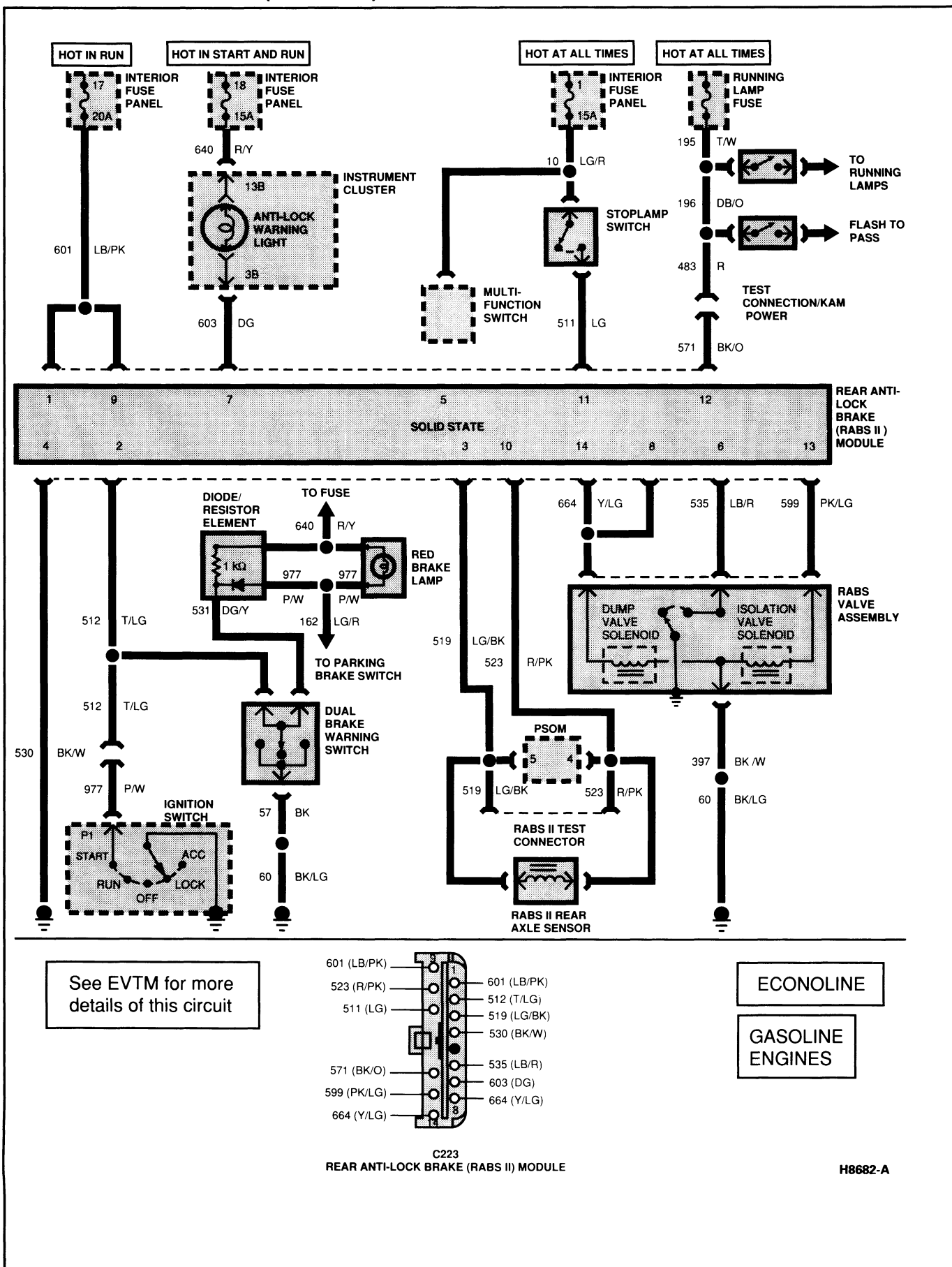
DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)**System Pre-Check**

The RABS II uses both the red BRAKE and yellow REAR ABS instrument panel warning lights to alert the driver to a system malfunction. Both lights must be working properly to assist in concern diagnosis. The steps listed below must be followed prior to beginning the RABS II diagnostic procedure.

NOTE: This repair procedure is written for REAR ABS II (RABS II) systems (as opposed to REAR ABS I (RABS I) systems). RABS II systems are standard for Econoline, F-150-250-350 single and dual rear wheel vehicles. In the event that you are not sure if you have a RABS I or a RABS II system in your vehicle, check the module part number. RABS II module part numbers will begin with either: F3TF-2C018- or F3UF-2C018-. All other part numbers should be considered to be a RABS I. If you have a RABS I module, you must refer to the repair manual for that model year vehicle.

Vehicle Setup

For 4-Wheel Drive vehicles, shift into 2-Wheel Drive. Drive the vehicle to a level area, and place the shift lever in PARK for automatic transmissions and NEUTRAL for manual transmissions. Turn the ignition off, set the parking brake and turn on the running lamps. Place blocks behind the wheels.

WARNING: PLACE BLOCKS BEHIND THE REAR WHEELS AND IN FRONT OF THE FRONT WHEELS TO PREVENT THE VEHICLE FROM MOVING WHILE THE SYSTEM PRE-CHECK IS BEING DONE.

Release the parking brake and continue to Brake Light Self Check.

Brake Light Self Check

The Red BRAKE warning light is used to indicate a low fluid level condition or parking brake applied condition. To check this light, insert the key in the ignition lock cylinder and turn it to the START position. The light should glow in this position. If it fails to glow, service the electrical system as required. Go to System Pre-Check Test B, Red Brake Light OFF and Does Not Self-Check.

Allow the key to spring back from the START position to the RUN position. At this time the red BRAKE light should turn off. If it does not turn off, recheck the parking brake switch to make sure that it is fully disengaged. In the event that the red BRAKE light remains on, go to System Pre-Check Test E, Red Brake Light ON.

Rear Anti-lock Bulb Self-Check

The yellow REAR ABS warning light is used to indicate a malfunction and a deactivation of the RABS II. To check this light, first follow the procedure above for Brake Light Self-Check, and allow the key to spring back from START position to the RUN position. The REAR ABS light should perform a self-check by glowing for approximately two seconds and then turning off. If it turns back on and does not flash, then a system concern has been detected. Refer to procedures for obtaining diagnostic trouble code. If it fails to glow, service the RABS II lamp electrical system. Go to System Pre-Check Test A, Yellow REAR ABS Light OFF and Does not Self-Check.

Rear Anti-lock Bulb Automatically Flashing After Bulb Self-Check

Press the brake pedal for 1 to 2 seconds, then release. If the yellow REAR ABS warning light begins to flash, this indicates that the Keep Alive Memory (KAM) power to the RABS II module has been disrupted. If this condition occurs, service the RABS II KAM power system as required. GO to System Pre-Check Test C, Yellow REAR ABS Light Self-Check OK, but light automatically begins flashing.

Obtaining the Diagnostic Trouble Code (DTC)

NOTE: Verify the ignition switch is in the RUN position. (NOTE: engine does not need to be running). Next, locate the black RABS II diagnostic connector. The diagnostic connector has two mating halves (one of which has a black / orange wire connected to it). Disconnect the two halves.

Attach one end of a jumper wire to the black with orange stripe wire side of the diagnostic connector. Momentarily ground the opposite end of the jumper wire by connecting it to a good chassis ground for 1-2 seconds. Grounding this wire should start the REAR ABS lamp flashing. If grounding this wire does not start the REAR ABS lamp flashing, go to System Pre-Check Test D, Yellow REAR ABS Light Self-check OK, but no flashout code when diagnostics is started.

CAUTION: Care must be taken to connect only the black / orange stripe wire to ground. Connecting the mating connector wire to ground will result in a blown fuse.

The code consists of a number of short flashes and ends with a long flash. Count the short flashes and include the following long flash in the count to obtain the code number. For example, three short flashes followed by one long flash indicates diagnostic trouble Code 4. The code will continue to repeat itself until the key is turned off. It is recommended that the code be verified by reading it several times. This code will be used later for system repair instructions. It should be written down for future use. A diagnostic trouble code of 16 will be obtained when the module detects normal system operation.

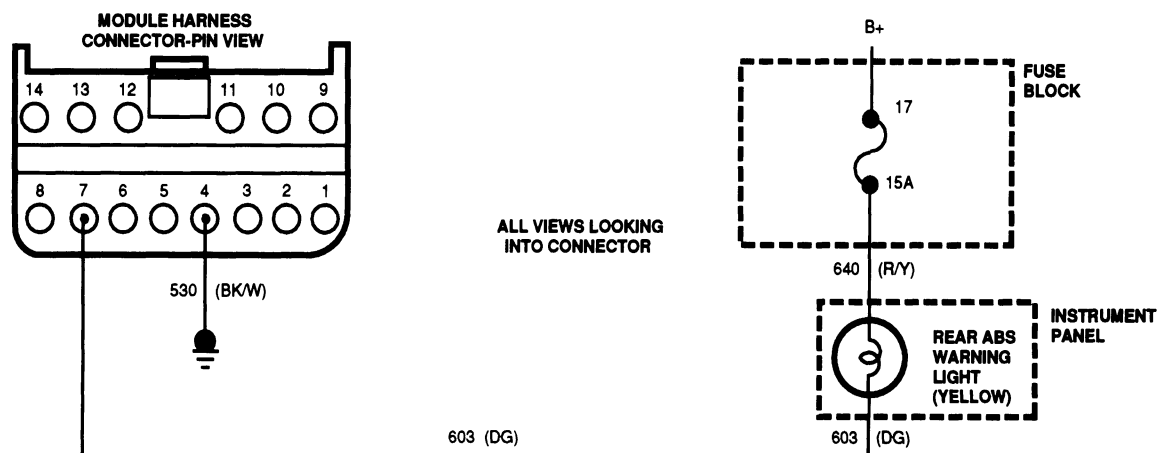
DIAGNOSIS AND TESTING (Continued)**Clearing the Keep Alive Memory (KAM)**

The last step of the System Pre-Check always includes clearing the Keep Alive Memory (KAM). To do this, simply turn off the ignition while the diagnostic connector halves are separated as described in the procedures for obtaining the diagnostic trouble code above, after which the diagnostic connector should be re-assembled to provide KAM power to the RABS II module. If at this time a valid code has been obtained, go to the appropriate pinpoint test for that code.

BRAKE AND REAR ABS WARNING LAMP SYSTEM PRE-CHECK CHART

Condition	Action To Take
Yellow REAR ABS Light OFF and Does not Self Check	See System Pre-Check Test A
Red Brake Light OFF and Does Not Self-Check	See System Pre-Check Test B
Yellow REAR ABS Light Self-Check OK, but light automatically begins flashing	See System Pre-Check Test C
Yellow REAR ABS Light Self-Check OK, but no flashout code when diagnostics is started	See System Pre-Check Test D
Red Brake light ON when key in RUN position	See System Pre-Check Test E

TH8876A

System Pre-Check Test A**System Pre-Check Test A: Yellow REAR ABS Light OFF and Does Not Self-Check****Affected Circuit(s) / Electrical Component(s)**

H8900-A

Description

The RABS II module will turn on the REAR ABS light for 1-2 seconds after the key has been turned from the OFF to the RUN position. If REAR ABS light prove-out fails to occur, it may be caused by a burned-out bulb or an open fuse to Circuit 640(R/Y). An open in Circuit 603(DG) will also keep the light prove-out from occurring.

Possible Contributing Base Brake Component / Vehicle Wiring Concerns

- Open fuse Circuit 640(R/Y)
- Missing power to warning lamp (open circuit 640(R/Y))
- Open circuit 603(DG)
- Burned out REAR ABS warning bulb
- Terminal backout in the module harness connector at Pin 7

DIAGNOSIS AND TESTING (Continued)

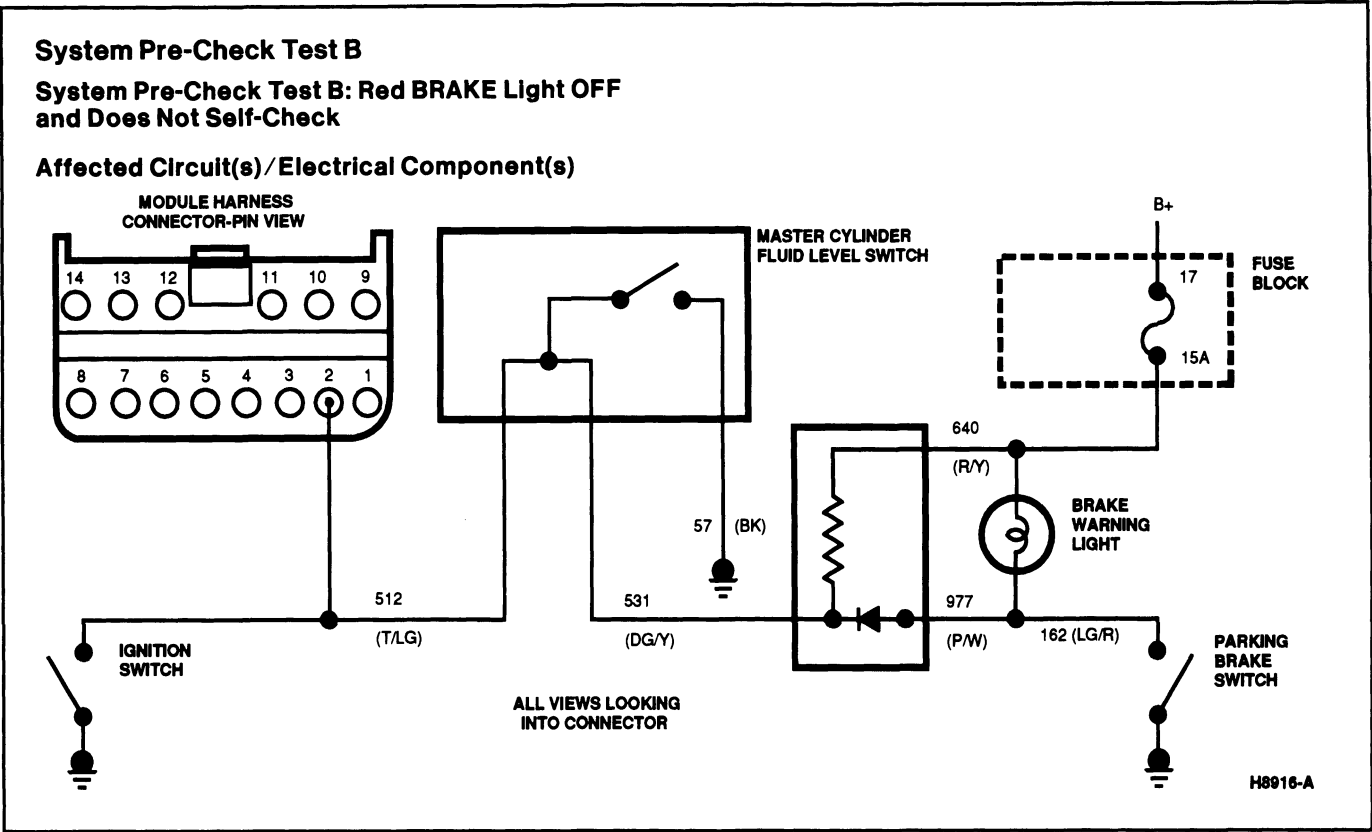
- Module connector not fully mated with RABS II module
- Defective RABS II module
- Open REAR ABS ground (Circuit 530(BK / W))

YELLOW REAR ABS LIGHT OFF AND DOES NOT SELF-CHECK

TEST STEP		RESULT	ACTION TO TAKE
A1	MODULE HARNESS CONNECTOR		
	<ul style="list-style-type: none"> ● Check to make sure module harness is fully plugged into RABS II module. 	Harness is fully plugged in Harness is not fully plugged in	GO to A2. CONNECT harness to module. REPEAT System Pre-Check.
A2	RABS II MODULE GROUND		
	<ul style="list-style-type: none"> ● Check for good RABS II module ground: <ul style="list-style-type: none"> — Disconnect battery. — Remove harness connector from module. — Set ohmmeter on the 200 ohm scale. — Check for resistance between harness connector Pin 4 and chassis ground. <p>NOTE: When checking resistance in the anti-lock system, always disconnect the battery. Improper resistance may occur with the vehicle battery connected.</p>	Resistance less than 1 ohm Resistance 1 ohm or greater	RECONNECT battery. GO to A3. CHECK for open in module ground wire. CHECK for loose, dirty or broken connector pins. REPAIR as necessary. REPEAT System Pre-Check.
A3	REAR ABS LIGHT POWER		
	<ul style="list-style-type: none"> ● Check for voltage to REAR ABS light: <ul style="list-style-type: none"> — Remove harness connector from module. — Set voltmeter on 20 VDC scale position. — Turn ignition to the ON position. — Check voltage between harness connector Pin 7 and a known good chassis ground. 	Voltage greater than 9V Voltage less than 9V	REPLACE module. REPEAT System Pre-Check. GO to A4.
A4	REAR ABS LIGHT 15 AMP FUSE		
	<ul style="list-style-type: none"> ● Remove and inspect REAR ABS light 15 amp fuse. 	Fuse is OK Fuse is blown	RE-INSTALL fuse and GO to A5. CHECK for short to ground between fuse panel and warning lights. REPAIR short and replace 15 amp fuse. REPEAT System Pre-Check.
A5	POWER TO REAR ABS LIGHT FUSE		
	<ul style="list-style-type: none"> ● Check for voltage to fuse. <ul style="list-style-type: none"> — Set voltmeter to 20 VDC scale. — Turn ignition to the ON position. — Check voltage between panel fuse connector and known good chassis ground. 	Voltage greater than 9V Voltage less than 9V	GO to A6. REPAIR fuse panel or vehicle electrical system. REPEAT System Pre-Check.
A6	RABS LIGHT BULB		
	<ul style="list-style-type: none"> ● Check REAR ABS light bulb. 	Bulb is OK Bulb is not OK	REPAIR open between RABS light fuse and Pin 7 of the module wiring harness connector. REPEAT System Pre-Check. REPLACE bulb. REPEAT System Pre-Check.

TH8877A

DIAGNOSIS AND TESTING (Continued)



Description

If the red BRAKE light does not turn on when the key is in the START position, service the warning bulb system as required. The most likely cause of non-functioning red BRAKE lights is a burned out bulb or an open fuse.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Open brake warning light bulb (RED)
- Open power fuse

- Open circuit 640(R/Y), 977(P/W), 512(T/LG), 531(DG/Y), 162(LG/R)
- Open resistor / diode circuit
- Unseated master cylinder fluid level switch connector
- Defective ignition bulb prove-out switch.

SYSTEM PRE-CHECK TEST B — RED BRAKE LIGHT OFF AND DOES NOT SELF-CHECK

TEST STEP		RESULT	ACTION TO TAKE
B1	RED BRAKE WARNING LIGHT/FUSE		
<ul style="list-style-type: none">● Turn ignition to RUN position.● Apply parking brake.● Observe red BRAKE warning light.		Red BRAKE warning light turns on	RELEASE parking brake GO to B2.
		Red BRAKE warning light does not turn on	REPAIR brake warning circuit. CHECK for open fuse. CHECK for burned-out bulb or open Circuit 640 (R/Y), 162 (LG/R). REPEAT System Pre-Check.

DIAGNOSIS AND TESTING (Continued)

SYSTEM PRE-CHECK TEST B — RED BRAKE LIGHT OFF AND DOES NOT SELF-CHECK (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B2	CHECK FOR CORRODED FLUID LEVEL CONNECTOR PINS		
	<ul style="list-style-type: none"> Remove fluid level switch connector located on master cylinder. Inspect both halves of fluid level switch connector for corrosion or connector pin back-out. 	<p>Connector pins not corroded and pins seated properly</p> <p>Corroded or bent connector pins</p>	<p>GO to B3.</p> <p>REPAIR/REPLACE connector as needed. REPEAT System Pre-Check.</p>
B3	CHECK FOR UNSEATED CONNECTOR		
	<ul style="list-style-type: none"> Firmly reconnect fluid level switch connector located on master cylinder. Turn key to START position. Observe red BRAKE light. 	<p>Red BRAKE light is ON when key in START position</p> <p>Red BRAKE light remains OFF when key in START position</p>	<p>Condition is resolved. REPEAT System Pre-Check.</p> <p>GO to B4.</p>
B4	DIODE RESISTOR ELEMENT/ CIRCUIT 531		
	<ul style="list-style-type: none"> Disconnect fluid level switch. Connect jumper wire from Circuit 531 (DG/Y) to known chassis ground. Observe red BRAKE light. 	<p>Red BRAKE light is OFF</p> <p>Red BRAKE light is ON</p>	<p>REPAIR open Circuit 977 (P/W), 531 (DG/Y) or open diode/resistor element. REPEAT System Pre-Check.</p> <p>LEAVE fluid level switch disconnected. GO to B5.</p>
B5	MASTER CYLINDER FLUID LEVEL SWITCH		
	<ul style="list-style-type: none"> Connect jumper wire from Circuit 531 (DG/Y) to Circuit 512 (T/LG). Turn key to START position. Observe red BRAKE light. 	<p>Red BRAKE light turns ON when key in START position</p> <p>Red BRAKE light remains OFF when key in START position</p>	<p>Master Cylinder fluid level switch is defective. REFER to Section 06-06 for fluid level switch removal and installation procedures. REPEAT System Pre-Check.</p> <p>Open in Circuit 512 (T/LG) or defective ignition switch. REPAIR/REPLACE and REPEAT System Pre-Check.</p>

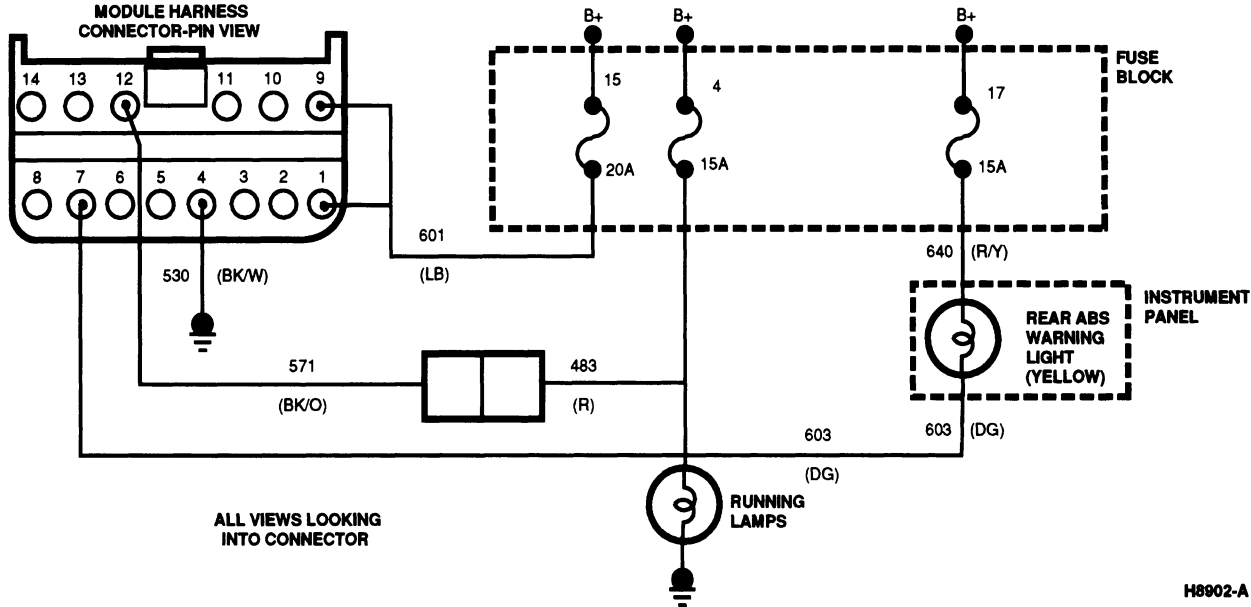
TH8878A

DIAGNOSIS AND TESTING (Continued)

System Pre-Check Test C

System Pre-Check Test C: Yellow REAR ABS Light
Self-Check OK, but light automatically begins
flashing

Affected Circuit(s) / Electrical Component(s)



Description

The RABS II warning light will automatically begin a flash-out sequence if the diagnostic connector is shorted to ground. An open Keep Alive Memory (KAM) fuse is the most likely cause of a grounded diagnostic connector.

Possible Contributing Base Brake Component / Vehicle Wiring Concerns

- Intermittent RABS II module power circuit.
- Intermittent RABS II module ground circuit.
- Intermittent RABS II light circuit.
- Blown Keep Alive Memory fuse.

SYSTEM PRE-CHECK TEST C — YELLOW REAR ABS LIGHT SELF-CHECK OK, BUT LIGHT AUTOMATICALLY BEGINS FLASHING

TEST STEP		RESULT	ACTION TO TAKE
C1	OBSERVE REAR ABS LIGHT FOR FLASH SEQUENCE	Flash sequence is a diagnostic trouble code	INSPECT Circuits 571 (BK/O) and 483 (R) for short to ground. REPAIR circuit and REPLACE RABS KAM fuse. (See owner's manual.) REPEAT System Pre-Check.
	Observe REAR ABS light and determine if the flashing is a diagnostic trouble code (one or more short pulses followed by one long pulse).	Flashing sequence is not a diagnostic trouble code	GO to C2.
C2	INTERMITTENT POWER TO MODULE	Voltage is steady and greater than 9 volts	GO to C3.
	Remove the module harness connector from the module. Set voltmeter to 20VDC scale. Turn the ignition to the ON position. Shake the instrument panel harness while measuring battery voltage between Pin 1, Pin 9 and chassis ground.	Voltage is intermittent or less than 9 volts	REPAIR Circuit 601 (LB/PK). REPEAT System Pre-Check.

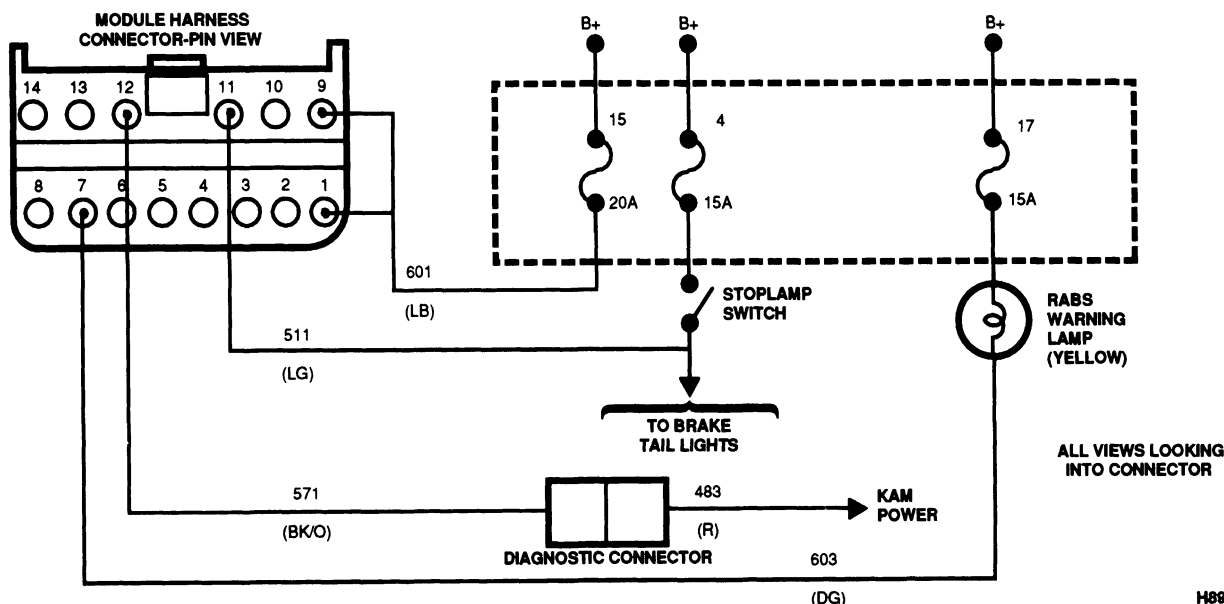
DIAGNOSIS AND TESTING (Continued)**SYSTEM PRE-CHECK TEST C — YELLOW REAR ABS LIGHT SELF-CHECK OK, BUT LIGHT AUTOMATICALLY BEGINS FLASHING (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
C3	DAMAGED MODULE GROUND		
	<ul style="list-style-type: none"> Disconnect the battery. Set the voltmeter on the 200 ohm scale. Shake the module harness while reading the resistance between Pin 4 and chassis ground. 	<p>Resistance is less than 1 ohm and steady</p> <p>Resistance is greater than 1 ohm or fluctuates</p>	<p>REPLACE module. RE-CONNECT the battery. REPEAT System Pre-Check.</p> <p>REPAIR poor ground in Circuit 530 (BK/W). RE-CONNECT the battery. REPEAT System Pre-Check.</p>

TH8898A

System Pre-Check Test D

System Pre-Check Test D: Yellow REAR ABS Light Self-Check OK, but no diagnostic trouble code when diagnostics is started.

Affected Circuit(s)/Electrical Component(s)

H8903-A

Description

The RABS II warning light should automatically begin a flash-out sequence if the diagnostic connector is shorted to ground for at least one second. This flashout sequence can be observed by watching the REAR ABS light. There are a few conditions which will prevent the flashout from occurring. These must be resolved before continuing the RABS II repair process.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Burned-out brake tail lights.
- Missing RABS II power (Circuit 601 [LB/PK] and associated fuse).
- Shorted RABS II light circuit (Circuit 603 [DG]).
- Incorrect module type (RABS I vs. RABS II).

DIAGNOSIS AND TESTING (Continued)

SYSTEM PRE-CHECK TEST D — YELLOW REAR ABS LIGHT SELF-CHECK OK, BUT NO FLASHOUT CODE WHEN DIAGNOSTICS IS STARTED

TEST STEP		RESULT	ACTION TO TAKE
D1	DETERMINE IF SYSTEM IS RABS I OR RABS II		
	<ul style="list-style-type: none"> Determine if the ABS system is a RABS I or a RABS II system. (See TABLE 1 below for assistance.) 	Control module is a RABS II Control module is a RABS I	GO to D2. This shop manual does not cover RABS I control module. See appropriate shop manual for vehicle which you are servicing.
D2	CHECK FOR SHORTED BRAKE SWITCH		
	<ul style="list-style-type: none"> Observe rear brake lights. 	Rear brake lights turned on continuously Rear brake lights not turned on continuously	REPAIR shorted stoplamp switch. REPEAT System Pre-Check. GO to D3.
D3	CHECK FOR BURNED-OUT REAR BRAKE LIGHTS		
	<ul style="list-style-type: none"> Press on brake pedal while observing rear brake lights. 	Rear brake lights turn on when brake pedal is pushed Rear brake lights do not turn on when brake pedal is pushed	GO to D4. REPAIR brake light system: Burned-out bulbs or open Circuit 511 (LG). REPEAT System Pre-Check.
D4	CHECK FOR LOSS OF BRAKE INPUT TO MODULE		
	<ul style="list-style-type: none"> Remove the module harness connector from the module. Check for terminal back-out. Set voltmeter to 20 VDC range. Press on brake pedal hard enough to turn on rear brake lights. Measure voltage from RABS harness connector Pin 11 to chassis ground while brake pedal is pressed. 	Voltage is greater than 9 volts Voltage is less than 9 volts	LEAVE module disconnected. GO to D5. REPAIR open in Circuit 511 (LG). RECONNECT module. REPEAT System Pre-Check.
D5	CHECK POWER TO THE MODULE		
	<ul style="list-style-type: none"> Turn the ignition to the ON position. Measure the voltage between RABS harness connector Pin 1 (or Pin 9) and chassis ground. 	Voltage is less than 9 volts Voltage is greater than 9 volts	REPAIR Circuit 601 (LB/PK) or associated fuse. RECONNECT module. REPEAT System Pre-Check. LEAVE module disconnected. GO to D6.
D6	CHECK FOR SHORTS IN MODULE HARNESS CONNECTOR		
	<ul style="list-style-type: none"> With same set up as in Step D5, observe yellow REAR ABS light. 	REAR ABS light is off REAR ABS light is on	LEAVE module disconnected. GO to D7. CHECK for short to ground in Circuit 603 (DG). RECONNECT the module. REPEAT System Pre-Check.
D7	CHECK CIRCUIT 571 (BK/O) CONTINUITY		
	<ul style="list-style-type: none"> Set the voltmeter to the 200 ohm scale. Disconnect the RABS diagnostic connector from its mating half (Circuits 571 [BK/O] and 483 [R]). Measure resistance of Circuit 571 (BK/O) from diagnostic connector to module harness connector Pin 12. Is the resistance less than 20 ohms? 	Yes No	REPLACE ECU. REPAIR Circuit 571 (BK/O). RECONNECT RABS II module. REPEAT System Pre-Check.

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DIAGNOSIS AND TESTING (Continued)

TABLE I. ORIGINAL EQUIPMENT — RABS I VS. RABS II

Vehicle Type	Model Year	RABS System
F-Series	87-92	RABS I (see note)
F-Series	93	RABS II
Econoline	90-92	RABS I (see note)
Econoline	93	RABS II

NOTE: A RABS I system which has previously been serviced may have its control module upgraded to a RABS II. In the event that you are uncertain whether you have a RABS I or RABS II control module, check the module part number to be certain of the type of system you have.

Part number F3TF-2C018- RABS II Module

Part number F3UF-2C018- RABS II Module

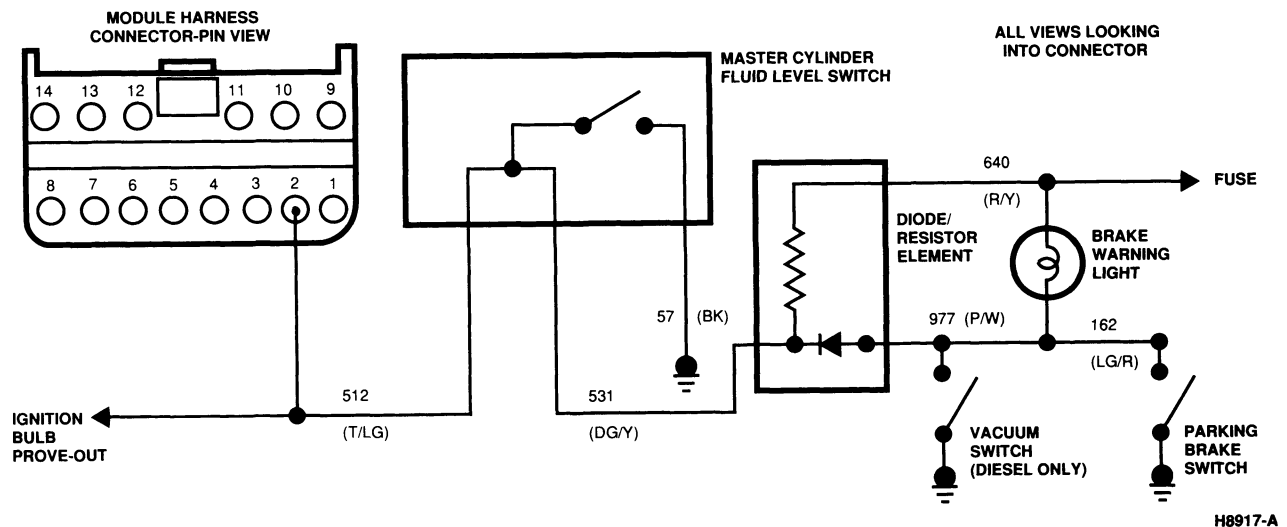
All other part numbers are RABS I Module

CAUTION: RABS I vehicles which have been upgraded with RABS II modules will NOT have Keep Alive Memory and therefore will not be able to store codes when the vehicle is turned off.

System Pre-Check Test E

System Pre-Check Test E: Red BRAKE Light ON When Key in RUN Position

Affected Circuit(s) / Electrical Component(s)



Description

- Red BRAKE light ON with ignition switch ON and parking brake released.

Possible Contributing Base Brake Component / Vehicle Wiring Concerns

- Brake fluid level low in master cylinder.
- Wiring between diode / resistor network and module is shorted to ground.
- RABS II module.
- Worn or damaged brake fluid level switch.

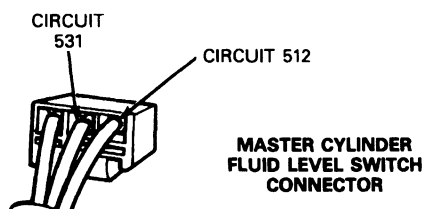
DIAGNOSIS AND TESTING (Continued)

SYSTEM PRE-CHECK TEST E — RED BRAKE LIGHT ON

TEST STEP		RESULT	ACTION TO TAKE
E1	PULL CODE		
	<ul style="list-style-type: none"> ● Pull code. ● Is code 4 obtained? 	<p>Yes</p> <p>No, no code is obtained</p> <p>No, code is not code 4</p>	<p>▶ RECONNECT data link connector and KAM connector. GO to Pinpoint Test — Code 4.</p> <p>▶ GO to System Pre-Check Test D.</p> <p>▶ GO to E2.</p>
E2	CHECK BRAKE FLUID LEVEL IN MASTER CYLINDER		
	<ul style="list-style-type: none"> ● Check the brake fluid level at the master cylinder reservoir. ● Is the fluid level within specification? 	<p>Yes</p> <p>No</p>	<p>▶ GO to E3.</p> <p>▶ CHECK for leaks in the vehicle brake system and REPAIR as required. FILL the master cylinder reservoir to the required level. REPEAT E1.</p>
E3	VERIFY FLOAT BOUYANCY		
	<ul style="list-style-type: none"> ● Remove the cap from the master cylinder reservoir. ● Using a clean steel implement, attempt to push the float down. ● Does the float move down? 	<p>Yes</p> <p>No, the float sits on the bottom</p>	<p>▶ GO to E4.</p> <p>▶ REPLACE the master cylinder reservoir. BLEED the brake system. REPEAT E1.</p>
E4	CHECK RABS II MODULE		
	<ul style="list-style-type: none"> ● Key OFF. ● Disconnect RABS II module harness connector. ● Key ON. ● Does the red BRAKE light turn on? 	<p>Yes</p> <p>No</p>	<p>▶ RECONNECT RABS II module connector. GO to E5.</p> <p>▶ REPLACE RABS II module. RECONNECT RABS II module connector. REPEAT E1.</p>
E5	LOCATE CAUSE OF RED BRAKE LIGHT ON		
	<ul style="list-style-type: none"> ● Key OFF. ● Disconnect the fluid level switch harness connector from the master cylinder. ● Key ON. ● Does the red BRAKE light turn on? 	<p>Yes</p> <p>No</p>	<p>▶ Diesel Only: GO to E6. All others: GO to E7.</p> <p>▶ GO to E8.</p>
E6	LOW VACUUM SWITCH CHECK (DIESEL ONLY)		
	<ul style="list-style-type: none"> ● Key OFF. ● Disconnect low vacuum switch harness connector. ● Key ON. ● Does the red BRAKE light turn on? 	<p>Yes</p> <p>No</p>	<p>▶ GO to E7.</p> <p>▶ RECONNECT all loose connections. REFER to section 06-07B, to diagnose reason for Low Vacuum Switch actuating the red BRAKE light.</p>
E7	PARKING BRAKE SWITCH		
	<ul style="list-style-type: none"> ● Key OFF. ● Disconnect parking brake switch harness connector. ● Key ON. ● Does the red BRAKE light turn on? 	<p>Yes</p> <p>No</p>	<p>▶ Key OFF. LOCATE and SERVICE short to ground in Circuit 977(P/W), 640(R/Y), 531(DG/Y), or 162(LG/R). RECONNECT all loose connections. REPEAT E1.</p> <p>▶ Key OFF. REPLACE parking brake switch. RECONNECT all loose connections. REPEAT E1.</p>

DIAGNOSIS AND TESTING (Continued)**SYSTEM PRE-CHECK TEST E — RED BRAKE LIGHT ON (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
E8	CHECK FLUID LEVEL SWITCH		
<ul style="list-style-type: none"> ● Key OFF. ● With the fluid level switch harness connector disconnected, jumper between Circuits 512(T/LG) and 531(DG/Y). ● Key ON. ● Does the red BRAKE light turn on? 		Yes	▶ LOCATE and SERVICE short to ground in Circuit 512(T/LG). RECONNECT all loose connections. REPEAT E1.
		No	▶ REPLACE master cylinder reservoir. BLEED brake system. RECONNECT all loose connections. REPEAT E1.



H8175-B

INTERMITTENT DIAGNOSIS PROCEDURE

TEST STEP		RESULT	ACTION TO TAKE
ID1	CLEAR CODES, RECONNECT COMPONENTS		
<ul style="list-style-type: none"> ● Reinstall any components removed and reconnect all connections. ● Clear all codes. ● Key ON. ● Does the REAR ABS warning light prove out? 		Yes	▶ GO to ID3.
		No, light stays on	▶ GO to ID2.
ID2	SERVICE CONNECTOR / TERMINAL FAULT		
<ul style="list-style-type: none"> ● Most likely problem is at one of the affected component connectors such that terminals unseat or back out upon installation. At each affected connection, look for: <ul style="list-style-type: none"> — Bent terminals. — Damaged connector terminal locks. — Damaged connector wedge. ● Are any of the above conditions noted? <p>NOTE: If one of the above conditions is found, check the length of the affected circuit once the connection is remade. If the wire is too tight (short), damage is likely to recur once vehicle is given back to the customer. Service the wire as necessary to correct tight wire conditions.</p>		Yes	▶ SERVICE connector and terminal as necessary. GO to ID7.
		No	▶ GO to ID6.
ID3	WIGGLE TEST		
<ul style="list-style-type: none"> ● Leave key on. ● Wiggle an affected circuit in one location only. <p>NOTE: Start at one component and wiggle connector by connector until the whole circuit has been tested.</p> <ul style="list-style-type: none"> ● Observe REAR ABS warning light. ● Is the REAR ABS warning light on? 		Yes	▶ SERVICE the wire terminal or connector as identified in the wiggle test. GO to ID5.
		No	▶ GO to ID4.
ID4	VERIFY ALL CIRCUITS HAVE BEEN TESTED		
<ul style="list-style-type: none"> ● Have all affected circuits for the code being serviced been tested? 		Yes	▶ Key off. GO to ID6.
		No	▶ GO to ID3 and check next circuit.

DIAGNOSIS AND TESTING (Continued)**INTERMITTENT DIAGNOSIS PROCEDURE (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
ID5	RETRIEVE CODE		
	<ul style="list-style-type: none"> Retrieve code. Is this code different than the code being serviced? 	Yes No	GO to the appropriate pinpoint test. SERVICE the wire, terminal, or connector as necessary. GO to ID7.
ID6	VERIFY ALL APPROPRIATE DIAGNOSTIC PROCEDURES HAVE BEEN RUN		
	<ul style="list-style-type: none"> Has the System Pre-Check been run and a code been retrieved? Have all steps of the pinpoint test for the code being serviced been performed? (If some tests were performed, then go the pinpoint step last completed and continue.) 	Yes, all diagnostic procedures have been run No	RETURN to the pinpoint test and proceed. RETURN to procedure(s) not yet performed and proceed.
ID7	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 	Yes No, code being serviced still exists No, different code is set	STOP. Concern has been corrected. GO to ID4. GO to appropriate pinpoint test.

TH8880A

PSOM Signal Verification Procedure

This procedure is intended to determine whether the cause for loss of or erratic Programmable Speedometer / Odometer Module (PSOM) function is due to the lack of a signal from the Rear Axle Sensor.

There are two basic reasons that PSOM would not receive a signal from the Rear Axle Sensor:

- The Rear Axle Sensor or the signal from the Rear Axle Sensor is faulty and either not being generated or is not reaching the RABS II module and / or PSOM. In cases where the concern is not intermittent and not reaching the RABS II module, the ABS warning light will be on upon vehicle startup and a rear axle diagnostic trouble code should be obtained upon RABS II diagnostic trouble code retrieval. Where the concern is intermittent and the ABS warning light does NOT come on during vehicle startup, a rear sensor diagnostic trouble code may still be stored in the RABS II module (see RABS II Diagnostic Codes).

- The wiring or interconnections in the vehicle harness between the RABS II and the PSOM module is faulty. This may lead to erratic PSOM function and is difficult to diagnose.

This procedure will only determine whether the Rear Axle Sensor is functioning based upon whether a signal is received at the PSOM module. If it is determined that the Rear Axle Sensor is sending out a proper signal, refer to Section 13-02A, PSOM System Diagnosis.

PROGRAMMABLE SPEEDOMETER/ ODOMETER MODULE (PSOM) SIGNAL VERIFICATION PROCEDURE

TEST STEP		RESULT	ACTION TO TAKE
SV1	DETERMINE STATE OF ABS WARNING LIGHT		
	<ul style="list-style-type: none"> Observe ABS warning light. Turn ignition to START. Allow ignition to return to the RUN position. Does the ABS warning light turn on? 	Yes No	GO to SV2. GO to System Pre-Check Test A. RETURN when ABS warning light fault is repaired.

DIAGNOSIS AND TESTING (Continued)**PROGRAMMABLE SPEEDOMETER/ODOMETER MODULE (PSOM) SIGNAL VERIFICATION PROCEDURE (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
SV2	OBTAIN ABS CODE		
	<ul style="list-style-type: none"> Obtain ABS code (refer System Pre-Check). Are any of the following codes obtained: 6, 9, or 10? <p>NOTE: Any other code obtained represents an ABS system concern and does NOT have an effect on the ability of the rear axle sensor to send the speed signal to PSOM. Resolve the ABS system concern indicated by the diagnostic trouble code first. When the ABS system concern is corrected, repeat this step to continue PSOM concern diagnosis.</p>	<p>Yes</p> <p>No, code 16 is obtained</p> <p>No, a code other than 6, 9, 10, 16 is obtained</p> <p>No, no code is obtained</p>	<p>GO to the pinpoint test for the code obtained.</p> <p>GO to SV3.</p> <p>GO to appropriate pinpoint test (refer to Service Code Index).</p> <p>Go to System Pre-Check Test D.</p>
SV3	VERIFY REAR AXLE SENSOR SPEED SIGNAL AT RABS II CONNECTOR		
	<ul style="list-style-type: none"> Key OFF. Remove the RABS II module connector from the RABS II module. Raise the vehicle so that all the wheels are clear of the ground. If the vehicle is a 4x4, verify the transfer case is in the 4x2 mode. Connect a Hand-Held Automotive Meter, Rotunda 105-00053 or equivalent between RABS II harness connector pin 10 (circuit 523-R/PK) and pin 3 (circuit 519 — LG/BK). Set the meter to the frequency counter (Hz) setting. Gradually spin up the rear wheels. Does the frequency increase as the rear wheel speed increases? 	<p>Yes</p> <p>No</p>	<p>RABS II module is receiving a proper signal. RETURN to Section 13-02A.</p> <p>GO to Drive Test — Code 6, Step DT6.3.</p>

CAUTION: When checking resistance in the RABS II system, always disconnect the battery. Improper resistance readings may occur with the vehicle battery connected.

STATIC PINPOINT TEST

CONDITION	ACTION TO TAKE
Yellow REAR ABS Light Flashes 2 Times Open Isolation Valve Circuit	See Pinpoint Test — Code 2
Yellow REAR ABS Light Flashes 3 Times Open Dump Valve Circuit	See Pinpoint Test — Code 3
Yellow REAR ABS Light Flashes 4 Times Red BRAKE Warning Light Illuminated RABS Valve Switch Closed or Open Dump Valve	See Pinpoint Test — Code 4
Yellow REAR ABS Light Flashes 5 Times System Dumps Too Many Times in 2WD (2WD and 4WD Vehicles). Condition Occurs While Making Normal or Hard Stops. Rear Brake May Lock	See Pinpoint Test — Code 5
Yellow REAR ABS Light Flashes 6 Times (Sensor Signal Rapidly Cuts In and Out). Condition Only Occurs While Driving	See Pinpoint Test — Code 6
Yellow REAR ABS Light Flashes 7 Times No Isolate Valve Self-Test	See Pinpoint Test — Code 7
Yellow REAR ABS Light Flashes 8 Times No Dump Valve Self-Test	See Pinpoint Test — Code 8
Yellow REAR ABS Light Flashes 9 Times High Sensor Resistance	See Pinpoint Test — Code 9
Yellow REAR ABS Light Flashes 10 Times Low Sensor Resistance	See Pinpoint Test — Code 10
Yellow REAR ABS Light Flashes 11 Times Stoplamp Switch Circuit Defective. Condition Indicated Only When Driving Above 35 mph	See Pinpoint Test — Code 11

(Continued)

DIAGNOSIS AND TESTING (Continued)

STATIC PINPOINT TEST (Cont'd)

CONDITION	ACTION TO TAKE
Yellow REAR ABS Light Flashes 12 Times Base Brake Hydraulic Loss or Worn or Damaged Master Cylinder Switch or Wiring	See Pinpoint Test — Code 12
Yellow REAR ABS Light Flashes 13 Times Module Failure	See Pinpoint Test — Code 13
Yellow REAR ABS Light Flashes 16 Times or More System OK	See Pinpoint Test — Code 16

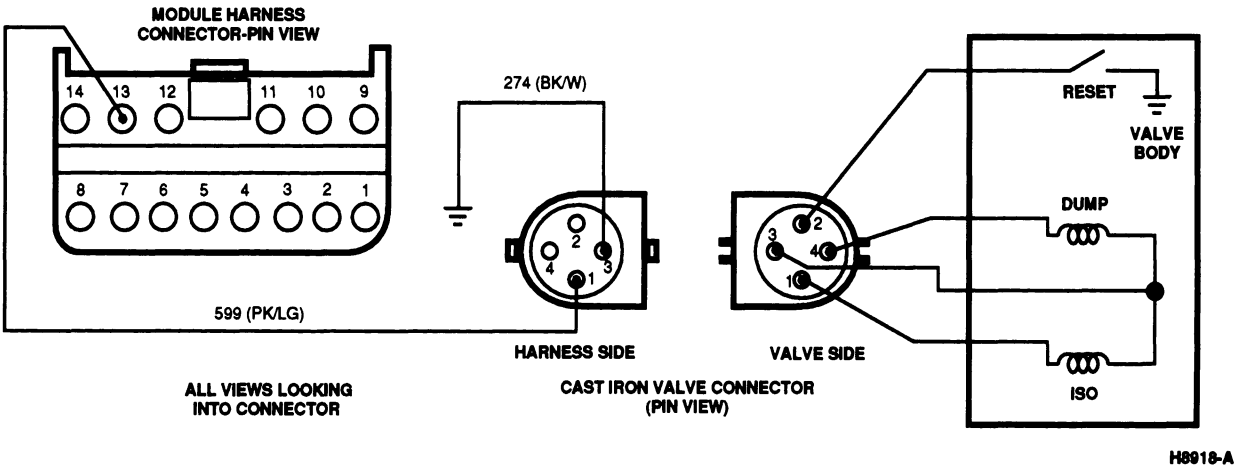
NOTE: Refer to Obtaining the Diagnostic Trouble Code in this section for procedure to obtain flashout code.

TH7008A

Pinpoint Test Code 2

Code 2 — Open RABS II Valve Isolation Solenoid
or Isolation Solenoid Wiring

Affected Circuit(s)/Electrical Component(s)



Description

Code 2 is generated by the module's detection of an open circuit in Circuit 599(PK / LG). The code may also be generated by a failed isolation solenoid (open coil) internal to the RABS II valve or a failed internal module circuit.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Terminal backout in the module harness connector at Pin 13.

- Terminal backout in the RABS II valve harness connector at Pin 1.
- Bulkhead connector (between engine compartment and instrument panel) terminal backout or loose connection.
- Module or RABS II valve connectors not fully mated with component.
- Intermittent open circuit in Circuit 599(PK / LG).

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 2

TEST STEP		RESULT	ACTION TO TAKE
2.1	VERIFY INTEGRITY OF MODULE CONNECTION		
	<ul style="list-style-type: none"> Turn the ignition OFF. Disconnect battery ground cable. Remove the module connector. Pull gently on Pin 13 (PK/LG) just behind the harness connector. 	<p>Terminal is fully engaged</p> <p>Terminal(s) in component connector are loose, bent, deformed, corroded, or missing</p> <p>Terminal(s) are loose in harness connector or pull completely out of connector</p>	<p>LEAVE module connector disconnected. GO to 2.2.</p> <p>SERVICE terminal or connector as needed. If not, REPLACE RABS II module. GO to 2.6.</p> <p>SERVICE terminal or connector as needed. GO to 2.6.</p>
2.2	VERIFY INTEGRITY OF VALVE CONNECTION		
	<ul style="list-style-type: none"> Remove valve connector. Inspect valve component connector for contamination or loose terminals. Pull gently on Pin 1 (PK/LG) just behind the harness connector. 	<p>Terminals in component connector are clean and firmly in place. Terminal in harness connector is firmly engaged</p> <p>Terminal(s) in component connector are loose, bent, deformed, corroded, or missing</p> <p>Terminal in harness connector moves back or comes free of connector</p>	<p>LEAVE valve connector disconnected. GO to 2.3.</p> <p>REPLACE RABS valve. GO to 2.6.</p> <p>SERVICE terminal or connector as needed. GO to 2.6.</p>
2.3	CHECK FOR CONTINUITY ALONG HARNESS CIRCUIT 599 (PK/LG)		
	<ul style="list-style-type: none"> Verify ohmmeter is on 200 ohm scale. Measure resistance between module harness connector Pin 13 and valve harness connector Pin 1. 	<p>Resistance is less than 10 ohms</p> <p>Resistance is greater than 10 ohms</p>	<p>Circuit is not open. GO to 2.4.</p> <p>FIND and REPAIR open circuit along Circuit 599 (PK/LG). GO to 2.6.</p>
2.4	CHECK FOR OPEN RABS VALVE ISOLATION SOLENOID		
	<ul style="list-style-type: none"> Verify ohmmeter is on 200 ohm scale. Measure resistance between RABS valve Pins 1 and 3. 	<p>Resistance is less than 6 ohms</p> <p>Resistance is greater than 6 ohms</p>	<p>Circuit is not open. GO to 2.5.</p> <p>Open circuit in RABS valve is indicated. REPLACE RABS valve. GO to 2.6.</p>

DIAGNOSIS AND TESTING (Continued)

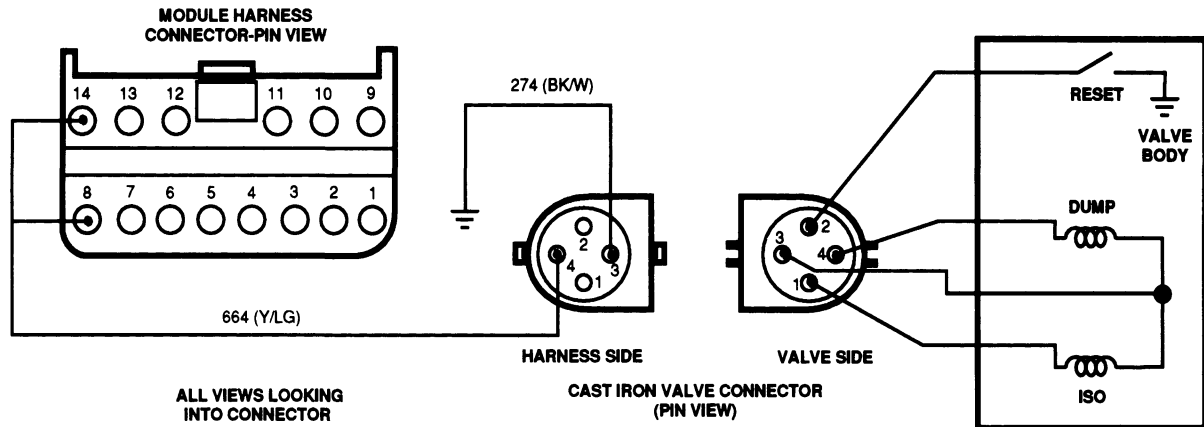
PINPOINT TEST — CODE 2 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
2.5	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	<p>Yes</p> <p>No</p>	<p>REPLACE ECU GO to Step 2.6. If ECU has been replaced and no resolution has been reached, REPLACE RABS Valve GO to Step 2.6.</p> <p>GO to diagnostic step last completed and continue.</p>
2.6	CLEAR CODE/PULL CODE		
	<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 483 [R]). Turn ignition ON. Begin diagnostic trouble code flashout by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 	<p>Diagnostic trouble code = 16</p> <p>Diagnostic trouble code = 2</p> <p>Diagnostic trouble code is different than before</p>	<p>GO to Test Drive Code 16.</p> <p>GO to 2.7.</p> <p>GO to Pinpoint Test for corresponding code.</p>
2.7	PINPOINT TEST STATUS		
	<ul style="list-style-type: none"> Has pinpoint test been completed? 	<p>Yes</p> <p>No</p>	<p>GO to 2.8.</p> <p>RETURN to last pinpoint test completed.</p>
2.8	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. Is resolution achieved? 	<p>Yes</p> <p>No</p>	<p>STOP. Repair is complete GO to Drive Test — Code 16.</p> <p>GO to 2.5.</p>

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DIAGNOSIS AND TESTING (Continued)**Pinpoint Test Code 3**

Code: 3 — Open RABS II Valve Dump Solenoid or Dump Solenoid Wiring

Affected Circuit(s)/Electrical Component(s)

H8919-A

Description

Code 3 is generated by the module's detection of an open circuit in line 664(Y/LG) or 274(BK/W). The code may also be generated by a failed dump solenoid (open coil) internal to the RABS II valve or a failed internal module circuit.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Terminal backout in the module harness connector at Pin 8 or 14.

- Terminal backout in the RABS II valve harness connector at Pin 4.
- Bulkhead connector (between engine compartment and instrument panel) terminal backout or loose connection.
- Module or RABS II valve connectors not fully mated with component.
- Intermittent open circuit in line 664(Y/LG).

PINPOINT TEST — CODE 3

TEST STEP		RESULT	ACTION TO TAKE
3.1	VERIFY INTEGRITY OF MODULE CONNECTION		
<ul style="list-style-type: none"> Turn ignition to the OFF position. Disconnect battery ground cable. Remove the module connector. Inspect module Pins 8 and 14. Pull gently on each wire just behind Pins 8 and 14 on harness connector. 		Terminals in module connector are clean and firmly in place. Terminals 8 and 14 in harness connector are firmly engaged	LEAVE module connector disconnected. GO to 3.2.
		Terminal(s) in module connector are loose, bent, deformed, corroded, or missing	SERVICE terminal or connector as needed. If not serviceable, REPLACE module. GO to 3.6.
		Terminals 8 or 14 in harness connector move back or come free of connector	SERVICE terminal or connector as needed. GO to 3.6.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 3 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
3.2	VERIFY INTEGRITY OF VALVE CONNECTION		
	<ul style="list-style-type: none"> Remove valve connector. Inspect valve connector Pin 4. Gently pull on Pin 4 wire just behind harness connector. 	<p>Terminals in valve connector are clean and firmly in place. Terminals in harness connector are firmly engaged.</p> <p>Terminal(s) in valve connector are loose, bent, deformed, corroded, or missing</p> <p>Terminal(s) in harness connector move back or come free of connector</p>	<p>LEAVE valve connector disconnected. GO to 3.3.</p> <p>SERVICE terminal or connector as needed. If not serviceable, REPLACE RABS valve. GO to 3.6.</p> <p>SERVICE terminal or connector as needed. GO to 3.6.</p>
3.3	CHECK FOR CONTINUITY ALONG HARNESS CIRCUIT 664 (Y/LG) FROM MODULE CONNECTOR PINS 8 AND 14		
	<ul style="list-style-type: none"> Set ohmmeter on 200 ohm scale. Measure resistance between module harness connector Pin 8 and valve harness connector Pin 4. Measure resistance between module harness connector Pin 14 and valve harness connector Pin 4. 	<p>Resistance is less than 10 ohms between module harness Pin 8 and valve harness Pin 4</p> <p>AND</p> <p>Resistance is less than 10 ohms between module harness Pin 14 and valve harness Pin 4</p> <p>Resistance is greater than 10 ohms between module harness Pin 8 and valve harness Pin 4</p> <p>Resistance is greater than 10 ohms between module harness Pin 14 and valve harness Pin 4</p>	<p>Circuit is not open. GO to 3.4.</p> <p>FIND and REPAIR open circuit along 664 (Y/LG). GO to 3.6.</p> <p>FIND and REPAIR open circuit along 664 (Y/LG). GO to 3.6.</p>
3.4	CHECK FOR OPEN RABS DUMP VALVE SOLENOID		
	<ul style="list-style-type: none"> Verify ohmmeter is on 200 ohm scale. Measure resistance between RABS valve Pins 4 and 3. 	<p>Resistance is less than 3 ohms</p> <p>Resistance is greater than 3 ohms</p>	<p>Circuit is not open. GO to 3.5.</p> <p>Open circuit in RABS valve is indicated. REPLACE RABS valve. GO to 3.6.</p>

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 3 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
3.5	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	<p>Yes</p> <p>No</p>	<p>REPLACE ECU GO to Step 3.6. If ECU has been replaced and no resolution has been reached, REPLACE RABS Valve GO to Step 3.6.</p> <p>GO to diagnostic step last completed and continue.</p>
3.6	CLEAR CODE / PULL CODE		
	<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 483 [R]). Turn ignition ON. Begin diagnostic trouble code flashout by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 	<p>Diagnostic trouble code = 16</p> <p>Diagnostic trouble code = 3</p> <p>Diagnostic trouble code is different than before</p>	<p>GO to Test Drive Code 16.</p> <p>GO to 3.7.</p> <p>GO to Pinpoint Test for corresponding code.</p>
3.7	PINPOINT TEST STATUS		
	<ul style="list-style-type: none"> Has pinpoint test been completed? 	<p>Yes</p> <p>No</p>	<p>GO to 3.8.</p> <p>RETURN to last pinpoint test completed.</p>
3.8	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. Is resolution achieved? 	<p>Yes</p> <p>No</p>	<p>STOP. Repair is complete GO to Drive Test — Code 16.</p> <p>GO to 3.5.</p>

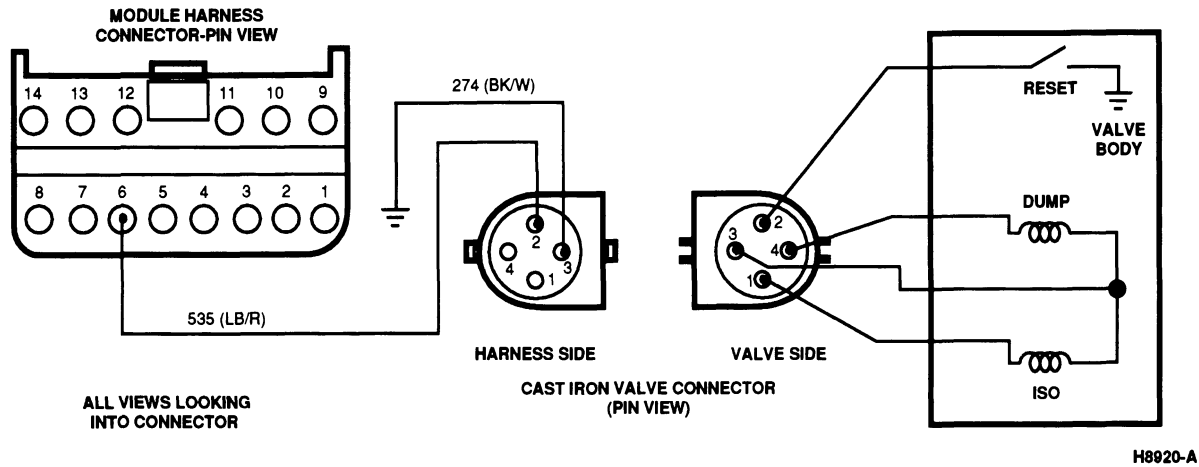
TH8882A

DIAGNOSIS AND TESTING (Continued)

Pinpoint Test Code 4

Code: 4 — Open/Grounded RABS Valve Reset Switch Circuit

Affected Circuit(s)/Electrical Component(s)



Description

Code 4 is generated by the module's detection of a resistance falling below 18k ohms (short) or above 26k ohms (open) in circuit 535(LB/R). This can indicate an open or short in the reset switch circuit, or a hydraulic leak into dump section of the valve.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Terminal backout in the module harness connector at Pin 6.
- Terminal backout in the RABS valve harness connector at Pins 2 or 3.

- Bulkhead connector (between engine compartment and instrument panel) terminal backout or loose connection.
- Module or RABS valve connectors not fully matted with component.
- Intermittent open or open circuit in Circuits 535 (LB/R), or 274 (BK/W).
- Intermittent short or short circuit in Circuit 535 (LB/R).
- Defective RABS valve (hydraulic or electrical).

PINPOINT TEST CODE 4

TEST STEP		RESULT	ACTION TO TAKE
4.1	VERIFY INTEGRITY OF MODULE CONNECTION		
<ul style="list-style-type: none">• Turn the ignition OFF.• Disconnect battery ground cable.• Inspect module component connector Pin 6.• Inspect module harness connector Pin 6.• Pull gently on Pin 6 wire just behind the harness connector.		Terminals in module connector are clean and firmly in place. Terminal 6 in harness connector is firmly engaged	Leave module connector disconnected. GO to 4.2.
		Terminal(s) in module connector are loose, bent, deformed, corroded, or missing	SERVICE terminal or connector as needed. If not serviceable, REPLACE module. GO to 4.10.
		Terminal 6 in harness connector moves back or comes free of connector	SERVICE terminal or connector as needed. GO to 4.10.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST CODE 4 (Continued)

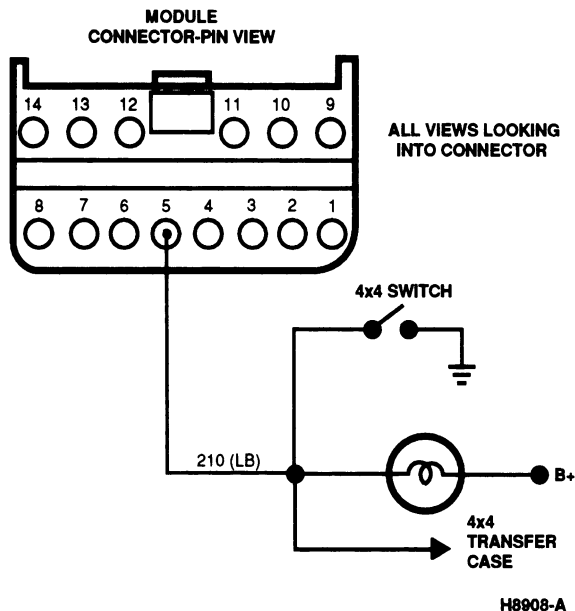
TEST STEP		RESULT	ACTION TO TAKE
4.2	VERIFY INTEGRITY OF VALVE CONNECTION		
	<ul style="list-style-type: none"> Remove valve connector. Inspect valve component connector Pins 2 and 3. Inspect valve harness connector Pins 2 and 3. Pull gently on Pin 2 wire just behind the harness connector. Pull gently on Pin 3 just behind the harness connector. 	<p>Terminals in valve connector are clean and firmly in place. Terminals 3 and 2 in harness connector are firmly engaged.</p> <p>Terminals in valve connector are loose, bent, deformed, corroded, or missing</p> <p>Terminal(s) in harness connector move back or come free of connector</p>	<p>Leave valve connector disconnected. GO to 4.3.</p> <p>SERVICE terminal or connector as needed. If not serviceable, REPLACE valve. GO to 4.10.</p> <p>SERVICE terminal or connector as needed. GO to 4.10.</p>
4.3	CHECK FOR CONTINUITY ALONG HARNESS CIRCUIT 535 (LB/R)		
	<ul style="list-style-type: none"> Set ohmmeter on 200 ohm scale. Measure resistance between module harness connector Pin 6 and valve harness connector Pin 2. 	<p>Resistance is less than 10 ohms</p> <p>Resistance is greater than 10 ohms</p>	<p>Circuit is not open. GO to 4.4.</p> <p>FIND and REPAIR open circuit along Circuit 535(LB/R). GO to 4.10.</p>
4.4	CHECK FOR CONTINUITY ALONG GROUND CIRCUIT 274(BK/W)		
	<ul style="list-style-type: none"> Set ohmmeter on 200 ohm scale. Measure resistance between valve harness connector Pin 3 and negative battery post. 	<p>Resistance is less than 12 ohms</p> <p>Resistance is greater than 12 ohms</p>	<p>Circuit is not open. GO to 4.5.</p> <p>FIND and REPAIR open circuit along Circuit 535(LB/R). GO to 4.10.</p>
4.5	CHECK FOR SHORT ALONG HARNESS CIRCUIT 535(LB/R)		
	<ul style="list-style-type: none"> Set ohmmeter on 200 ohm scale. Measure resistance between module harness connector Pin 6 and chassis ground. 	<p>Resistance is greater than 12 ohms</p> <p>Resistance is less than 12 ohms</p>	<p>Circuit is not shorted. GO to 4.6.</p> <p>FIND and REPAIR short circuit along Circuit 535(LB/R). GO to 4.10.</p>
4.6	CHECK FOR CLOSED RABS VALVE RESET SWITCH		
	<ul style="list-style-type: none"> Verify ohmmeter is on 200k ohm scale. Measure resistance between RABS valve connector Pin 2 and RABS valve body. 	<p>Resistance is greater than 10k ohms</p> <p>Resistance is less than 10k ohms</p>	<p>Reset switch is not closed. GO to 4.7.</p> <p>Shorted circuit in RABS valve is indicated. REPLACE RABS valve. GO to 4.10.</p>
4.7	CHECK RESISTANCE BETWEEN VALVE SWITCH AND VALVE COMMON		
	<ul style="list-style-type: none"> Verify ohmmeter is on 200k ohm scale. Measure resistance between RABS valve Pins 2 and 3. 	<p>Resistance greater than 10k ohms for cast iron valve</p> <p>Resistance less than 10k ohms for cast iron valve</p>	<p>RABS valve internal circuit is OK. GO to 4.8.</p> <p>Shorted or open circuit in RABS valve is indicated. REPLACE RABS valve. GO to 4.10.</p>

DIAGNOSIS AND TESTING (Continued)

Pinpoint Test Code 5

Code: 5 Excessive dump solenoid activity.
System dumps too many times in 2WD mode
(2WD and 4WD vehicles).

Affected Circuit(s)/Electrical Component(s)



Description

Code 5 is generated when the maximum number of allowable dump pulses has been exceeded. The system will only recognize this condition during an anti-lock stop in 2WD mode. The code may be caused by a blocked RABS dump valve orifice, a stuck dump valve, an open circuit in Circuit 210 (LB), a worn or damaged 4x4 transfer case that causes the vehicle to remain in 4x4 after 4x2 has been selected, or mechanical problems in the rear brake system. (Rear brakes may lock.)

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Parking brake drag.
- Worn or damaged 4x4 switch.
- Rear brake assembly grabby or hanging up.
- Connector corrosion or contamination.
- Intermittent open circuit in Circuit 210 (LB).
- Pierced wire insulation to battery power (4x4 only).

PINPOINT TEST — CODE 5

TEST STEP		RESULT	ACTION TO TAKE
5.1	DRIVE STATUS		
	<ul style="list-style-type: none"> • Determine if vehicle is in 2- or 4-wheel drive when code occurred (except all wheel drive Aerostar). 	4-wheel drive 2-wheel drive	GO to 5.2. GO to 5.3.
5.2	CHECK FOR INCORRECT 4WD SWITCH SIGNAL, OR SHORT TO POWER TO RABS II MODULE		
	<ul style="list-style-type: none"> • Disconnect RABS II module harness connector from module to deactivate RABS. • Key ON. • Shift into 4x4 mode. • Set voltmeter to 20VDC scale. • Measure voltage between Pin 5 of the module harness and chassis ground. • Is the measured voltage less than 1V? 	Yes No, greater than 1V	GO to 5.3. REPAIR 4x4 indicator switch or REPAIR short in Circuit 210 (LB). REFER to the appropriate section in Group 07 for procedures. GO to 5.4.
5.3	CHECK FOR LOW OR ERRATIC SENSOR SIGNAL		
	<ul style="list-style-type: none"> • Disconnect module harness connector. • Position vehicle on hoist and raise both front and rear wheels just enough to clear the floor. • Start the engine and turn the wheels at 5 mph. • Place voltmeter on 2000mV AC scale. • Measure the voltage across module harness connector Pins 3 and 10. • Is the voltage less than 650mV RMS or is sensor signal erratic? 	Yes No, voltage is greater than 650mV RMS	COMPLETE pinpoint test for Code 6, steps 6.2 through 6.8, then RETURN. GO to 5.4 to verify. REINSTALL module connector. GO to drive test for Code 5.

DIAGNOSIS AND TESTING (Continued)

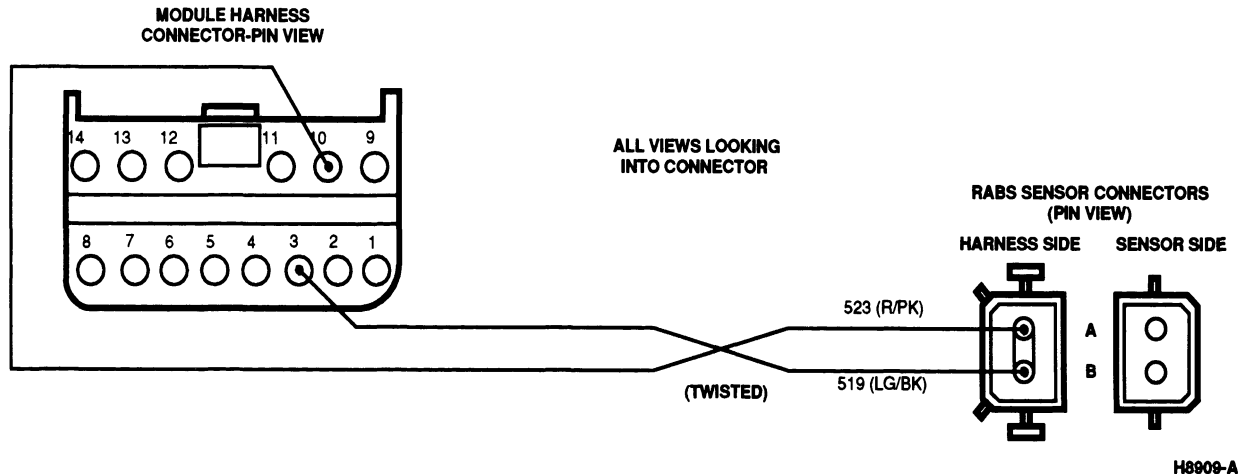
PINPOINT TEST — CODE 5 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
5.4	MAKE SURE ALL STEPS ARE COMPLETED		
<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>		Yes	<p>▶ REPLACE ECU GO to Step 5.5.</p> <p>If ECU has been replaced and no resolution has been reached, REPLACE RABS Valve GO to Step 5.5.</p>
		No	<p>▶ GO to diagnostic step last completed and continue.</p>
5.5	CLEAR CODE / PULL CODE		
<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 481 [R]). Turn ignition ON. Begin diagnostic trouble code flashout by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 		Diagnostic trouble code = 16	<p>▶ GO to Test Drive Code 16.</p>
		Diagnostic trouble code = 5	<p>▶ GO to 5.6.</p>
		Diagnostic trouble code is different than before	<p>▶ GO to Pinpoint Test for corresponding code.</p>
5.6	PINPOINT TEST STATUS		
<ul style="list-style-type: none"> Has pinpoint test been completed? 		Yes	<p>▶ GO to 5.7.</p>
		No	<p>▶ RETURN to last pinpoint test completed.</p>
5.7	VERIFY INTEGRITY OF VEHICLE WIRING		
<p>If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. Is resolution achieved? 		Yes	<p>▶ STOP. Repair is complete GO to Drive Test — Code 16.</p>
		No	<p>▶ GO to 5.4.</p>

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DIAGNOSIS AND TESTING (Continued)**Pinpoint Test Code 6**

Code: 6 — Erratic speed sensor while rolling or bad speed sensor wiring.

Affected Circuit(s)/Electrical Component(s)**Description**

Code 6 is generated by the module's detection of an interruption in the continuous signal from the speed sensor while rolling, caused by an intermittent open internal to the speed sensor, Circuit 519 (LG/BK) or Circuit 523 (R/PK), or a damaged speed sensor ring. This condition can be detected anytime the brake pedal is not applied and 20 seconds has elapsed since the ignition self-test.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Terminal backout in the module harness connector at Pins 3 and 10.

- Terminal backout in the RABS speed sensor harness connector at Pins A and B.
- Bulkhead connector (between engine compartment and instrument panel) terminal backout or loose connection.
- Module or RABS speed sensor connectors are not fully mated with component.
- Intermittent open/short circuit in Circuits 519 (LG/BK) or 523 (R/PK).
- Damaged speed sensor (possibly metal shavings on pole piece).
- Damaged speed sensor ring (possibly teeth missing).

PINPOINT TEST — CODE 6

TEST STEP		RESULT	ACTION TO TAKE
6.1	VERIFY INTEGRITY OF MODULE CONNECTION		
<ul style="list-style-type: none"> Turn ignition OFF. Disconnect battery negative cable. Remove the module connector. Inspect module component connector for contamination and loose or bent terminals. Pull gently on Circuit 519 (LG/BK) just behind Pin 3 on the harness connector. Pull gently on Circuit 523 (R/PK) just behind Pin 10 on the harness connector. 		Terminals in component connector are clean and firmly in place. Terminals in harness connector are firmly engaged.	Leave module connector disconnected. GO to 6.2.
		Terminal(s) in component connector are corroded, bent, or loose.	SERVICE terminals or connector as needed. GO to 6.7.
		Terminal(s) in harness connector are corroded, bent, or move back or come free of connector.	SERVICE terminals or connector as needed. GO to 6.7.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 6 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
6.2	VERIFY INTEGRITY OF SENSOR CONNECTION		
	<ul style="list-style-type: none"> Verify ignition is OFF. Remove sensor connector. Inspect sensor component connector for contamination and bent or loose terminals. Gently pull on Circuit 519 (LG/BK) behind Pin B of harness connector. Gently pull on Circuit 523 (R/PK) behind Pin A of harness connector. 	<p>Terminals in component connector are clean and firmly in place. Terminal in harness connector is firmly engaged.</p> <p>Terminal(s) in component connector are corroded, bent, or loose.</p> <p>Terminal(s) in harness connector are corroded, bent, or move back or come free of connector.</p>	<p>REINSTALL RABS sensor connector. GO to 6.3.</p> <p>REPLACE RABS sensor. GO to 6.7.</p> <p>SERVICE terminal or connector as needed. GO to 6.7.</p>
6.3	VERIFY PROPER SENSOR WIRE ROUTING		
	<ul style="list-style-type: none"> Inspect wire routing. 	<p>Wires are properly secured and show no sign of wear or being pinched.</p> <p>Wire(s) are worn, insulation is pinched, or almost completely severed.</p>	<p>GO to 6.4.</p> <p>FIND and REPAIR as necessary. GO to 6.7.</p>
6.4	CHECK FOR ERRATIC SENSOR SIGNAL AND LOOSE WIRE CONNECTORS		
	<ul style="list-style-type: none"> Set ohmmeter on the 20 K ohm scale. Check resistance between Pin 10 and Pin 3 of the harness connector while shaking the harness from sensor to module. 	<p>Constant reading of 900 to 2500 ohms</p> <p>Reading is erratic or out of range</p>	<p>Signal is not erratic. GO to 6.5.</p> <p>FIND and REPAIR open / short circuit along Circuits 519 (LG/BK) and 523 (R/PK). GO to 6.7.</p>
6.5	VERIFY SENSOR INTEGRITY		
	<ul style="list-style-type: none"> Set ohmmeter on the 20 K ohm scale. Check resistance between Pins A and B of the sensor connector. 	<p>Resistance between 900-2500 ohms</p> <p>Resistance out of 900-2500 ohm range</p>	<p>GO to 6.6.</p> <p>REPLACE RABS speed sensor. GO to 6.7.</p>
6.6	CHECK FOR METAL CHIPS ON SENSOR MAGNET POLE PIECE		
	<ul style="list-style-type: none"> Verify ignition is OFF. Remove the sensor from the differential and inspect for a build up of metal chips on sensor magnetic pole. 	<p>No metal chips are present</p> <p>Metal chips are present</p>	<p>Leave speed sensor out. GO to 6.7.</p> <p>DRAIN and CLEAN differential. GO to 6.7.</p>

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 6 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
6.7	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	<p>Yes</p> <p>No</p>	<p>REPLACE ECU. GO to Step 6.8. If ECU has been replaced and no resolution has been reached, REPLACE rear axle sensor. GO to Step 6.8.</p> <p>GO to diagnostic step last completed and continue.</p>
6.8	CLEAR CODE / PULL CODE		
	<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 481 [R]). Turn ignition ON. Begin diagnostic trouble code flashback by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 	<p>Diagnostic trouble code = 16</p> <p>Diagnostic trouble code = 6</p> <p>Diagnostic trouble code is different than before</p>	<p>GO to Test Drive Code 16.</p> <p>GO to 6.9.</p> <p>GO to Pinpoint Test for corresponding code.</p>
6.9	PINPOINT TEST STATUS		
	<ul style="list-style-type: none"> Has pinpoint test been completed? 	<p>Yes</p> <p>No</p>	<p>GO to 6.10.</p> <p>RETURN to last pinpoint test completed.</p>
6.10	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. Is resolution achieved? 	<p>Yes</p> <p>No</p>	<p>STOP. Repair is complete GO to Drive Test — Code 16.</p> <p>GO to 6.7.</p>

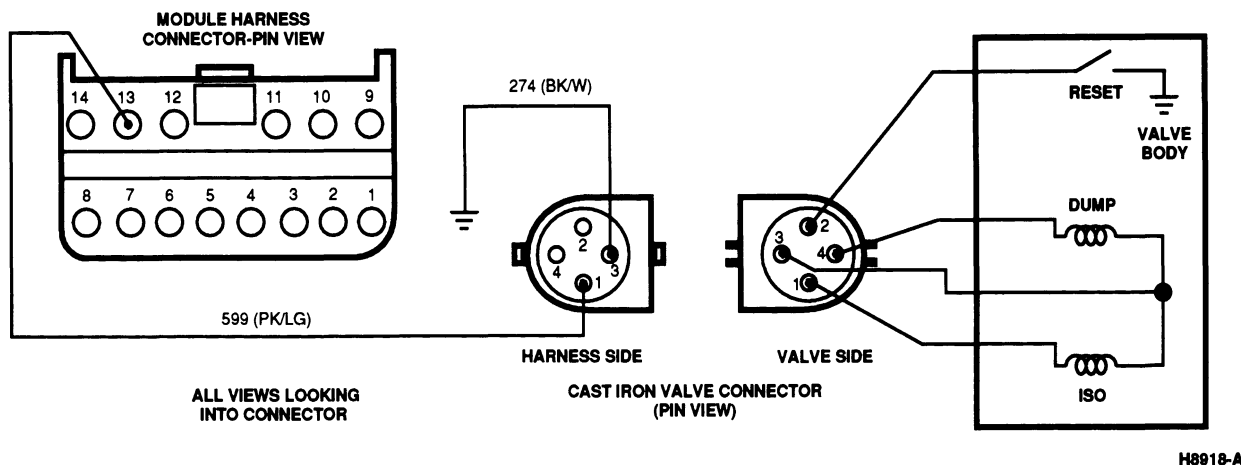
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DIAGNOSIS AND TESTING (Continued)

Pinpoint Test Code 7

Code: 7 — No Isolation Solenoid During Self-Check

Affected Circuit(s)/Electrical Component(s)



Description

Code 7 is generated when the module detects a missing Isolation solenoid output. This can only be detected during an ignition self-check or during RABS stop.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Module internal fuse blown or internal open circuit.
- Shorted isolation solenoid internal to the RABS valve.
- Intermittent short or shorted circuit in Circuit 599 (PK/LG).
- Contamination or bent Pins 1 and 3 of valve connector shorting together.

PINPOINT TEST — CODE 7

TEST STEP		RESULT	ACTION TO TAKE
7.1	CHECK FOR RABS VALVE ISOLATION SOLENOID OR WIRING SHORTED TO GROUND		
	<ul style="list-style-type: none"> ● Turn the ignition OFF. ● Disconnect battery negative cable. ● Remove the module connector. ● Set the ohmmeter on the 200 ohm scale. ● Measure the resistance between module harness connector Pin 13 and chassis ground. 	<p>Resistance greater than 10 ohms</p> <p>Resistance less than 10 ohms</p>	<p>▶ Circuit is not shorted. Leave module connector disconnected. GO to 7.5.</p> <p>▶ Circuit is shorted. Leave module connector disconnected. GO to 7.2.</p>
7.2	CHECK INTEGRITY OF VALVE CONNECTION		
	<ul style="list-style-type: none"> ● Remove valve connector. ● Inspect valve component connector and Pins 1 and 3. 	<p>Terminals in valve connector are clean and firmly in place.</p> <p>Terminal(s) in valve connector are loose, bent, deformed, or corroded.</p>	<p>▶ Circuit is not shorted. Leave valve connector disconnected. GO to 7.3.</p> <p>▶ SERVICE terminals or connector as needed. If not serviceable, REPLACE RABS valve. GO to 7.6.</p>

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 7 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
7.3	CHECK FOR SHORTED RABS ISOLATION SOLENOID		
	<ul style="list-style-type: none"> Verify valve connector removed. Set the ohmmeter on the 200 ohm scale. Measure the resistance between Pins 1 and 3 of valve connector. 	Resistance greater than 3 ohms Resistance less than 3 ohms	LEAVE valve connector disconnected. GO to 7.4. REPLACE RABS valve. GO to 7.6.
7.4	CHECK FOR SHORT TO GROUND ALONG HARNESS CIRCUIT 599 (PK/LG)		
	<ul style="list-style-type: none"> Set ohmmeter on 20K ohm scale. Measure resistance between module harness connector Pin 13 (PK/LG) and chassis ground. 	Resistance less than 20 K ohms Resistance greater than 20 K ohms	REPAIR short in Circuit 599 (PK/LG) between module and RABS valve. GO to 7.6. Conflict of information. REPEAT 7.2.
7.5	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	Yes No	REPLACE ECU GO to Step 7.6. If ECU has been replaced and no resolution has been reached, REPLACE RABS Valve GO to Step 7.6. GO to diagnostic step last completed and continue.
7.6	CLEAR CODE/PULL CODE		
	<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 57 1 [BK/O] and 48 1 [R]). Turn ignition ON. Begin diagnostic trouble code flashout by connecting Circuit 57 1 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 	Diagnostic trouble code = 16 Diagnostic trouble code = 7 Diagnostic trouble code is different than before	GO to Test Drive Code 16. GO to 7.7. GO to Pinpoint Test for corresponding code.
7.7	PINPOINT TEST STATUS		
	<ul style="list-style-type: none"> Has pinpoint test been completed? 	Yes No	GO to 7.8. RETURN to last pinpoint test completed.
7.8	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. Is resolution achieved? 	Yes No	STOP. Repair is complete GO to Drive Test — Code 16. GO to 7.5.

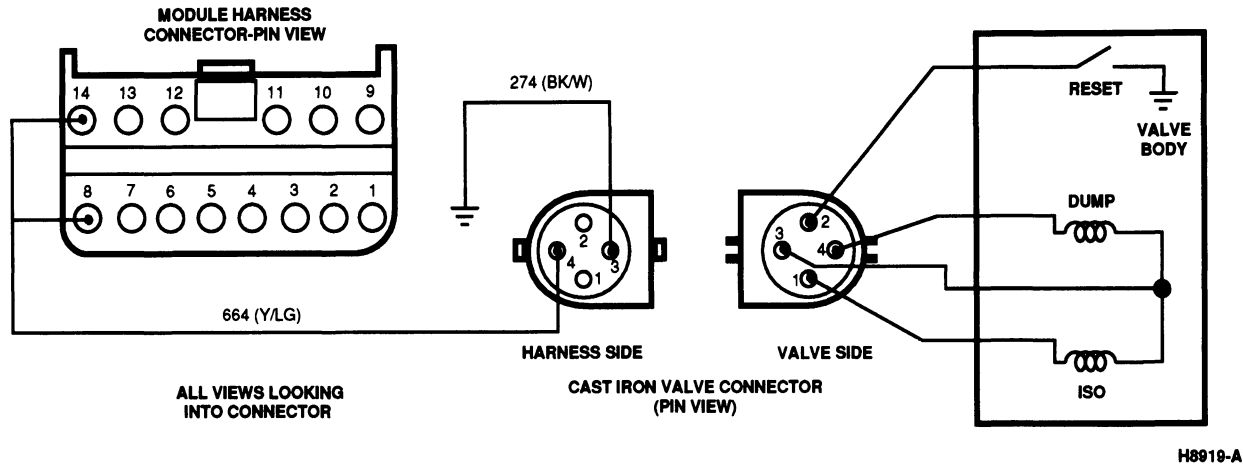
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DIAGNOSIS AND TESTING (Continued)

Pinpoint Test Code 8

Code: 8 — No Dump Solenoid During Self-Check

Affected Circuit(s)/Electrical Component(s)



Description

Code 8 is generated when the module detects a missing Dump solenoid output. This concern can only be detected during an ignition self-test or during a REAR ABS stop.

Possible Contributing Base Brake Component / Vehicle Wiring Concerns

- Module internal fuse blown or internal open circuit.
- Shorted dump solenoid internal to RABS valve.
- Intermittent short or shorted circuit in Circuit 664 (Y/LG).
- Bulkhead connector between engine compartment and instrument panel terminals shorted.

PINPOINT TEST — CODE 8

TEST STEP		RESULT	ACTION TO TAKE
8.1	CHECK FOR RABS VALVE DUMP SOLENOID OR WIRING SHORTED TO GROUND		
<ul style="list-style-type: none">● Turn the ignition OFF.● Disconnect battery negative cable.● Remove the module connector.● Set the ohmmeter on the 200 ohm scale.● Measure the resistance between module harness connector Pin 8 and chassis ground.● Measure the resistance between module harness connector Pin 14 and chassis ground.		Resistance greater than 10 ohms between module harness Pin 8 and ground AND Resistance greater than 10 ohms between module harness Pin 14 and ground	Leave module connector disconnected. GO to 8.4.
		Resistance less than 10 ohms between module harness Pin 8 ground	Leave module connector disconnected. GO to 8.2.
		Resistance less than 10 ohms between module harness Pin 14 and ground	Leave module connector disconnected. GO to 8.2.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 8 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
8.2	CHECK FOR SHORTED RABS DUMP SOLENOID		
	<ul style="list-style-type: none"> Remove valve connector. Set the ohmmeter on the 200 ohm scale. Measure the resistance between Pins 3 and 4 of valve connector. 	Resistance greater than 1 ohm Resistance less than 1 ohm	Leave valve connector disconnected. GO to 8.3 . REPLACE RABS II valve. GO to 8.5 .
8.3	CHECK FOR SHORT TO GROUND ALONG HARNESS CIRCUIT 664 (Y/LG)		
	<ul style="list-style-type: none"> Set ohmmeter on 20 ohm scale. Measure resistance between module harness connector Pin 8 and valve harness connector Pin 4. Measure resistance between module harness connector Pin 14 and valve harness connector Pin 4. 	Resistance less than 10 ohms between module Pin 8 and valve Pin 4 Resistance less than 10 ohms between module Pin 14 and valve Pin 4 Resistance greater than 10 ohms between module Pin 8 and valve Pin 4 AND Resistance greater than 10 ohms between module Pin 14 and valve Pin 4	REPAIR short in Circuit 664 (Y/LG) between module and RABS valve. GO to 8.5 . REPAIR short in Circuit 664 (Y/LG) between module and RABS valve. GO to 8.5 . Conflict of information. REPEAT 8.1 .
8.4	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	Yes No	REPLACE ECU GO to Step 8.5 . If ECU has been replaced and no resolution has been reached, REPLACE RABS Valve GO to Step 8.5 . GO to diagnostic step last completed and continue.
8.5	CLEAR CODE /PULL CODE		
	<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 481 [R]). Turn ignition ON. Begin diagnostic trouble code flashout by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 	Diagnostic trouble code = 16 Diagnostic trouble code = 8 Diagnostic trouble code is different than before	GO to Test Drive Code 16. GO to 8.6 . GO to Pinpoint Test for corresponding code.

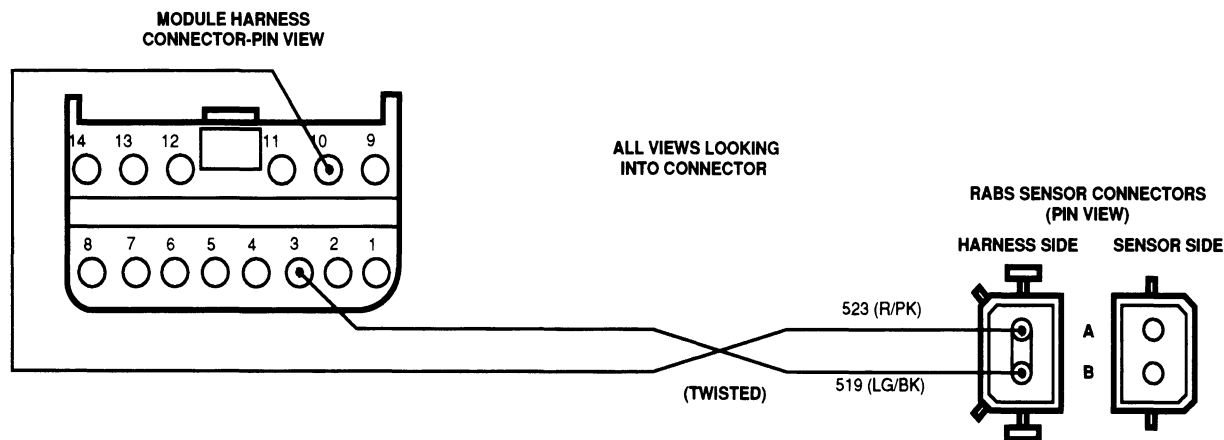
DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 8 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
8.6	PINPOINT TEST STATUS		
	● Has pinpoint test been completed?	Yes No	GO to 8.7. RETURN to last pinpoint test completed.
8.7	VERIFY INTEGRITY OF VEHICLE WIRING		
	If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related. ● REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. ● Is resolution achieved?	Yes No	STOP. Repair is complete GO to Drive Test — Code 16. GO to 8.4.

TH8885A

Pinpoint Test Code 9

Code: 9 — High Speed Sensor Resistance or Open Speed Sensor Wiring**Affected Circuit(s) / Electrical Component(s)**

H8909-A

Description

Code 9 is generated by the module's detection of high speed sensor resistance. The module will consider the speed sensor circuit to have a high resistance when it exceeds approximately 3 K ohms. The code may also be generated by a failed internal module circuit. The module can only detect this condition when the vehicle is at rest.

Possible Contributing Base Brake Component / Vehicle Wiring Concerns

- Terminal backout in the module harness connector at Pin 3 or Pin 10.

- Terminal backout in the RABS speed sensor harness connector at Pins A or B.
- Module or RABS speed sensor connectors not fully mated with component.
- Open or intermittent open circuit in Circuits 519 (LG / BK) or 523 (R / PK).

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 9

TEST STEP		RESULT	ACTION TO TAKE
9.1	VERIFY INTEGRITY OF MODULE CONNECTION		
	<ul style="list-style-type: none"> Turn ignition OFF. Disconnect battery negative cable. Remove the module connector. Pull gently on Circuit 519 (LG/BK) just behind Pin 3 on the harness connector. Pull gently on Circuit 523 (R/PK) just behind Pin 10 on the harness connector. 	Terminal is fully engaged Terminal moves back or comes free of connector	Leave module connector disconnected. GO to 9.2 . SERVICE terminal or connector as needed. GO to 9.6 .
9.2	VERIFY INTEGRITY OF SENSOR CONNECTION		
	<ul style="list-style-type: none"> Remove sensor connector. Inspect sensor component connector for contamination or loose terminals. Gently pull on Circuit 519 (LG/BK) behind Pin B of harness connector. Gently pull on Circuit 523 (R/PK) behind Pin A of harness connector. 	Terminals in component connector are clean and firmly in place. Terminal in harness connector is firmly engaged. Terminals in component connector are loose. Terminal in harness connector moves back or comes free of connector.	Leave sensor connector disconnected. GO to 9.3 . REPLACE RABS sensor. GO to 9.6 . SERVICE terminal or connector as needed. GO to 9.6 .
9.3	CHECK FOR CONTINUITY ALONG HARNESS CIRCUITS 519 (LG/BK) and 523 (R/PK)		
	<ul style="list-style-type: none"> Set ohmmeter on 200 ohm scale. Measure resistance between module harness connector Pin 3 and sensor harness connector Pin B. Measure resistance between module harness connector Pin 10 and sensor harness connector Pin A. 	Resistance is less than 10 ohms Resistance is greater than 10 ohms	Circuit is not open. GO to 9.4 . FIND and REPAIR open circuit along Circuit 519 (LG/BK) and 523 (R/PK). GO to 9.6 .
9.4	CHECK FOR OPEN SENSOR		
	<ul style="list-style-type: none"> Verify ohmmeter is on 20 K ohm scale. Measure resistance between RABS sensor Pins A and B. 	Resistance is less than 2500 ohms Resistance is greater than 2500 ohms	GO to 9.5 . REPLACE RABS sensor. GO to 9.6 .
9.5	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	Yes No	REPLACE ECU GO to Step 9.6 . If ECU has been replaced and no resolution has been reached, REPLACE rear axle sensor. GO to Step 9.6 . GO to diagnostic step last completed and continue.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 9 (Continued)

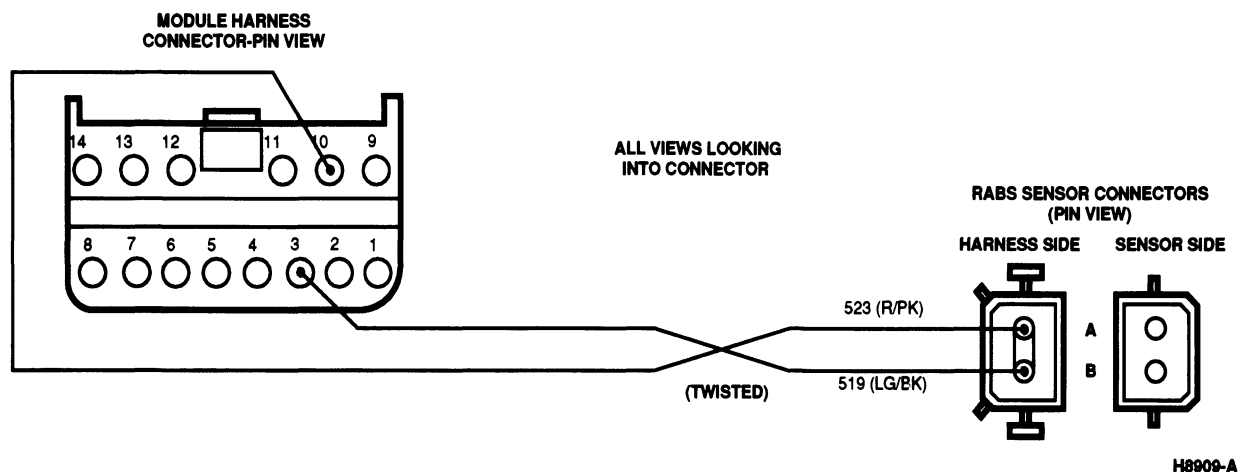
TEST STEP		RESULT	ACTION TO TAKE
9.6	CLEAR CODE / PULL CODE		
<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 481 [R]). Turn ignition ON. Begin diagnostic trouble code flashout by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 		Diagnostic trouble code = 16 Diagnostic trouble code = 9 Diagnostic trouble code is different than before	GO to Test Drive Code 16. GO to 9.7. GO to Pinpoint Test for corresponding code.
9.7	PINPOINT TEST STATUS		
<ul style="list-style-type: none"> Has pinpoint test been completed? 		Yes No	GO to 9.8. RETURN to last pinpoint test completed.
9.8	VERIFY INTEGRITY OF VEHICLE WIRING		
If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related. <ul style="list-style-type: none"> REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. Is resolution achieved? 		Yes No	STOP. Repair is complete GO to Drive Test — Code 16. GO to 9.5.

TH8886A

Pinpoint Test Code 10

Code: 10 — Low Speed Sensor Resistance or Shorted Speed Sensor Wiring

Affected Circuit(s)/Electrical Component(s)



DIAGNOSIS AND TESTING (Continued)**Description**

Code 10 is generated by the module's detection of low sensor resistance. The code may also be generated by a short circuit in the Circuits 519 (LG/BK) or 523 (R/PK), or a failed internal module circuit. Module can only detect when vehicle is at rest.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Short between module harness connector Pin 3 and Pin 10.

- Short between RABS speed sensor connector Pins A and B.
- Bulkhead connector (between engine compartment and instrument panel) sensor terminals shorted together.
- Intermittent short circuit in Circuits 519 (LG/BK) or 523 (R/PK).

PINPOINT TEST — CODE 10

TEST STEP		RESULT	ACTION TO TAKE
10.1	VERIFY INTEGRITY OF MODULE CONNECTION		
	<ul style="list-style-type: none"> ● Turn ignition OFF. ● Disconnect battery negative cable. ● Remove the module connector. ● Pull gently on wire just behind Pin 3 on the harness connector. ● Pull gently on wire just behind Pin 10 on the harness connector. 	<p>Terminal is fully engaged</p> <p>Terminal moves back and comes free of connector</p>	<p>Leave module connector disconnected. GO to 10.2.</p> <p>SERVICE terminal or connector as needed. GO to 10.7.</p>
10.2	VERIFY INTEGRITY OF SENSOR CONNECTION		
	<ul style="list-style-type: none"> ● Remove sensor connector. ● Inspect sensor component connector. ● Gently pull on wire behind Pin B of harness connector. ● Gently pull on wire behind Pin A of harness connector. 	<p>Terminals in component connector are clean and firmly in place. Terminals in harness connector are firmly engaged</p> <p>Terminal(s) in component connector are loose, bent, deformed, or corroded</p> <p>Terminal(s) in harness connector move back or come free of connector</p>	<p>Leave sensor connector disconnected. GO to 10.3.</p> <p>REPLACE RABS II sensor. GO to 10.7.</p> <p>SERVICE terminal or connector as needed. GO to 10.7.</p>
10.3	CHECK FOR SHORT ALONG HARNESS CIRCUIT 519 (LG/BK) WITH CIRCUIT 523 (R/PK)		
	<ul style="list-style-type: none"> ● Set ohmmeter on 20 K ohm scale. ● Verify sensor connector is disconnected. ● Measure resistance between module harness connector Pin 3 and Pin 10. 	<p>Resistance is greater than 20 K ohms</p> <p>Resistance is less than 20 K ohms</p>	<p>Circuits are not shorted. GO to 10.4.</p> <p>FIND and REPAIR short along Circuits 519 (LG/BK) and 523 (R/PK). GO to 10.7.</p>
10.4	CHECK FOR SHORT TO CHASSIS GROUND ALONG CIRCUIT 523 (R/PK)		
	<ul style="list-style-type: none"> ● Verify ohmmeter is on 20 K ohm scale. ● Measure resistance between module harness connector Pin 10 and chassis ground. 	<p>Resistance is greater than 20 K ohms</p> <p>Resistance is less than 20 K ohms</p>	<p>Circuit is not shorted. GO to 10.5.</p> <p>FIND and REPAIR short circuit along Circuit 523 (R/PK). GO to 10.7.</p>

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 10 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
10.5	CHECK FOR SHORTED SENSOR		
	<ul style="list-style-type: none"> Verify ohmmeter is on 20 K ohm scale. Measure resistance between RABS sensor Pins A and B. 	Resistance is greater than 900 ohms Resistance is less than 900 ohms	GO to 10.6. REPLACE rear axle speed sensor. GO to 10.7.
10.6	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	Yes No	REPLACE ECU GO to Step 10.7. If ECU has been replaced and no resolution has been reached, REPLACE rear axle sensor. GO to Step 10.7. GO to diagnostic step last completed and continue.
10.7	CLEAR CODE/PULL CODE		
	<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 483 [R]). Turn ignition ON. Begin diagnostic trouble code flashout by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 	Diagnostic trouble code = 16 Diagnostic trouble code = 10 Diagnostic trouble code is different than before	GO to Test Drive Code 16. GO to 10.8. GO to Pinpoint Test for corresponding code.
10.8	PINPOINT TEST STATUS		
	<ul style="list-style-type: none"> Has pinpoint test been completed? 	Yes No	GO to 10.9. RETURN to last pinpoint test completed.
10.9	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. Is resolution achieved? 	Yes No	STOP. Repair is complete GO to Drive Test — Code 16. GO to 10.6.

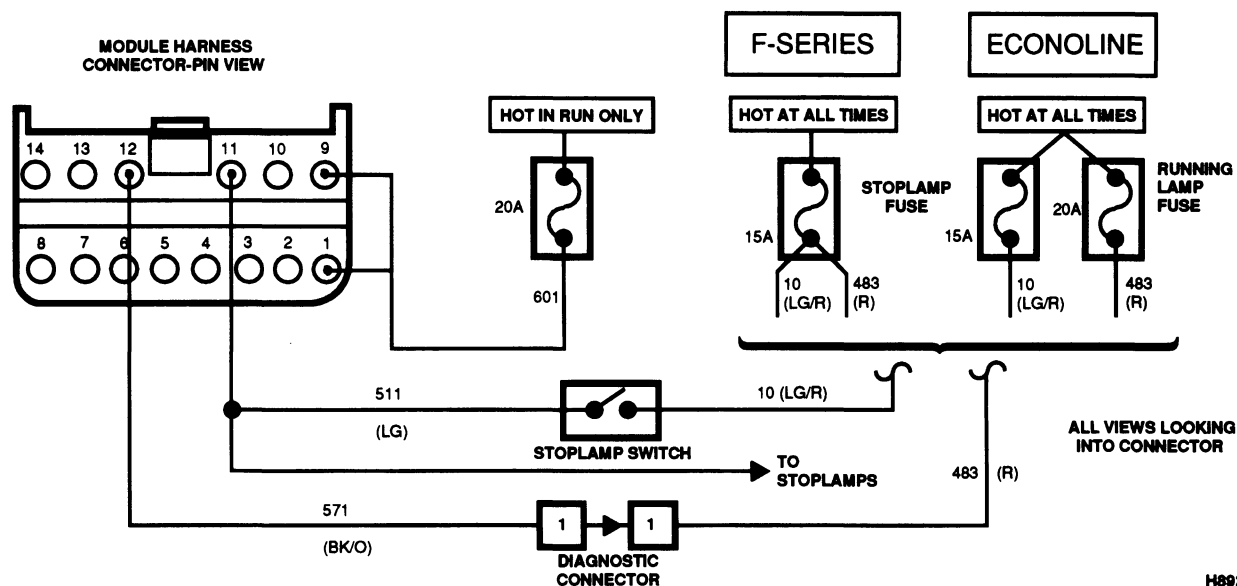
TH8887A

DIAGNOSIS AND TESTING (Continued)

Pinpoint Test Code 11

Code: 11 — Stoplamp switch always closed or stoplamp switch circuit worn or damaged.

Affected Circuit(s)/Electrical Component(s)



Description

Code 11 is caused by the stoplamp switch always being closed prior to the vehicle moving. If the stoplamp switch remains closed when the vehicle begins to move, the REAR ABS warning light will turn on at approximately 16 mph. Code 11 will not be latched in the control modules memory until the speed of the vehicle exceeds 37 mphs for at least 10 seconds. If the vehicle does not exceed 37 mph for at least 10 seconds, then the REAR ABS warning light will turn on but the module will not latch a code. Code 11 can be caused by a driver who is resting their foot on the brake with just enough pressure to close the stoplamp switch, while driving at least 37 mph for a minimum of ten seconds. When this occurs, a Code 11 will be latched by the control unit.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Terminal backout in the module harness connector at Pin 11.
- Missing (burned-out) stoplamps. All stoplamps must be missing or burned out to cause a Code 11.
- An intermittent/continuous open in Circuit 511 (LG). This open would be between module connector Pin 11 and the stoplamp switch.
- Worn or damaged stoplamp switch.

PINPOINT TEST — CODE 11

TEST STEP		RESULT	ACTION TO TAKE
11.1	CHECK VEHICLE STOPLAMP OPERATION		
	<ul style="list-style-type: none"> • Turn ignition to the OFF position. • Apply pressure to the brake pedal and then release pressure while observing the stoplamps. 	Lamps illuminate when pressure is applied to pedal, and turn off when pressure is released	GO to 11.4.
		Lamps do not illuminate	GO to 11.2.
		Lamps always illuminated	REPAIR or REPLACE vehicle stoplamp switch GO to 11.6.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 11 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
11.2	CHECK VEHICLE STOPLAMPS		
	<ul style="list-style-type: none"> Check vehicle stoplamp bulbs. <p>NOTE: Both bulbs need to be burned out to cause a Code 11).</p>	Bulbs are not burned out Bulbs are burned out	GO to 11.3. REPLACE stoplamp bulbs and GO to 11.6.
11.3	CHECK FOR BLOWN STOPLAMP FUSE		
	<ul style="list-style-type: none"> Remove and visually inspect stoplamp fuse located in the fuse panel. 	Fuse is blown Fuse is not blown	REPLACE fuse and investigate reason for blown fuse. GO to 11.6. CHECK Circuit 511 (LG) for open condition. If none found, then REPAIR or REPLACE vehicle stoplamp switch. GO to 11.6.
11.4	CHECK FOR CONTINUITY BETWEEN MODULE CONNECTOR PIN 11 AND THE STOPLAMP SWITCH		
	<ul style="list-style-type: none"> Set ohmmeter on 20 volt scale. Step on brake pedal. Measure voltage between module connector Pin 11 and chassis ground. 	Voltage greater than 9 volts Voltage is less than 2 volts	REINSTALL all connectors. GO to 11.5. FIND and REPAIR open circuit between RABS II module connector (Pin 11), and stoplamp switch. REINSTALL all connectors. GO to 11.6.
11.5	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	Yes No	REPLACE ECU GO to Step 11.6. If ECU has been replaced and no resolution has been reached, REPLACE stoplamp switch. GO to Step 11.6. GO to diagnostic step last completed and continue.
11.6	CLEAR CODE/PULL CODE		
	<ul style="list-style-type: none"> Turn ignition OFF. Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Verify all connectors are installed. Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 481 [R]). Turn ignition ON. Begin diagnostic trouble code flashout by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. Observe and count code. 	Diagnostic trouble code = 16 Diagnostic trouble code = 11 Diagnostic trouble code is different than before	GO to Test Drive Code 16. GO to 11.7. GO to Pinpoint Test for corresponding code.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 11 (Continued)

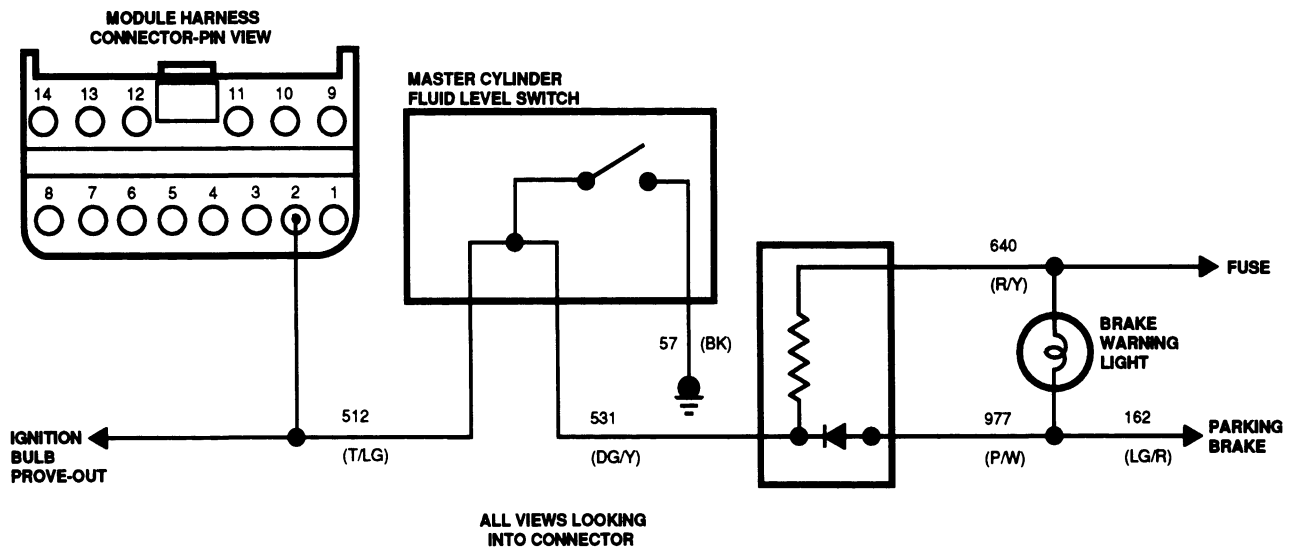
TEST STEP	RESULT	ACTION TO TAKE
11.7 PINPOINT TEST STATUS		
<ul style="list-style-type: none"> Has pinpoint test been completed? 	Yes No	GO to 11.5. RETURN to last pinpoint test completed.

TH8888A

Pinpoint Test Code 12

Code: 12 — Loss of hydraulic brake fluid for one second or more during an anti-lock stop.

Affected Circuit(s)/Electrical Component(s)



H8911-A

Description

Code 12 is generated when the module detects that the brake fluid level in the master cylinder reservoir is low for one or more seconds during an anti-lock stop. It can also be generated by a short in the stoplamp circuit.

Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Low master cylinder fill level.
- Fluid leaks in vehicle brake system.

- Worn or damaged master cylinder fluid level switch, or fluid level circuit shorted to ground.
- Master cylinder float that sticks in the bottom of reservoir or does not float.
- Failed diode-resistor element in stoplamp circuit.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 12

TEST STEP		RESULT	ACTION TO TAKE
12.1	DIODE RESISTOR ELEMENT		
	<p>NOTE: This pinpoint test should not be attempted until after the base brake system has been verified to be operating correctly. This means that the red BRAKE light should not be ON. See System Pre-Check section for assistance in correcting the condition of red BRAKE light is ON when key is in the RUN position.</p> <ul style="list-style-type: none"> ● Turn ignition to the OFF position. ● Release the parking brake. ● DIESEL VEHICLES ONLY: remove diesel low vacuum switch. ● Turn ignition from the OFF position to the ON position. ● Observe REAR ABS light (after 2 second bulb prove-out). 	<p>REAR ABS light is OFF, red BRAKE light is OFF</p> <p>REAR ABS light is ON, red BRAKE light is OFF</p> <p>REAR ABS light is OFF or ON, red BRAKE light is ON</p>	<p>LEAVE key in the ON position. GO to 12.2.</p> <p>GO to 12.5.</p> <p>GO to System Pre-Check Test E.</p>
12.2	DIODE RESISTOR ELEMENT (Continued)		
	<ul style="list-style-type: none"> ● Set parking brake ON. ● Observe REAR ABS warning light. 	<p>REAR ABS light turns ON</p> <p>REAR ABS light remains OFF</p>	<p>CHECK for open Circuit 640 (R/Y). If circuit is OK, REPLACE diode/resistor element.</p> <p>GO to 12.3.</p>
12.3	CHECK TERMINALS		
	<ul style="list-style-type: none"> ● Inspect and clean master cylinder fluid level switch as necessary. ● Are terminals clean? 	<p>Yes</p> <p>No</p>	<p>RECONNECT connectors. GO to 12.5.</p> <p>CLEAN terminals. RECONNECT connectors. GO to 12.5.</p>
12.4	MAKE SURE ALL STEPS ARE COMPLETED		
	<ul style="list-style-type: none"> ● This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <p>Have all prior diagnostic steps been completed as described above?</p>	<p>Yes</p> <p>No</p>	<p>REPLACE ECU GO to Step 12.5.</p> <p>If ECU has been replaced and no resolution has been reached, REPLACE RABS Valve GO to Step 12.5.</p> <p>GO to diagnostic step last completed and continue.</p>
12.5	CLEAR CODE/PULL CODE		
	<ul style="list-style-type: none"> ● Turn ignition OFF. ● Reconnect battery ground cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> ● Verify all connectors are installed. ● Locate and disconnect the diagnostic connector from its mating half (Circuits 571 [BK/O] and 481 [R]). ● Turn ignition ON. ● Begin diagnostic trouble code flashout by connecting Circuit 571 (BK/O) to a chassis ground for at least 1 second. ● Observe and count code. 	<p>Diagnostic trouble code = 16</p> <p>Diagnostic trouble code = 12</p> <p>Diagnostic trouble code is different than before</p>	<p>GO to Test Drive Code 16.</p> <p>GO to 12.6.</p> <p>GO to Pinpoint Test for corresponding code.</p>

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST — CODE 12
(Continued)

TEST STEP		RESULT	ACTION TO TAKE
12.6	PINPOINT TEST STATUS		
	<ul style="list-style-type: none"> Has pinpoint test been completed? 	Yes No	GO to 12.7. RETURN to last pinpoint test completed.
12.7	VERIFY INTEGRITY OF VEHICLE WIRING		
	If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related. <ul style="list-style-type: none"> REFER to the Intermittent Wiring Diagnosis Procedure and perform for ALL affected circuits as shown on this pinpoint test mini-schematic. Is resolution achieved? 	Yes No	STOP. Repair is complete GO to Drive Test — Code 16. GO to 12.4.

TH8889A

Pinpoint Test Code 13

RABS II Module Failure

Description

Code 13 is generated when a fault is found with the RABS II module. Module must be replaced and Test Drive Code 16 must be performed.

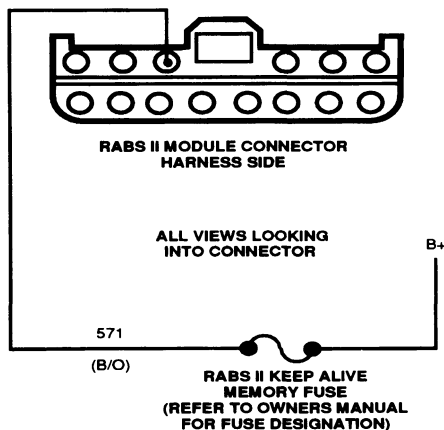
- The RABS II Keep Alive Memory (KAM) fuse has blown.

If the KAM fuse has blown, the REAR ABS warning light will begin flashing Code 16 (or a diagnostic trouble code if a concern has been detected) if the stoplamp switch is depressed (F-Series), or the running lamps are turned on (Econoline).

Therefore, check the KAM fuse when diagnosing complaints of REAR ABS light flashing.

Pinpoint Test Code 16

Affected Circuit(s)/Electrical Component(s)



H8922-A

Description

Code 16 is always present, unless a system concern has been detected and a diagnostic trouble code has been stored. This code should be used by the technician to verify that the RABS II system is OK.

Code 16 will be output by the module when one of two conditions exist:

- The technician ground Circuit 571 (BK / O).

Drive Test — Code 16

Purpose

This drive test will be used when either of the two conditions listed below exists.

- Required Repair Verification

This drive procedure will be used after all vehicle repairs. Once a vehicle has been repaired, it is necessary to verify the repair by driving the vehicle. This is because the RABS II module is unable to detect some system concerns until the vehicle is being driven a certain way. Therefore the drive verification test is a very important step.

- Symptom Evaluation Drive

When a vehicle is brought to the dealer, the customer may only have a general concern about the way their vehicle is braking. In these situations there may not be a clear system concern to troubleshoot. In this type of situation, this drive test is designed to produce common system concern symptoms. Use this drive test to determine a symptom. Once a symptom is found, a symptom troubleshooting procedure can be followed to repair the vehicle.

Drive Description

This drive test is designed to be a generic drive test that is used for three purposes listed below.

- To verify a repair of the RABS II system on a vehicle.

DIAGNOSIS AND TESTING (Continued)

2. To attempt to recreate an intermittent concern.

3. To attempt to detect a symptom when a diagnostic trouble code or a concern symptom is not known.

DRIVE TEST — CODE 16

TEST STEP		RESULT	ACTION TO TAKE
DT1.1	KEEP ALIVE MEMORY (KAM) FUSE CHECK		
	<ul style="list-style-type: none"> Key ON. Observe REAR ABS light prove-out. Turn on headlamps and press on the brake pedal. With the headlamps ON and while pushing on the brake pedal, monitor the yellow REAR ABS light in the dash for 10 seconds. Does the REAR ABS light prove out normally? 	Yes No, the REAR ABS light flashes	GO to DT1.2 . REPLACE KAM fuse (see Owner's Manual for fuse location). REPEAT DT1.1 .
DT1.2	LOW SPEED REAR ABS STOP		
	NOTE: Wetting down the area where stop is to be performed will aid this test. <ul style="list-style-type: none"> Drive vehicle at approximately 10 mph. Press on brake pedal hard enough to lock all four wheels, and observe the left rear wheel in the driver's mirror. Repeat the second step, except observe right rear wheel in passenger mirror. Do both rear wheels lock or does one wheel lock consistently? (Momentary lock up is permissible.) NOTE: An assistant to observe rear wheels would be helpful.	Yes, and REAR ABS light is not on No, but other symptoms are detected No, and REAR ABS light is not on REAR ABS light comes on and stays on	GO to Symptom B. One or both rear wheels lock up. GO to DT1.6 . GO to DT1.3 . GO to DT1.7 .
DT1.3	CHECK FOR UNWARRANTED RABS II ACTIVITY		
	NOTE: Stop should be performed on dry pavement. <ul style="list-style-type: none"> Drive vehicle at approximately 20 mph. Perform a light to medium (normal traffic) stop. Turn off the windshield wipers if they are on. (Wipers can cause a pulsation in the brake pedal that can be mistaken for RABS II activity.) Feel for pulsation in the brake pedal within 10 seconds after the vehicle has come to a stop. Is there any pulsation in the pedal any time during the stop or within 10 seconds after the vehicle has stopped? 	Yes, and REAR ABS light is not on No, but other symptoms are detected No, and REAR ABS light is not on REAR ABS light comes on and stays on	GO to Symptom A, Unwarranted RABS II Activity. GO to DT1.6 . GO to DT1.4 . GO to DT1.7 .
DT1.4	BRAKE STOP LAMP / SWITCH CHECK		
	<ul style="list-style-type: none"> Turn key ON. Press on the brake pedal. Release brake pedal. Do the stoplamps come on and then turn off properly? 	Yes No	GO to DT1.5 . GO to pinpoint test Code 11.
DT1.5	DETERMINE DRIVE TEST IS COMPLETE		
	<ul style="list-style-type: none"> Has customer concern been addressed and corrected by previous actions? 	Yes No	STOP. Vehicle RABS II function has been verified. REFER to Symptom Chart.
DT1.6	DETERMINE NEXT DIAGNOSTIC STEP BASED ON BRAKE SYMPTOM		
	<ul style="list-style-type: none"> Are any of the following symptoms present? <ul style="list-style-type: none"> Hard or soft brake pedal Lack of sufficient vehicle deceleration upon brake application 	Yes No	GO to Symptom Chart. Concern is not in the RABS II system. REFER to Section 06-00 for diagnosis.

DIAGNOSIS AND TESTING (Continued)

DRIVE TEST — CODE 16 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
DT1.7	OBTAIN DIAGNOSTIC TROUBLE CODE		
	<ul style="list-style-type: none"> Obtain diagnostic trouble code. Is the diagnostic trouble code the same as before and has the entire pinpoint test for the code been completed? 	Yes No, pinpoint test is not complete No, code obtained is different No, no code or Code 16 is obtained	REDO steps once more. RETURN to the last step completed in the pinpoint test. GO to the pinpoint test for the code obtained. GO to System Pre-Check, Test D.

TH8890A

Drive Test — Code 4 Only

Purpose

If Pinpoint Test Code 4 is not successful in resolving the system concern, this drive test can be used to conduct additional, more in depth, diagnostics.

CAUTION: Only perform this test when directed to do so. This drive test is only designed to resolve a Code 4 condition. Performing this test for any other reason will often lead to incorrect diagnosis of system problem and incorrect replacement of components.

This drive test assumes that pinpoint test Code 4 has been completed. If this is not the case, complete the test before proceeding.

Drive Description

This drive test is designed to induce a Code 4 if there is a system concern that can create a Code 4 on a repeatable basis. Carefully record the data when performing the drive test. It is important to know what part of the drive test you are in when a diagnostic trouble Code 4 is detected.

TEST STEP		RESULT	ACTION TO TAKE
DT4.1	VERIFY PROPER WARNING LIGHT PROVE-OUT		
	<ul style="list-style-type: none"> Start the vehicle and observe the REAR ABS warning light for proper warning light prove-out. Does the REAR ABS warning light prove-out properly? 	Yes No	GO to DT4.2. GO to System Pre-Check Test A.
DT4.2	VALVE RESET SWITCH CHECK		
	<ul style="list-style-type: none"> Drive the vehicle at approximately 10 mph on dry pavement. <p>CAUTION: Do not exceed 10 mph to prevent flat-spotting of tires.</p> <ul style="list-style-type: none"> Press on brake pedal hard enough to lock all four wheels. After the vehicle has stopped, place the vehicle in PARK and take foot off the brake pedal. Wait 30 seconds. Does the RABS warning light come on? 	Yes No	Key OFF. Go to DT4.4. Key OFF. GO to DT4.3.
DT4.3	RABS HYDRAULIC VALVE LEAK TEST		
	<ul style="list-style-type: none"> Press hard on the brake pedal and keep pressure on the brake pedal for 30 seconds. While keeping pressure on the brake, monitor the height of the brake pedal. Does the brake pedal drop slowly toward the floor? <p>NOTE: The condition is similar to the Master Cylinder Bypass condition. It is important that the pedal be quickly and forcefully applied to rule out Master Cylinder Bypass as the cause if a hydraulic leak is detected. Typically, Master Cylinder Bypass only occurs at low line pressures.</p>	Yes No	REPLACE RABS Valve. GO to Drive Test — Code 16 to verify concern is resolved. RETURN to the pinpoint test for code 4, Step 4.11.

DIAGNOSIS AND TESTING (Continued)

TEST STEP		RESULT	ACTION TO TAKE
DT4.4	OBTAIN DIAGNOSTIC TROUBLE CODE		
	<ul style="list-style-type: none"> Obtain Diagnostic Trouble Code. Is Code 4 Obtained? 	<p>Yes</p> <p>No, code obtained is Code 16</p> <p>No, code obtained is NOT code 4</p> <p>No, no code is obtained</p>	<p>REPLACE RABS Valve. GO to Drive Test — Code 16 to verify concern is resolved.</p> <p>INCONSISTENT result If RABS Warning light did come on in Step DT4.2, then a Diagnostic Trouble Code other than Code 16 should be stored. REPEAT DT4.4 and verify Code 16 is obtained.</p> <p>GO to the pinpoint test for the code obtained.</p> <p>GO to System Pre-Check, Test D.</p>
DT4.5	BLOCKED ISOLATION ORIFICE		
	<ul style="list-style-type: none"> Disconnect RABS II module. Raise the vehicle on a hoist far enough to allow all wheels to spin freely. Verify that the vehicle is in 4x2 mode and the hubs are unlocked (4x4 only). Start the vehicle, place in DRIVE and allow rear wheels to spin at idle for at least 30 seconds. Apply the brake pedal with the force of a normal traffic stop. Do the rear wheels react uncharacteristically slow or continue to spin? 	<p>Yes</p> <p>No, rear wheels stop normally</p>	<p>RECONNECT RABS II module. REPLACE RABS II valve. GO to Drive Test — Code 16 to verify concern is resolved.</p> <p>RABS II valve is OK. RECONNECT RABS II module. RETURN to Pinpoint Test for Code 4 (Step 4.11).</p>

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Drive Test — Code 5 Only**Purpose**

If pinpoint test Code 5 is not successful in resolving the system concern, this drive test can be used to conduct additional, more in depth, diagnostics.

CAUTION: Only perform this test when directed to do so. This drive test is only designed to resolve a Code 5 condition. Performing this test for any other reason will often lead to incorrect diagnosis of system problem and incorrect replacement of components.

This drive test assumes that pinpoint test Code 5 has been completed. If this is not the case, complete the test before proceeding.

Drive Description

This drive test is designed to induce a Code 5 if there is a system that can create a Code 5 on a repeatable basis. Carefully record the data when performing the drive test. It is important to know what part of the drive test you are in when diagnostic trouble Code 5 is detected.

NOTE: Four Wheel Drive Issue

Discuss with the customer to determine if the vehicle was in four wheel drive when the light came on. During normal 4x2 anti-lock operation, the module energizes the dump solenoid a maximum of 16 times without interruption. Conditions experienced in 4x2 operation will not require more than 16 dump pulses. If the module notices that conditions call for a 17th dump pulse, it assumes there is a problem with RABS II, deactivates the system (turning the REAR ABS warning light on), and sets a Code 5. During normal 4x4 operation, the module only allows 16 dump pulses but does not deactivate the RABS II or light the yellow REAR ABS warning light if more than 16 dump pulses are requested. If, for reasons described below, the module receives incorrect information from the 4x4 switch, and therefore improperly assumes the vehicle is in 4x2, a Code 5 will often be improperly set. The most common reasons for incorrect information being sent to the RABS II module are:

- 4x4 indicator switch worn or damaged.
- Vehicle wiring concern in Circuit 210 (LB) between the 4x4 indicator switch and the RABS II module.
- Customer has switched from 4x4 to 4x2 but the transfer case has not yet disengaged.

NOTE: The customer must also enter an anti-lock stop, at the same time, for this event to occur.

DIAGNOSIS AND TESTING (Continued)

DRIVE TEST — CODE 5

TEST STEP		RESULT	ACTION TO TAKE
DT5.1	VERIFY PROPER WARNING LIGHT PROVE-OUT		
	<ul style="list-style-type: none"> Start the vehicle and observe the REAR ABS warning light for proper warning light prove-out. Does the REAR ABS warning light prove-out properly? 	Yes No	GO to DT5.2 . GO to System Pre-Check Test A.
DT5.2	BASE BRAKE STOPPING TEST		
	<ul style="list-style-type: none"> Remove the harness connector from the RABS II module. Drive the vehicle at approximately 20 mph. Perform a light to medium (normal traffic) stop. Do the rear wheels lock up? 	Yes No	RECONNECT RABS II module. REFER to Base Brake Diagnosis in Section 06-00 for Rear-Wheel Lock. RECONNECT RABS II module. GO to DT5.3 .
DT5.3	DRY ROAD STOP TEST		
	<ul style="list-style-type: none"> Drive the vehicle at approximately 10 mph on dry pavement. <p>CAUTION: Do not exceed 10 mph to prevent flat-spotting of tires.</p> <ul style="list-style-type: none"> Press on brake pedal hard enough to lock all four wheels and observe the left rear wheel in the driver's mirror. Do the rear wheels lock up? (Momentary lock up followed by spinup is permissible.) 	Yes No	REPLACE RABS valve. GO to Drive Test — Code 16 to verify concern is resolved. GO to DT5.4 .
DT5.4	VERIFY PROPER RABS II OPERATION IN 4X2		
	<p>WARNING: PERFORM THIS TEST ON AN AXLE HOIST ONLY.</p> <ul style="list-style-type: none"> Place vehicle on the hoist and raise high enough to clear all wheels off the ground. Verify vehicle is in 4x2 mode. (4x4 vehicles only.) Place vehicle transmission in Drive Low (automatic) or First gear (manual). Accelerate vehicle drive wheels to 10 mph. Press hard on the brake pedal until wheels stop. Do the rear wheels first lock up and then spin? <p>NOTE: Because vehicle is not on the ground, wheels will spin for a significant time. This is not indicative of vehicle braking performance.</p>	Yes No, wheels lock up and remain locked up	LEAVE key ON. GO to DT5.5 . REPLACE RABS valve. GO to Drive Test — Code 16 to verify concern is resolved.
DT5.5	OBTAIN DIAGNOSTIC TROUBLE CODE		
	<ul style="list-style-type: none"> Obtain diagnostic trouble code. Is Code 5 obtained? 	Yes No, code obtained is Code 16 No, code obtained is NOT code 5 No, no code is obtained	INCONSISTENT result DT5.4 indicates RABS Valve is functioning correctly. CLEAR code REPEAT DT5.4. If result repeats, RETURN to pinpoint test for Code 5, Step 5.6. RETURN to pinpoint test for Code 5, Step 5.6. GO to the pinpoint test for the code obtained. Go to System Pre-Check, Test D.

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DIAGNOSIS AND TESTING (Continued)

Drive Test — Code 6**Purpose**

If pinpoint test Code 6 is not successful in resolving the system concern, this drive test can be used to conduct additional, more in depth, diagnostics.

CAUTION: Only perform this test when directed to do so. This drive test is only designed to resolve a Code 6 condition. Performing this test for any other reason will often lead to incorrect diagnosis of system problem and incorrect replacement of components.

This drive test assumes that pinpoint test Code 6 has been completed. If this is not the case, complete the test before proceeding.

Drive Description

This drive test is designed to induce a Code 6 if there is a system concern that can create a Code 6 on a repeatable basis. Carefully record the data when performing the drive test. It is important to know what part of the drive test you are in when a Code 6 diagnostic trouble code is detected.

DRIVE TEST — CODE 6

TEST STEP		RESULT	ACTION TO TAKE
DT6.1	VERIFY PROPER WARNING LIGHT PROVE-OUT		
	<ul style="list-style-type: none"> Key ON and observe the REAR ABS warning light for proper bulb prove-out. Does the REAR ABS warning light prove-out properly? 	Yes No	Key OFF. GO to DT6.2 . GO to System Pre-Check, Test A.
DT6.2	MEASURE SENSOR OUTPUT		
	<ul style="list-style-type: none"> Put vehicle on hoist and raise so that the rear wheels can rotate freely. Verify the vehicle is in 4x2 mode and hubs are unlocked. Set an AC voltmeter on the 2000mV scale. Remove the cap from the sensor test connector and connect the AC voltmeter across the connector leads. Start the engine and turn the rear wheels at 5 mph. Measure the voltage output of the sensor. 	Voltage is 650mV (RMS) or greater Voltage is less than 650mV (RMS)	REINSTALL the sensor test connector cap. GO to DT6.3 . REINSTALL the sensor test connector cap. REPLACE sensor. GO to Drive Test — Code 16 to verify concern is resolved.
DT6.3	MEASURE SENSOR AIR GAP		
	<ul style="list-style-type: none"> Remove Rear Axle Differential Cover. Measure the shortest distance from the sensor pole piece to the teeth on the speed sensor ring. Rotate the axle 60°-90°. Repeat the second and third steps for a total of five measurements. Are all measurements between 0.005 inch and 0.050 inch and within 0.010 inch of each other? 	Yes No, measurements are not between 0.005 inch and 0.050 inch No, not all measurements are within 0.010 inch of each other	GO to DT6.5 . CHECK for foreign material under sensor mounting flange and on carrier housing. REPLACE sensor GO to DT6.4 . REINSTALL sensor. GO to Drive Test — Code 16 to verify concern is resolved.
DT6.4	IMPROPER SENSOR GAP RESOLUTION		
	<ul style="list-style-type: none"> Verify that the installed sensor is seated fully in the bore and the hold-down bolt is tightened to specification. Repeat measurements from Step DT6.3. Are all measurements between 0.005 inch and 0.050 inch and within 0.010 inch of each other? 	Yes No	GO to Drive Test — Code 16 to verify concern is resolved. REPLACE rear axle. GO to Drive Test — Code 16 to verify concern is resolved.
DT6.5	CHECK CONDITION OF SPEED SENSOR RING TEETH		
	<ul style="list-style-type: none"> Carefully inspect each tooth on the speed sensor ring. (Rear Axle Differential cover should still be off.) Are any teeth missing, malformed, or damaged? 	Yes No	REPLACE rear axle. GO to Drive Test — Code 16 to verify concern is resolved. RETURN to pinpoint test for Code 6, Step 6.9.

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DIAGNOSIS AND TESTING (Continued)

SYMPTOM DIAGNOSTIC CHART

Symptom Description	Refer to
Unwarranted RABS II Activity	Symptom A
Rear Wheels Lockup	Symptom B
Hard / Soft Brake Pedal	Symptom C
Lack of Decel (Med / Hard Braking)	Symptom D

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WARNING: PERFORM INDICATED PINPOINT TEST OR DRIVE TEST STEPS ONLY. DO NOT PERFORM OTHER STEPS, ALTHOUGH WITHIN THE TEST BOX YOU MAY APPEAR TO BE DIRECTED TO DO SO. ALWAYS RETURN TO THE SYMPTOM CONDITION CHART IF NO RESOLUTION IS REACHED BY PERFORMING A PARTICULAR TEST.

SYMPTOM A: UNWARRANTED RABS II ACTIVITY

CONDITION	POSSIBLE SOURCE	ACTION
Premature loss of rear axle sensor signal during decel.	<ul style="list-style-type: none"> ● Metal chips on sensor pole piece. ● Gap between sensor and speed sensor ring is too large (greater than 0.050 inches). ● Missing or damaged speed sensor ring teeth. ● Sensor / speed sensor ring interference (gap is too small [less than 0.005 inches]). 	<ul style="list-style-type: none"> ● Refer to pinpoint test, Code 6, step 6 only. ● Refer to drive test — Code 6, step DT6.3-DT6.4 only. ● Refer to drive test — Code 6, step DT6.5 only. ● Refer to drive test — Code 6, step DT6.5 only.
Intermittent sensor signal to RABS II module during decel.	<ul style="list-style-type: none"> ● Intermittent open or shorted sensor circuit. ● Intermittent open sensor circuit at intermediate connections especially bulkhead. ● Chafed wire insulation or pinched wire due to improper routing causing intermittent short. ● Underhood sensor test connector shorted. 	<ul style="list-style-type: none"> ● Perform intermittent diagnosis for Circuits 519(LG/BK) and 523(R/PK) between RABS II module and sensor. ● Perform intermittent diagnosis for Circuit 519(LG/BK) and 523(R/PK) at intermediate connectors. ● Inspect wiring harness from rear axle to frame for chafing or rub marks. ● Inspect underhood sensor test connector for presence of cap, corrosion, and excessive dirt in the terminal cavities.
Maladjusted rear brakes or "grabby" brake shoe linings.	<ul style="list-style-type: none"> ● Rear brake adjustment too tight. ● Linings are "grabby". 	<ul style="list-style-type: none"> ● Refer to Section 06-00. ● Refer to Section 06-00.

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SYMPTOM B: ONE OR BOTH REAR WHEELS LOCK UP

CONDITION	POSSIBLE SOURCE	ACTION
RABS valve failure.	<ul style="list-style-type: none"> ● Damaged RABS valve reset switch. ● Leaky dump valve. ● Hydraulically inoperative RABS valve. 	<ul style="list-style-type: none"> ● Refer to drive test — Code 4, steps DT4.2 and DT4.4 only. ● Refer to drive test — Code 4, step DT4.3 only. ● Refer to drive test — Code 4, step DT4.5 only.
RABS sensor output low or lost at lower vehicle speeds.	<ul style="list-style-type: none"> ● Sensor air gap too large. ● Sensor / speed sensor ring assembly does not produce sufficient output. 	<ul style="list-style-type: none"> ● Refer to drive test — Code 6, step DT6.3 only. ● Refer to drive test — Code 6, step DT6.2 only. ● Perform intermittent diagnosis for Circuit 519 (LG/BK) and 523 (R/PK) between RABS II module and sensor. ● Perform intermittent diagnosis for Circuit 519 (LG/BK) and 523 (R/PK) at intermediate connectors.

DIAGNOSIS AND TESTING (Continued)

SYMPTOM B: ONE OR BOTH REAR WHEELS LOCK UP (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Base brake mechanical concern.	<ul style="list-style-type: none"> ● Brake related concern: <ul style="list-style-type: none"> — Damp or contaminated rear brake shoe linings. — Stuck / leaking wheel cylinder. — Overadjusted rear brakes. ● Hung-up parking brake. ● Leaking rear axle seal. 	<ul style="list-style-type: none"> ● Refer to Section 06-00, Brake Diagnosis Chart. ● Refer to Section 06-05. ● Refer to the appropriate section in Group 05.
4x4 system mechanical electrical concern.	<ul style="list-style-type: none"> ● Hubs engaged although shift lever is in 4x2 position. ● Faulty 4x4 indicator switch or short to 12V in 4x4 circuit 210 (LB). 	<ul style="list-style-type: none"> ● Refer to Section 07-07D or -07E. ● Refer to pinpoint test for Code 5, steps 5.3 and 5.5 only.
Vehicle electrical concern.	<ul style="list-style-type: none"> ● Stoplamp input to RABS II module not present. ● Stoplamps inoperative. 	<ul style="list-style-type: none"> ● Refer to pinpoint test for Code 11, steps 11.1-11.4 only. ● Refer to Section 17-01.

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SYMPTOM C: HARD OR SOFT BRAKE PEDAL

CONDITION	POSSIBLE SOURCE	ACTION
RABS valve inoperative (hard / soft).	<ul style="list-style-type: none"> ● Stuck shut isolation valve (hard). ● Leaky dump valve (soft). ● Leaky isolation valve during RABS stop (soft). 	<ul style="list-style-type: none"> ● Refer to drive test — Code 4, step DT4.5 only. ● Refer to drive test — Code 4, step DT4.3 only. ● Refer to drive test — Code 5, step DT5.4 only.
Vehicle electrical concern.	<ul style="list-style-type: none"> ● Stoplamp switch always on while driving. 	<ul style="list-style-type: none"> ● Refer to pinpoint test for Code 11, steps 11.1-11.4 only.
Base brake hydraulic concern (soft).	<ul style="list-style-type: none"> ● Hydraulic leak in brake line or hose, fitting, master cylinder, wheel cylinder, or caliper. ● Air in brake system. 	<ul style="list-style-type: none"> ● Refer to Section 06-00. ● Refer to Section 06-00.
Base brake mechanical concern (hard).	<ul style="list-style-type: none"> ● Brake related concern: <ul style="list-style-type: none"> — Little or no vacuum boost. — Stuck or inoperative wheel cylinder or caliper. — Pinched or crimped brake line or hose. 	<ul style="list-style-type: none"> ● Refer to Section 06-00.

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DIAGNOSIS AND TESTING (Continued)**SYMPTOM D: LACK OF DECELERATION DURING MEDIUM/HARD BRAKE APPLICATIONS**

CONDITION	POSSIBLE SOURCE	ACTION
RABS valve inoperative.	<ul style="list-style-type: none"> Leaky dump valve. Stuck shut isolation valve. 	<ul style="list-style-type: none"> Refer to drive test — Code 4, step DT4.3. Refer to Drive Test — Code 4, step DT4.5 ONLY.
RABS sensor input to RABS II module intermittent or improper.	<ul style="list-style-type: none"> Short/open in frame or instrument panel harness (Circuits 519 and/or 523) <ul style="list-style-type: none"> At RABS II module connector (Pins 3 and 10) At RABS sensor connector At bulkhead or other interconnection Pinched wire or worn insulation due to improper routing Test connector (in engine compartment) Metal chips on sensor. Borderline high sensor to speed sensor ring air gap, excessive speed sensor ring radial runout, damaged or missing speed sensor ring teeth. 	<ul style="list-style-type: none"> Refer to pinpoint test Code 6, steps 6.1-6.5 only. Refer to pinpoint test Code 6, step 6.6 only. Refer to drive test — Code 6 steps DT6.3-DT6.4 only.
Vehicle electrical concern.	<ul style="list-style-type: none"> Low vacuum switch inoperative (diesel only). 	<ul style="list-style-type: none"> Refer to Section 06-07B.
Base brake hydraulic concern.	<ul style="list-style-type: none"> Hydraulic leak in brake line or hose, fitting, master cylinder, wheel cylinder, or caliper. Air in brake system. 	<ul style="list-style-type: none"> Refer to Section 06-00. Refer to Section 06-00.
Base brake mechanical concern.	<ul style="list-style-type: none"> Brake related concern: <ul style="list-style-type: none"> Little or no vacuum boost. Stuck or inoperative wheel cylinder or caliper. Pinched or crimped brake line or hose. Ineffective brake shoe or pad linings. 	<ul style="list-style-type: none"> Refer to Section 06-00.

REMOVAL AND INSTALLATION**Fuses**

Three replaceable fuses are involved with the RABS II. The fuses are located in the fuse box.

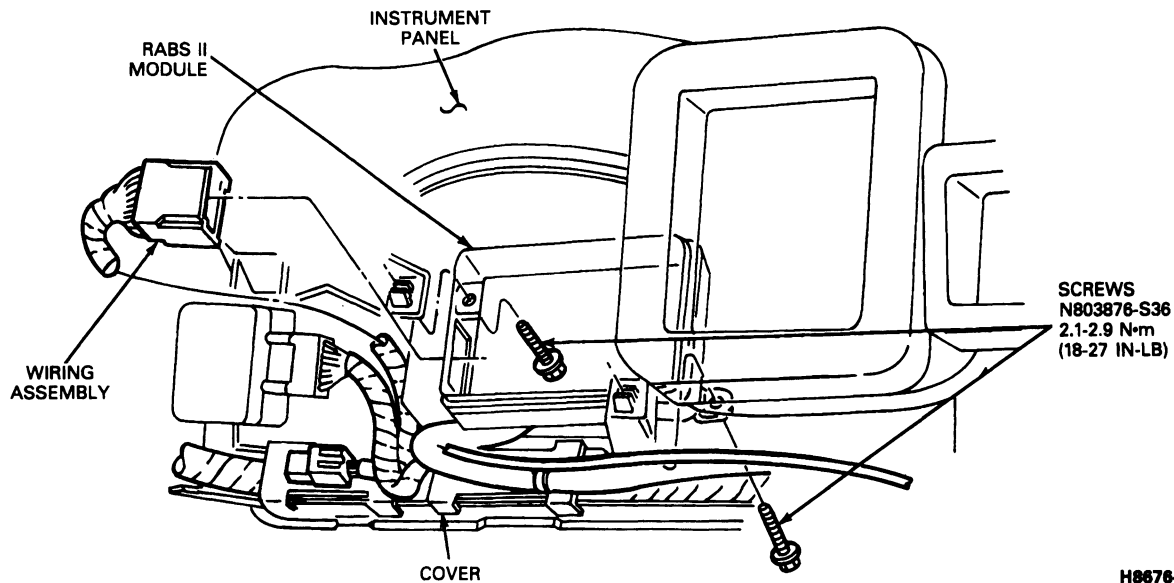
- A 20 amp fuse protects the total RABS II system.
- A 15 amp fuse protects the red BRAKE and yellow warning lights.
- Another 15 amp fuse protects the four-way stoplamp cluster. Refer to Section 18-01.

RABS II Module**F-150-250-350****Removal and Installation**

- Disconnect the wiring harness from the RABS II module by depressing the plastic tab on the connector and pulling the connector off.

- Remove the two screws that retain the module to the dash panel. Remove the module.

For installation, follow removal procedures in reverse order, followed by a system check for proper operation. Tighten screws to 2.1-2.9 N·m (18-27 ft-lb).

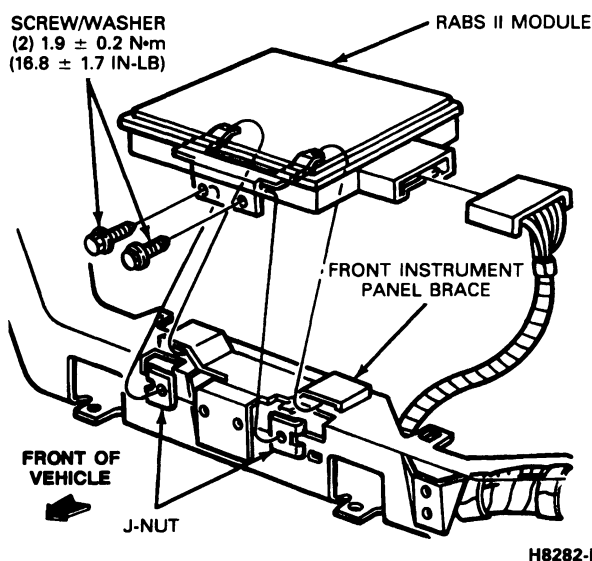
REMOVAL AND INSTALLATION (Continued)**RABS II Module Location, F-150-250-350**

H8676-B

E-150-250-350**Removal and Installation**

1. Remove the screws that hold the module to the instrument panel lower brace. Pull the module off the retainer clip assembly.
2. Disconnect the wiring harness from the RABS II module by depressing the plastic tab on the connector and pulling the connector off.

For installation, follow removal procedures in reverse order, followed by a system check for proper operation.



H8282-B

RABS II Valve**F-150-250-350****Removal**

1. Disconnect the inlet and outlet brake lines from the RABS valve. Cap the lines.
2. Disconnect the wiring harness to the valve.
3. Remove the three nuts retaining the valve to the frame rail and remove the valve.

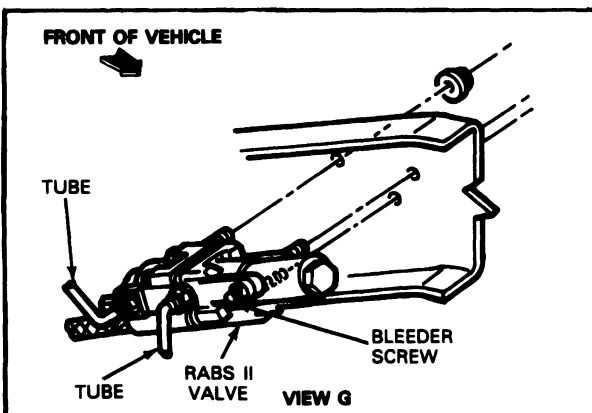
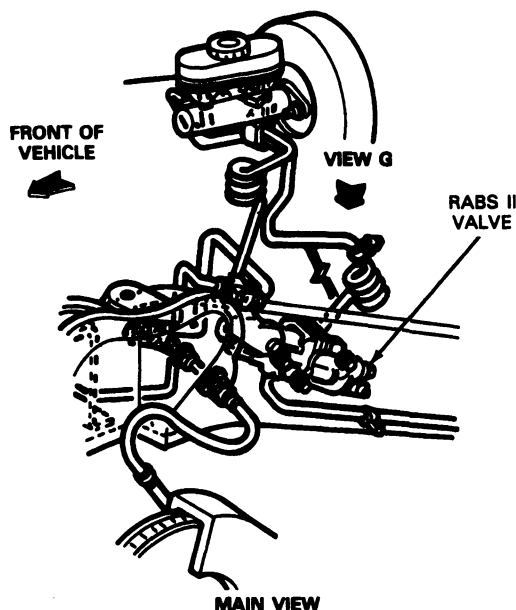
Installation

1. Position the RABS valve on the frame rail. Install the three nuts and tighten to 17-23 N·m (12-17 ft-lb).
2. Connect the brake wiring harness connector.
3. Connect the brake lines to the valve and tighten as follows:
 - a. 1/2-20 threaded fittings use 14-23 N·m (10-17 ft-lb)
 - b. 7/16-24 threaded fittings use 14-20 N·m (10-15 ft-lb)

CAUTION: Do not over-tighten the fittings.

REMOVAL AND INSTALLATION (Continued)

4. Bleed the brake system as described in Section 06-00. It is not necessary to energize the valve electrically to bleed the rear brakes.



H5412-D

E-150-250-350**Removal**

1. Disconnect the inlet and outlet brake lines from the RABS valve.
2. Disconnect the wiring harness from the valve harness.
3. Remove the three screws retaining the valve to the frame rail liner and remove the valve.

Installation

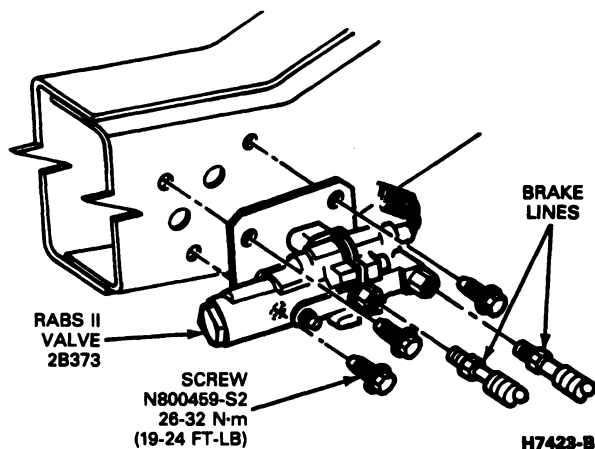
1. Position the RABS valve on the frame rail liner. Install the three screws and tighten to 26-32 N·m (19-24 ft·lb).
2. Connect the brake valve wiring harness to the main harness connector.

3. Connect the brake lines to the valve and tighten as follows:
 - a. 1/2-20 threaded fitting — 14-23 N·m (10-17 ft·lb).
 - b. 7/16-24 threaded fitting — 14-20 N·m (10-15 ft·lb).

CAUTION: Do not over-tighten the fittings.

4. Bleed the brake system as described in Section 06-00.

NOTE: It is not necessary to energize the valve electrically to bleed the rear brakes.

**RABS II Sensor****Removal**

1. Pull the wiring harness connector off.
2. Remove the sensor hold down bolt and remove the sensor from the axle housing.

Installation

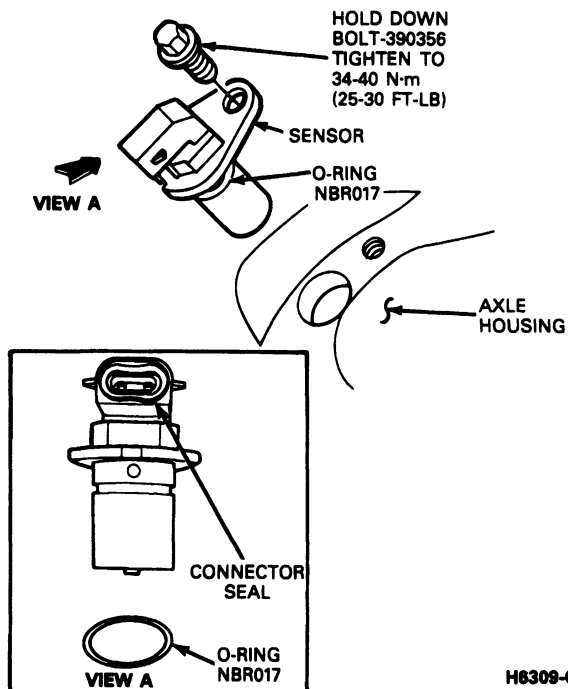
1. Clean the axle mounting surface. Use care to prevent dirt from entering the axle housing.
2. Inspect and clean the magnetized sensor pole piece to ensure that it is free from loose metal particles which could cause erratic system operation. Inspect the sensor O-ring for damage and replace if necessary.
3. Lightly lubricate the sensor O-ring with motor oil, align the sensor bolt hole, and install.

NOTE: Do not apply force to the plastic sensor connector. The sensor flange should slide to the mounting surface. The air gap setting is between .127-1.14mm (0.005-0.045 inch).

4. Install the hold-down bolt and tighten to 34-40 N·m (25-30 ft·lb).

REMOVAL AND INSTALLATION (Continued)

5. Inspect the blue sensor connector seal and replace if missing or damaged. Push the connector on the sensor.

**Speed Sensor Ring****Inspection**

1. Remove the sensor as described above.
2. View the speed sensor ring teeth through the sensor hole. Rotate the rear axle and check the excitor ring teeth for damage or breakage. Dented or broken teeth could cause the RABS II system to function when not required.

Removal

To service the speed sensor ring, the differential case must be removed from the axle housing, and the speed sensor ring pressed off the case.

NOTE: Upon removal, discard speed sensor ring. Do not reuse. For service procedures, refer to the appropriate axle section in Group 05.

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
014-00047	Digital Volt-Ohmmeter

SECTION 06-09B Brake, 4-Wheel Anti-lock

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Acceleration Sensor	06-09B-3	Pinpoint Test J — Codes 32, 36, 42 or 56	06-09B-33
Brake System Bleeding	06-09B-3	Pinpoint Test K — Codes 33, 37, 43 or 57	06-09B-36
Electronic Control Unit (ECU)	06-09B-2	Pinpoint Test L — Code 51	06-09B-39
Fuse	06-09B-3	Pinpoint Test M — Code 52	06-09B-41
Hydraulic Control Unit (HCU)	06-09B-2	Pinpoint Test N — Code 53	06-09B-42
Operation	06-09B-3	Pinpoint Test P — Code 63	06-09B-44
Anti-lock Brakes	06-09B-3	Pinpoint Test Q — Code 65	06-09B-47
Pump Motor Relay	06-09B-3	Pinpoint Test R — Code 67	06-09B-50
System Diode	06-09B-3	Pinpoint Test S — No Code	06-09B-52
System Relay	06-09B-3	PSOM Signal from ABS Verification Procedure	06-09B-9
Wheel Sensors	06-09B-3	Warning Indicator Functions	06-09B-4
DIAGNOSIS AND TESTING		REMOVAL AND INSTALLATION	
Automatic Memory Erasing	06-09B-10	Brake Booster Assembly	06-09B-58
Diagnostic Procedures	06-09B-4	Electronic Control Unit	06-09B-59
Drive Test	06-09B-53	Hydraulic Control Unit	06-09B-58
Light Flash Technique	06-09B-11	Master Cylinder	06-09B-58
Manual Memory Erasing	06-09B-10	Speed Sensor Ring, Front	06-09B-60
On-Board Diagnostics	06-09B-10	Speed Sensor Ring, Rear	06-09B-61
Pinpoint Test A — Code 17	06-09B-15	Speed Sensor, Rear	06-09B-60
Pinpoint Test B — Code 22	06-09B-18	Wheel Speed Sensor, Front	06-09B-60
Pinpoint Test C — Code 23	06-09B-20	SPECIAL SERVICE TOOLS/EQUIPMENT	06-09B-62
Pinpoint Test D — Code 24	06-09B-23	SPECIFICATIONS	06-09B-61
Pinpoint Test E — Code 25	06-09B-24	VEHICLE APPLICATION	06-09B-1
Pinpoint Test F — Code 26	06-09B-26		
Pinpoint Test G — Code 27	06-09B-28		
Pinpoint Test H — Codes 31, 35, 41 or 55	06-09B-30		

VEHICLE APPLICATION

Bronco

DESCRIPTION AND OPERATION

WARNING: DO NOT INHALE DUST FROM BRAKES, CLUTCHES OR ASSOCIATED COMPONENTS. INHALATION OF DUST CONTAINING ASBESTOS FIBERS CAN BE INJURIOUS TO YOUR HEALTH AND COULD CAUSE CANCER OR ASBESTOSIS. COMPRESSED AIR OR BRUSHES MUST NOT BE USED TO CLEAN BRAKES, BRAKE DRUMS, CLUTCHES AND ASSOCIATED COMPONENTS. A VACUUM CLEANER EQUIPPED FOR THIS PURPOSE SHOULD BE CAREFULLY USED TO REMOVE ANY DUST. ADHERENT DUST SHOULD BE REMOVED WITH A DAMP RAG. ANY DUST SHOULD BE CONTAINED IN A SEALED AND LABELED BAG FOR DISPOSAL. WEAR AN APPROVED HIGH EFFICIENCY CARTRIDGE OR AIR LINE RESPIRATOR AND USE EXTRA CAUTION TO AVOID BREATHING THIS DUST. USE NON-ASBESTOS REPLACEMENT PARTS WHENEVER POSSIBLE.

The 4-wheel anti-lock brake system (ABS) prevents wheel lockup by automatically modulating the brake pressure during an emergency stop. By not locking the wheels, the driver can improve steering control during hard braking and stop the vehicle in the shortest possible distance under most conditions.

The ABS system controls both front and rear brakes separately. The brake pedal force required to engage the ABS function may vary with the road surface conditions. A dry surface requires a higher force, while a slippery surface requires much less force.

During the ABS operation, the driver will sense a pulsation in the brake pedal, accompanied by a slight up and down movement in the pedal height. In addition, a mechanical noise from the engine compartment may be heard. The pedal effort and pedal feel during normal braking are similar to that of a conventional power brake system.

The ABS consists of the following major components:

- Hydraulic Control Unit (HCU)
- Electronic Control Unit (ECU)
- Two front wheel speed sensors

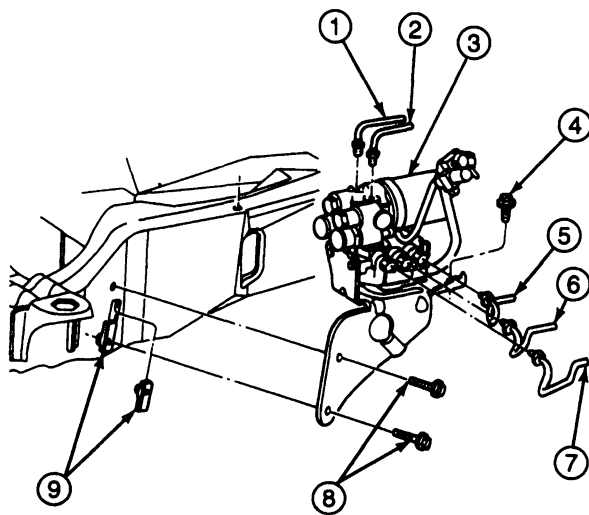
DESCRIPTION AND OPERATION (Continued)

- One rear axle speed sensor
- Acceleration sensor
- System relays
- Pump motor relay

Hydraulic Control Unit (HCU)

The Hydraulic Control Unit (HCU) is located in the front of the engine compartment on the left frame rail. It consists of a valve body assembly, a pump and a motor assembly. During normal braking, fluid from the master cylinder enters the HCU through two inlet ports located at the top of the HCU. The fluid then passes through three normally open inlet valves, one to each wheel in the front and one line to the rear wheels. If the Electronic Control Unit (ECU) senses that a wheel is about to lock, the ECU pulses the appropriate inlet valve which closes that valve. This prevents any more fluid from entering the affected brake. The ECU then looks at that wheel again. If it is still decelerating, the ECU pulses the normally closed outlet valve which decreases the pressure trapped in the line.

The valve body, the pump and the motor are not serviceable separately.

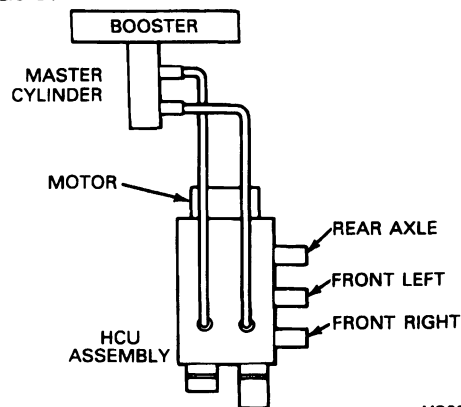


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Item	Part Number	Description
1	2B112	Tube
2	2234	Tube
3	2C215	Hydraulic Control Unit (HCU)
4	W611633	Screw
5	2263	Tube
6	2264	Tube
7	2B523	Tube
8	N606703	Bolt 37-50 N-m (27-37 Ft-Lb)

(Continued)

Item	Part Number	Description
9	N801107	U-Nut

HYDRAULIC SCHEMATIC

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Electronic Control Unit (ECU)

The Electronic Control Unit (ECU) is located in the engine compartment behind the driver's side head lamp on a bracket mounted on the surface of the plastic fender apron.

It is an on-board diagnostic, non-repairable unit consisting of two microprocessors and the necessary circuitry for their operation. These microprocessors are programmed identically. The ECU monitors system operation during normal driving as well as during anti-lock braking.

In addition, the ECU provides a speed signal to the programmable speedometer / odometer module (PSOM). Refer to Section 13-01 for additional information about PSOM.

Under normal driving conditions, the microprocessors produce short test pulses to check the electrical system without any mechanical reaction. The ECU continuously monitors the speed of each wheel to determine if any wheel is beginning to lock. When a wheel locking tendency is detected, the ECU signals the appropriate solenoid valve in the hydraulic control unit to open or close as well as the pump motor to turn on and recycle brake fluid back to the master cylinder. This results in moderate pulsations of the brake pedal and pump noise which may be heard in the passenger compartment. During normal braking, the brake pedal feel will be identical to a standard brake system.

Most concerns which occur to the anti-lock brake system will be stored as a coded number in the Keep-Alive Memory (KAM) of the ECU. This means that once a code is stored, it will be retained by the ECU even with the key in the OFF position. The codes can be retrieved by following the on-board diagnostic procedures. Refer to Diagnosis and Testing.

DESCRIPTION AND OPERATION (Continued)**Wheel Sensors**

The anti-lock brake system uses three sets of variable-reluctance sensors and toothed speed sensor rings to determine the rotational speed of each wheel. The sensors operate on magnetic induction principal. As the teeth on the speed indicator ring rotate past the stationary sensor, a signal proportional to the speed of the rotation is generated and sent to the ECU through a twisted-pair wire cable and wiring harness.

The front sensors are attached to the suspension knuckles, and the speed indicator rings are pressed onto the backside of the rotor. The rear sensor is integrated into the rear axle housing.

Acceleration Sensor

The acceleration sensor is attached to the left frame rail under the driver.

It is used to provide the ECU with deceleration G force information. This information is used by the ECU to select the anti-lock control program depending upon road conditions, as well as providing necessary information for ABS to perform in 4WD.

System Relay

The system relay is located in the position of the relay block behind the power network box.

The system relay has two functions, first when the relay is energized, it supplies power to the six valve solenoids in the valve block assembly and the pump motor relay coil. Second, it supplies ground to the ABS warning light when the relay is de-energized. The system relay is controlled by the ECU and is energized when it receives an ignition input signal.

Pump Motor Relay

The pump motor relay is located in the fifth position of the power network box.

This relay supplies power to the pump motor. The relay coil receives power from the system relay and is controlled by the ECU by providing ground to the coil ground.

System Diode

The system diode is located in the relay box mounted behind the power network box with the system relay. The system diode enables the ABS warning light to illuminate when ignition is ON and the system is disabled by switching the system relay to the default position.

Fuse

Both the system power fuse and pump motor fuse are located in the power network box.

Operation**Anti-lock Brakes**

When the brakes are applied, fluid is forced from the master cylinder outlet ports to the Hydraulic Control Unit (HCU) inlet ports. This pressure is transmitted through three normally open solenoid valves contained inside the HCU, then through the outlet ports of the HCU to the wheels. The primary (rear) circuit of the master cylinder feeds the rear brakes. The secondary (front) circuit of the master cylinder feeds the front brakes. If the Electronic Control Unit (ECU) senses that a wheel is about to lock, based on wheel speed sensor data, it pulses the normally open solenoid valve closed, for that circuit. This prevents any more fluid from entering that circuit. The ECU then looks at the sensor signal from the affected wheel again. If that wheel is still decelerating, it opens the normally closed solenoid valve for that circuit. This dumps any pressure that is trapped between the normally open valve and the brake back to the reservoir. Once the affected wheel comes back up to speed, the ECU returns the valves to their normal condition allowing fluid flow to the affected brake.

The ECU monitors the electromechanical components of the system. Malfunction of the Anti-lock Brake System will cause the ECU to shut off or inhibit the system. However, normal power assisted braking remains. Malfunctions are indicated by the ABS warning light inside the vehicle.

The 4-wheel anti-lock brake system is self monitoring. When the ignition switch is placed in the RUN position, the ECU will perform a preliminary self check on the anti-lock electrical system indicated by a three to four second illumination of the amber ABS warning light in the instrument cluster. During vehicle operation, including normal and anti-lock braking, the ECU monitors all electrical anti-lock functions and some hydraulic operations.

In most malfunctions of the anti-lock brake system, the amber ABS warning light will be illuminated. However, most malfunctions are recorded as a coded number in the ECU memory and assist in pinpointing the component needing service. If system is OK, Code 16 will be present.

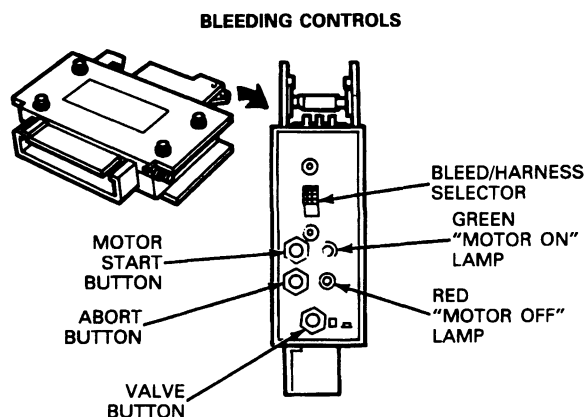
Brake System Bleeding**Hydraulic System Bleeding**

CAUTION: Perform this procedure only if the Hydraulic Control Unit (HCU) has been replaced. Follow conventional bleed procedures if the HCU is not being replaced.

1. Perform conventional brake system bleed.

DESCRIPTION AND OPERATION (Continued)

2. Connect Anti-lock Brake Adapters T90P-50-ALA (bleeder box) and T93T-50-ALA (jumper cable).
3. Press down on the brake pedal and depress the VALVES button on the bleeder box (pedal will fall).
4. Release the VALVES button and release the brake pedal.
5. Repeat steps 3 and 4 once more.
6. Depress the MOTOR START button and let the pump motor run for 1 minute.
7. Perform conventional brake system bleed.



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DIAGNOSIS AND TESTING

For general brake system diagnosis refer to Section 06-00.

Warning Indicator Functions

The anti-lock brake system uses one amber ABS warning light to alert the driver of malfunctions in the system.

The amber ABS warning light will come on for numerous reasons. It warns the driver that the ABS has been disabled. Normal power-assisted braking remains but the wheels can lock during a panic stop while the indicator is on. Certain procedures must be followed to find the concern in this situation. They are explained in this section. If system is OK, Code 16 will be present.

Make sure the diagnostic procedures are followed step-by-step in order as indicated.

WARNING: FOLLOWING THE WRONG SEQUENCE OR BYPASSING STEPS WILL LEAD TO UNNECESSARY REPLACEMENT OF PARTS, AND/OR INCORRECT RESOLUTION OF THE SYMPTOM.

The diagnostic procedure consists of five sections:

1. System Pre-Check
2. Anti-lock Quick Electrical Check Sheet
3. Diagnostic Tests (including electrical schematics)
4. Symptom Chart
5. Intermittent Diagnosis Procedure

Diagnostic Procedures**System Pre-Check**

The System Pre-Check is used to screen a vehicle for relatively simple diagnostic repairs such as loose connectors, blown fuses, etc. However, the System Pre-Check is also used to prepare the vehicle for further diagnostics. In addition, warning lamp faults are dealt with in this test.

NOTE: It is imperative that this procedure be performed first. Failure to do so may result in incorrect diagnosis of problem, wasted time, and improper replacement of good components.

Anti-lock Electrical Quick Check Sheet

This sheet is used as a reference and is meant to be used in conjunction with the Rotunda EEC-IV Pin Breakout Box 007-000033 or equivalent and jumper connector T93T-50-ALA or equivalent.

Many of the values given for various components depend on the presence of a good ground at pin 60.

NOTE: The pin 60 chassis ground must be verified as sound before any quick electrical check involving pin 60 may be used. At any time, any known good chassis ground may be substituted for a pin 60 designation.

Keep in mind that a measurement falling outside the specification can mean one of two things:

1. The wiring between two components is worn or damaged, or
2. The component is not electrically correct.

NOTE: Connections between components must be verified as sound before replacement of affected components. Failure to observe above will often lead to improper replacement of components and incorrect resolution of concern. Replacement of good components will not resolve a vehicle wiring concern.

Diagnostic Pinpoint Tests

These tests are specific for each code. However, jumping to a pinpoint test as a first step can be misleading. The tests have been written under the assumption that the System Pre-Check has been performed and passed.

NOTE: Do not proceed to any pinpoint test unless directed to do so.

At times, running completely through the pinpoint test will not lead to problem resolution. Often, the concern is due to an intermittent connection, termination, or circuit concern. Refer to the Intermittent Diagnosis Guides in this section when situations like this arise.

DIAGNOSIS AND TESTING (Continued)

It should be also noted that several circuits pass through one or more interconnections between components. These are also areas of potential concern and should be considered.

Symptom Chart

There are times when a customer concern will not cause the ABS warning light to illuminate or a code to be stored. Many times, this is due to a failure of some mechanical brake component.

The symptom chart is intended to give the technician a starting point in resolving these types of problems. Again, the System Pre-Check must be performed prior to consulting the symptom chart to verify other diagnostic trouble codes have not been set, and to maximize the effectiveness of this method of diagnosis.

Intermittent Diagnostic Guidelines

As previously mentioned, intermittent concerns are the most difficult concerns to diagnose.

An understanding of code storage and automatic code erasure is important.

First, codes can only be stored if the ECU has power. The ECU gets primary power from the ignition feed into pin 20. If this voltage is missing or less than 8V, the ECU will not initialize and therefore, a code cannot be stored. A Code 16 (system OK) will be present whenever the module sees the required voltage assuming no other failures are present.

A previously stored diagnostic trouble code will be automatically erased if no system concerns occur for 50 ignition cycles.

Therefore, some codes read out in the System Pre-Check may not result in any trouble found in the pinpoint test performed. In most cases, this is an indication of an intermittent electrical concern.

To minimize misdiagnosis, use the Intermittent Diagnosis Procedure if no resolution has been reached by the end of a particular pinpoint test.

If you are at this point because the warning light is on and you have been unable to obtain any code, go to the System Pre-Check procedure. This procedure is only meant to address those problems that have been reduced to an intermittent wiring concern.

PRE-CHECK

TEST STEP		RESULT	ACTION TO TAKE
PC1	PERFORM UNDERHOOD SYSTEM PRE-CHECK		
	<ul style="list-style-type: none"> Verify that all of the following connectors are connected and the terminals are secure and free of contaminants or corrosion. <ul style="list-style-type: none"> 40-pin ECU connector 8-pin HCU connector 4-pin pump motor connector 2-pin front sensor connectors (2) Open power distribution box and verify that both the system relay and pump motor relay and diode are fully seated. Gently pull on relay and diode terminals beneath power distribution box to make sure all are secure. Verify that both the system fuse and pump motor fuse are present and intact. Verify that the system ground eyelet at the left hand radiator support is firmly attached to the weld stud and is free of corrosion and excessive dirt. 	<p>All connections, terminals and grounds are secure. Fuses are intact</p> <p>Any of the above are missing, not connected or loose</p>	<p>GO to PC2.</p> <p>Correct condition. GO to PC2.</p>
PC2	PERFORM UNDER-VEHICLE SYSTEM PRE-CHECK		
	<ul style="list-style-type: none"> Verify that the 3-pin acceleration connector and the 2-pin rear axle sensor connector are connected and the terminals are secure and free of contaminants or corrosion. Are all connectors, terminals and grounds secure? 	<p>Yes</p> <p>No</p>	<p>GO to PC3.</p> <p>SERVICE as required. GO to PC3.</p>
PC3	CHECK ABS WARNING LIGHT SEQUENCE (KEY ON / ENGINE OFF)		
	<ul style="list-style-type: none"> Observe ABS warning light on dash. Turn ignition to ON. Does ABS warning light come on? 	<p>Yes, and stays on for 3 seconds and goes out (normal bulb proveout)</p> <p>Yes, comes on and stays on (hard light)</p> <p>No</p>	<p>GO to PC6.</p> <p>Go to PC4.</p> <p>GO to PC7.</p>

DIAGNOSIS AND TESTING (Continued)

PRE-CHECK (Continued)

TEST STEP		RESULT	ACTION TO TAKE
PC4	CODE RETRIEVAL EQUIPMENT HOOKUP		
<ul style="list-style-type: none"> ● Verify that an ABS concern has been detected (ABS warning light ON). ● Key OFF. ● Using SUPER STAR II Tester: <ul style="list-style-type: none"> — Connect tester to red ABS data link connector located near ECU. — Turn test power ON and put HOLD/TEST button in TEST position. ● Using 12V test light or ABS warning light: <ul style="list-style-type: none"> — Locate red ABS data link connector near ECU and install 12V test light between Pins C (Circuit 603 [DG]) and E (Circuit 57 [BK]). — If no test light is available, ABS warning light will flash. ● Jumper ABS data link connector pins B (Circuit 606 [BK/LB]) and E (Circuit 57 [BK]). ● Is equipment hooked up properly? 		Yes No	► GO to PC5. ► RE-ATTEMPT PC4. SERVICE as required.
PC5	RETRIEVE ABS DIAGNOSTIC TROUBLE CODES		
<ul style="list-style-type: none"> ● Using SUPER STAR II Tester: <ul style="list-style-type: none"> — Key in RUN. — Read out and record all diagnostic trouble codes. <p>CAUTION: Be sure to read out and record all codes. Failure to do so may result in improper diagnosis and unnecessary repairs.</p> <p>NOTE: After first code, the remaining codes will follow in 15-second intervals. Leave STAR Tester HOLD/TEST button in the TEST position.</p> ● Using 12V test light or ABS warning light: <ul style="list-style-type: none"> — Key in RUN. — Count flashes. <p>NOTE: Digits will be separated by 3-6 seconds. Diagnostic trouble codes will be separated by 15 seconds.</p> <ul style="list-style-type: none"> — Record all codes. When flashing stops there are no codes remaining. — Remove jumper in ABS TEST connector. ● Are there any codes present? 		Yes (other than Code 16) Yes (Code 16) No, no code is obtained	► Starting with the first code recorded, GO to the pinpoint test for that code. ► If previous action has been taken, concern most likely has been corrected and ABS system is OK. Otherwise, GO to Symptom Chart. ► GO to Pinpoint Test S.

DIAGNOSIS AND TESTING (Continued)

PRE-CHECK (Continued)

TEST STEP		RESULT	ACTION TO TAKE
PC6	ROAD TEST VEHICLE		
NOTE: Step PC6 is optional, for additional information only. <ul style="list-style-type: none"> ● Drive vehicle and observe ABS warning light. ● Does ABS warning light come on during any of the following? <ul style="list-style-type: none"> — When vehicle moves initially (light comes on at or near 6 mph). — While driving under 25 mph. — While driving at or over 25 mph. — While in an anti-lock stop. 		Yes, at or near 6 mph, concern most likely found during pump check Yes, while driving under 25 mph, most likely cause is missing wheel speed sensor output Yes, while driving over 25 mph, most likely cause is an erratic wheel speed sensor output No, but vehicle has abnormal ABS or brake system operation No, and no abnormal operation or symptoms detected	► GO to PC4 . VERIFY pump diagnostic trouble code has been set. ► GO to PC4 . VERIFY sensor diagnostic trouble code has been set. ► GO to PC4 . VERIFY sensor diagnostic trouble code has been set. ► GO to symptom chart. ► GO to PC4 . VERIFY Code 16 (System OK) is present.
PC7	ABS WARNING LIGHT DOES NOT PROVE-OUT/CHECK BULB		
<ul style="list-style-type: none"> ● Inspect ABS warning light bulb in dash. ● Is the bulb blown? 		Yes No	► REPLACE bulb. GO to PC3 . ► LEAVE bulb out. GO to PC8 .
PC8	VERIFY ABS WARNING LAMP FEED IS INTACT		
<ul style="list-style-type: none"> ● Insert 12V test light between ABS bulb socket (+) and a known good chassis ground. ● Does test light illuminate? 		Yes No	► GO to PC9 . ► SERVICE open circuit or short to ground on warning light feed. REINSERT bulb back into socket. GO to PC3 .
PC9	VERIFY ABS WARNING LAMP GROUND BETWEEN BULB AND ABS DIODE		
<ul style="list-style-type: none"> ● Open power network box and remove ABS diode. ● Verify diode terminals are clean and firmly in place. ● Check for continuity between ABS bulb socket ground and diode terminal in power network box for Circuit 603 (DG). ● Is there continuity? 		Yes No	► GO to PC10 . ► SERVICE open circuit in warning light ground or loose terminal. REINSERT ABS diode. GO to PC3 .
PC10	VERIFY INTACT ABS WARNING LAMP GROUND BETWEEN ABS DIODE AND ABS SYSTEM RELAY		
<ul style="list-style-type: none"> ● Remove ABS system relay. ● Verify relay terminals are clean and firmly in place. ● Check for continuity between ABS diode Circuit 532 (O/Y) and ABS System Relay Circuit 532 (O/Y). ● Is there continuity? 		Yes No	► GO to PC11 . ► SERVICE open circuit in Circuit 532 (O/Y) between ABS diode and ABS system relay or loose terminals. REINSERT ABS diode and system relay. GO to PC3 .

DIAGNOSIS AND TESTING (Continued)

PRE-CHECK (Continued)

TEST STEP		RESULT	ACTION TO TAKE
PC11	CHECK GROUND BETWEEN ABS SYSTEM RELAY AND CHASSIS GROUNDS		
	<ul style="list-style-type: none"> Inspect chassis ground stud at left-hand radiator support for loose or corroded eyelets. Clean and tighten any loose or dirty ground eyelets. Check for continuity between ABS system relay Circuit 57 (BK) and left-hand radiator support chassis ground stud. Is there continuity? 	Yes	<ul style="list-style-type: none"> REINSERT ABS system relay. REPLACE ABS warning bulb. REPEAT Steps PC8-PC11 looking for intermittent condition (see Intermittent Diagnosis).
		No	<ul style="list-style-type: none"> SERVICE open circuit between ABS system relay and chassis ground. REINSERT ABS system relay. GO to PC3.

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INTERMITTENT DIAGNOSIS PROCEDURE

TEST STEP		RESULT	ACTION TO TAKE
ID1	CLEAR CODES, RECONNECT COMPONENTS		
	<ul style="list-style-type: none"> Remove the pinout box. Reinstall any components removed and remake all connections. Clear all codes. Key ON. Does the ABS warning light prove out? 	Yes	GO to ID3 .
		No, light stays on.	GO to ID2 .
ID2	SERVICE CONNECTOR / TERMINAL CONCERN		
	<ul style="list-style-type: none"> Most likely concern is at one of the affected component connectors such that terminals unseat or back out upon installation. At EACH affected connection, including intermediate connections, look for: <ul style="list-style-type: none"> Bent terminals. Damaged connector terminal locks. Damaged connector wedge. Are any of the above conditions noted? <p>NOTE: If one of the above conditions is found, check the tightness of the affected circuit once the connection is remade. If the wire is too tight (short), damage is likely to recur once vehicle is given back to the customer. Service the wire as necessary to correct tight wire conditions.</p>	Yes	SERVICE connector and terminal as necessary. GO to ID7 .
		No	GO to ID6 .
ID3	WIGGLE TEST		
	<ul style="list-style-type: none"> Leave key ON. Wiggle an affected circuit in one location only. <p>NOTE: Start at one component and wiggle connector by connector until the whole circuit has been tested.</p> <ul style="list-style-type: none"> Observe ABS warning light. Is the ABS warning light on? 	Yes	Key off. GO to ID5 .
		No	GO to ID4 .
ID4	VERIFY ALL CIRCUITS HAVE BEEN TESTED		
	<ul style="list-style-type: none"> Have all affected circuits for the code being serviced been tested? 	Yes	Key off. GO to ID6 .
		No	GO to ID3 and check next circuit.
ID5	RETRIEVE CODE		
	<ul style="list-style-type: none"> Retrieve code. Is this code different than the code being serviced? 	Yes	GO to the appropriate pinpoint test.
		No	SERVICE the wire, terminal, or connector as necessary. GO to ID7 .

DIAGNOSIS AND TESTING (Continued)

INTERMITTENT DIAGNOSIS PROCEDURE (Continued)

TEST STEP		RESULT	ACTION TO TAKE
ID6	VERIFY ALL APPROPRIATE DIAGNOSTIC PROCEDURES HAVE BEEN RUN		
	<ul style="list-style-type: none"> Has the System Pre-Check been run and a code been retrieved? Have all steps of the pinpoint test for the code being serviced been performed. If only some tests were performed, then go to the pinpoint step last completed and continue. Have ALL steps of the symptom pinpoint test (if applicable) been performed. If only some tests were performed, go to the pinpoint step last completed and continue. 	Yes, all diagnostic procedures have been run. No	RETURN to the pinpoint test and proceed. RETURN to procedure(s) not yet performed and proceed.
ID7	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 	Yes No, code being serviced still exists. No, different code is set.	STOP. Concern has been corrected. GO to ID4. GO to appropriate pinpoint test.

TH8853A

PSOM Signal from ABS Verification Procedure

This procedure is intended to determine whether the cause for loss of or erratic Programmable Speedometer / Odometer Module (PSOM) function is due to the lack of a signal from the ECU.

There are three basic reasons that PSOM would not receive a signal from the ABS ECU:

- The ECU has no ignition power and therefore cannot initialize or function. In this case, the ABS warning light will come on and stay on upon vehicle start-up.
- The Rear Axle Sensor or the signal from the Rear Axle Sensor is either damaged, not being generated or is not reaching the ECU. The ECU, in turn, is unable to provide the speed signal to PSOM. In cases where the concern is not intermittent, the ABS warning light will be on upon vehicle start-up. Where the concern is intermittent, and the ABS warning light does NOT come on during vehicle start-up, a rear sensor diagnostic trouble code will often be stored in the ECU (see ABS Diagnostic Trouble Codes).

- The wiring or interconnections in the vehicle harness between the ECU and the PSOM module is damaged. This, in most cases, will lead to erratic PSOM function, and is the most difficult to diagnose.

NOTE: The ECU will continue to send a signal to PSOM in all other cases, including when the ABS system is disabled, with the exception of the first two ABS system concerns.

This procedure will only determine if the ECU is not sending out a signal. If it is determined that the ECU is sending out a proper signal, Section 13-02A should be consulted with the knowledge that a proper signal is available from the ABS system.

PROGRAMMABLE SPEEDOMETER/ODOMETER MODULE (PSOM) SIGNAL VERIFICATION PROCEDURE

TEST STEP		RESULT	ACTION TO TAKE
SV1	DETERMINE STATE OF ABS WARNING LIGHT		
	<ul style="list-style-type: none"> Observe ABS warning light. Turn ignition to START. Allow ignition to return to the RUN position. Does the ABS warning light turn on? 	Yes No	GO to SV2. GO to PC7. RETURN when ABS warning light concern is repaired.

DIAGNOSIS AND TESTING (Continued)**PROGRAMMABLE SPEEDOMETER/ODOMETER MODULE (PSOM) SIGNAL VERIFICATION PROCEDURE (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
SV2	OBTAIN ABS DIAGNOSTIC TROUBLE CODE		
<ul style="list-style-type: none"> Obtain ABS diagnostic trouble code (refer to PC4 and PC5). Are any of the following codes obtained: 33, 37, 43, or 57? <p>NOTE: Any other code obtained represents an ABS system concern and does NOT have an effect on the ability of the ECU to send the speed signal to PSOM. Resolve the ABS system concern indicated by the diagnostic service code first. When the ABS system concern is corrected, repeat this step to continue PSOM diagnosis.</p>		<p>Yes</p> <p>No, Code 16 is obtained</p> <p>No, a code other than 16/33/37/43/57 is obtained</p> <p>No code is obtained</p>	<p>GO to K1 to address rear axle sensor concern.</p> <p>GO to SV3.</p> <p>GO to appropriate pinpoint test (refer to Service Code Index).</p> <p>GO to PC12 to resolve lack of power to ECU concern. REPEAT SV2 if PSOM still does not function.</p>
SV3	VERIFY ECU SPEED SIGNAL AT PSOM CONNECTOR		
<ul style="list-style-type: none"> Key OFF. Remove the PSOM harness connector from the PSOM module. Raise the vehicle so that the rear wheels are clear of the ground. If the vehicle is a 4x4, verify the transfer case is in the 4x2 mode. Connect Rotunda Hand-Held Automotive Meter 105-00053, or equivalent between PSOM harness connector Pin 7 (Circuit 491 [O/LB]) and Pin 2 (Circuit 530 [LG/Y]). Set the meter to the frequency counter (Hz) setting. Gradually spin up the rear wheels. Does the frequency increase as the rear wheel speed increases? <p>CAUTION: The terminals in the PSOM harness connector spread very easily and upon reconnection will often result in erratic PSOM operation. Use an assistant to aid in the measurement of the speed signal. Make sure that no more pressure than absolutely necessary to obtain a reading is applied between the meter probes and the connector terminals.</p>		<p>Yes</p> <p>No</p>	<p>ECU is providing a proper signal. RETURN to Section 13-02A.</p> <p>GO to K1.</p>

Manual Memory Erasing

All error codes must be output, all faults corrected (anti-lock light off), and vehicle driven about 40 km/h (25 mph) before the memory will clear.

Automatic Memory Erasing

A diagnostic trouble code will be automatically erased if no system concerns occur for 50 ignition cycles.

On-Board Diagnostics

The anti-lock brake system electronic control module is capable of performing on-board diagnostics using Rotunda SUPER STAR II Tester 007-00041A or equivalent.

If the SUPER STAR II Tester is not available, the Lamp Flash technique should be used.

The ECU monitors system operation and can store all defined service codes in its memory. It is important to understand that there are some concerns the ECU cannot recognize. Therefore, if a symptom exists and no diagnostic trouble codes are stored by the ECU, other diagnostic steps must be followed.

The module cannot store a diagnostic trouble code if there is no power to the module. This concern can be found by following the System Pre-Check procedures.

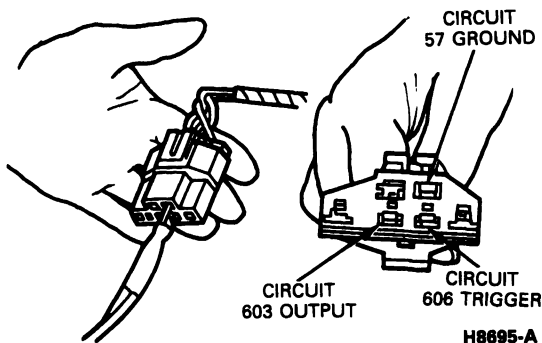
STAR Tester Connection and Battery Check

- Turn the ignition switch to OFF.
- Locate the STAR Tester data link connector in the engine compartment, near the ECU labeled ABS TEST.

DIAGNOSIS AND TESTING (Continued)

3. Connect the SUPER STAR II Tester connector to the vehicle data link connector.

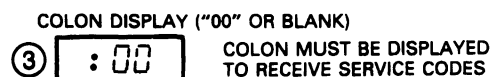
NOTE: Only one multi-pin connector is used.



4. Turn on the power switch on the right side of the SUPER STAR II Tester. A steady 00 or blank screen signifies that the SUPER STAR II Tester is ready to start the on-board diagnostics and receive diagnostic trouble codes.

NOTE: If the message LO BAT appears in the upper left corner of the read-out display and stays on, replace the SUPER STAR II Tester's 9-volt battery before continuing with the on-board diagnostics. The message LO BAT appears momentarily when power switch is turned off.

5. With the ignition switch still off, push the button in the center of the SUPER STAR II Tester.
6. Push the button again. This deactivates the sequence.
7. If the SUPER STAR II Tester passes the above test (00 or blank screen with button in TEST position), proceed with the on-board diagnostic procedure. If any diagnostic trouble codes appear during the on-board diagnostics, refer to the diagnostic trouble code index.



H8696-A

On-Board Diagnostics Procedure

The diagnostic trouble codes can be retrieved from the ECU in the following manner:

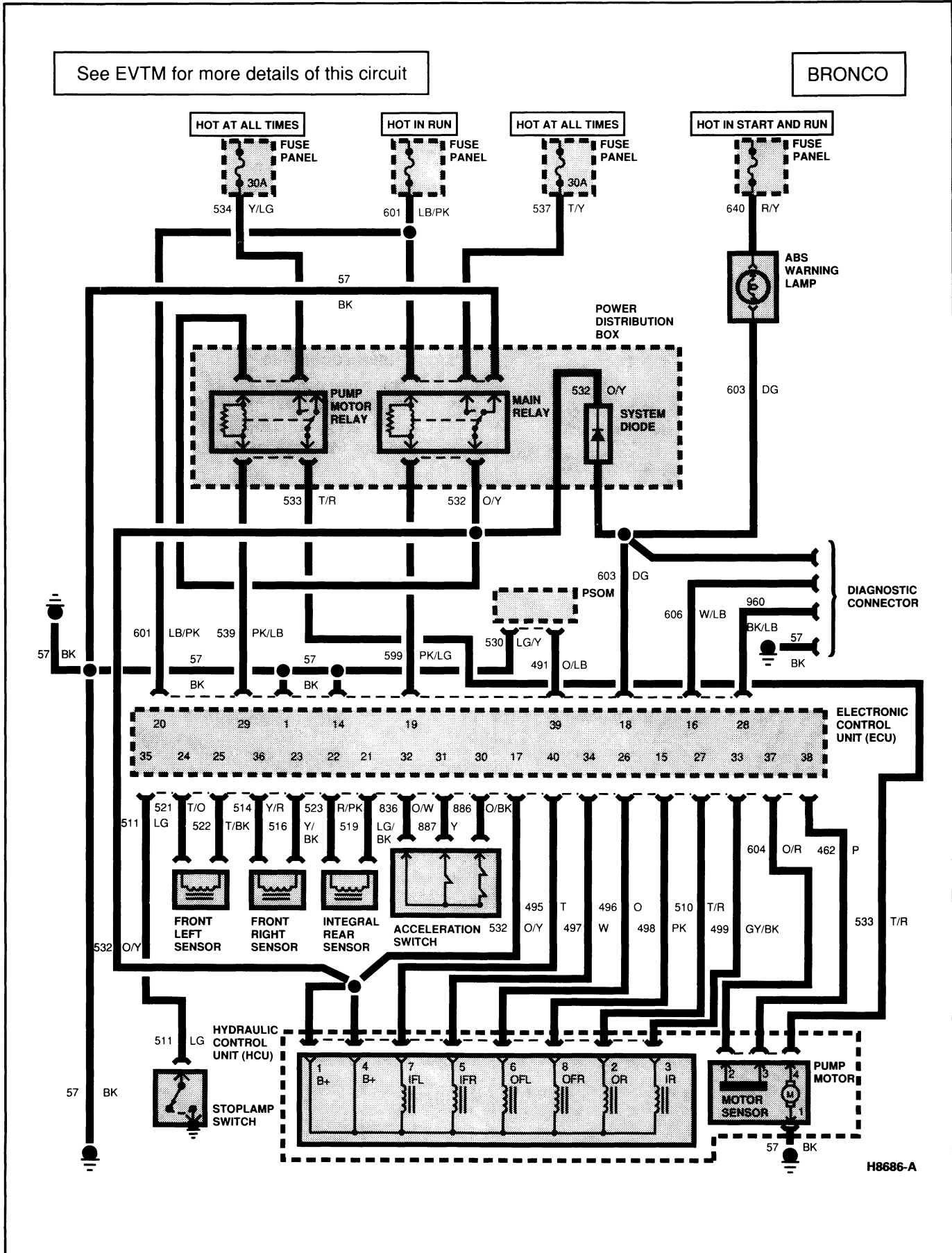
1. Connect the SUPER STAR II Tester to the connector located in the engine compartment.
2. Turn on the SUPER STAR II Tester and latch the button down in the TEST position.
3. Turn the ignition switch to RUN.
4. Read the first code output; after approximately 15 seconds the next code will be output.

NOTE: Write down all codes. Code 16 indicates system OK. Do not replace module.

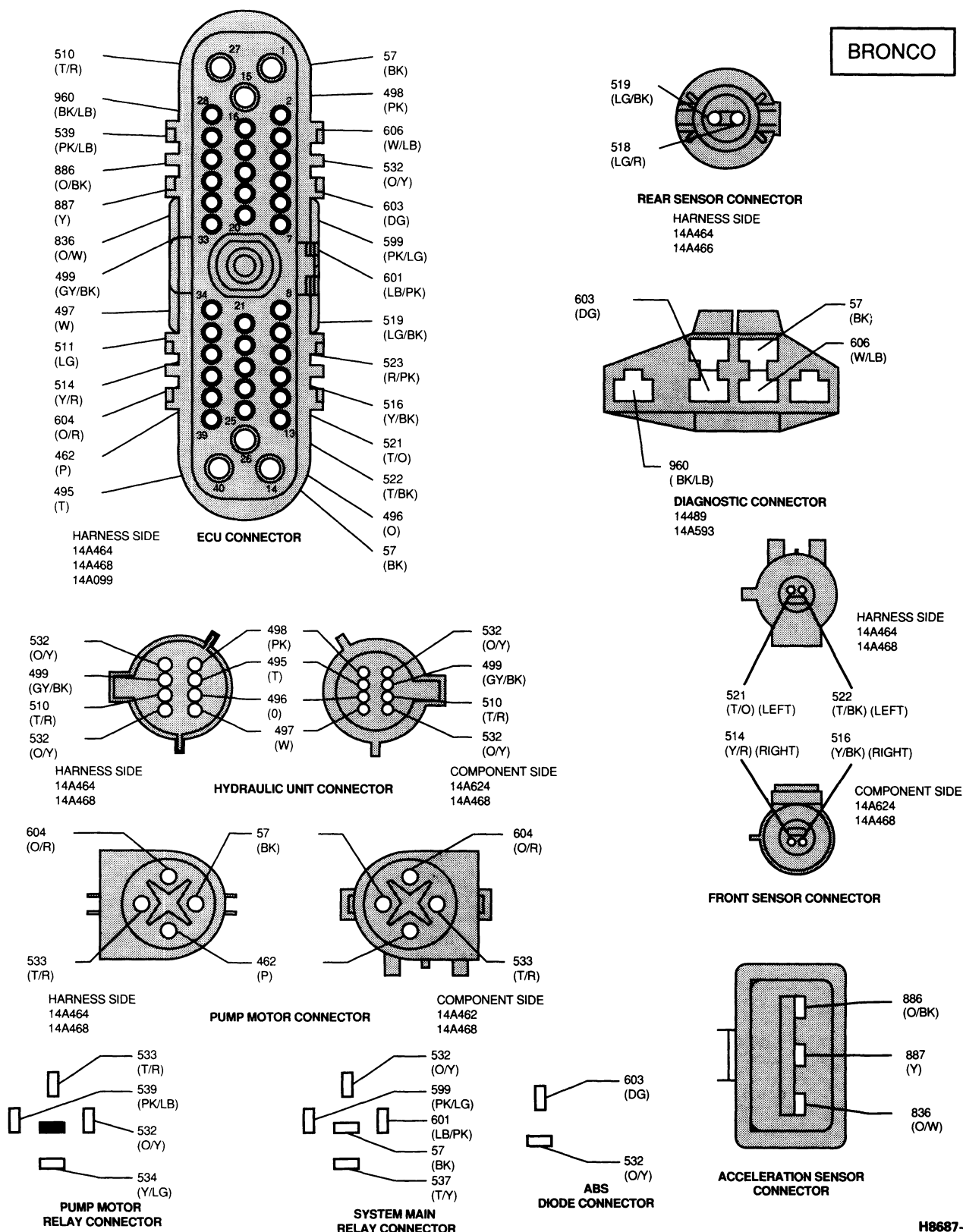
Light Flash Technique

1. Locate test connector in the engine compartment and install 12V test light between Pin C and E.
NOTE: If 12V test light is not available, the anti-lock warning light also flashes during this test.
2. With the ignition off, jumper Pin E to B.
3. Turn ignition switch to RUN position.
4. Remove jumper between Pins E and B after 5 seconds.
5. Count light flashes of test light or ABS warning light.

DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)

NOTE: Perform the following measurements with Rotunda 105-00053 Hand-Held Automotive Meter, or equivalent.

ANTI-LOCK QUICK CHECK SHEET

Measure Between				
Item To Be Tested	Ignition Mode	Pin Number(s)	Scale/Range	Specification
ECU Ground Check	Off	60 + Chassis Gnd	Ohms	Continuity
	Off	14 + Chassis Gnd	Ohms	Continuity
	Off	17 + Chassis Gnd	Ohms	Continuity
Battery Power to ECU Check	On	20 + 60	Volts	8V minimum
Jumper Pins 60 + 19 (Energizing System Relay) Power from System Relay	On	17 + 60	Volts	<ul style="list-style-type: none"> ● 8V Minimum ● Verify ABS warning lamp is OFF
System Relay Coil	Off	19 + 20	Ohms	54-68 Ohms
Pump Motor Relay Coil	Off	17 + 29	Ohms	54-68 Ohms
ABS Warning Light Ground through System Relay	Off	17 + 60	Ohms	Continuity
IFR Isolation (Inlet) Valve Resistance	Off	17 + 34	Ohms	5-8 Ohms
IFL Isolation (Inlet) Valve Resistance	Off	17 + 40	Ohms	5-8 Ohms
IRA Isolation (Inlet) Valve Resistance	Off	17 + 33	Ohms	5-8 Ohms
OFR Dump (Outlet) Valve Resistance	Off	17 + 15	Ohms	3-6 Ohms
OFL Dump (Outlet) Valve Resistance	Off	17 + 26	Ohms	3-6 Ohms
ORA Dump (Outlet) Valve Resistance	Off	17 + 27	Ohms	3-6 Ohms
FR Wheel Speed Sensor Resistance	Off	23 + 36	kOhms	1.0-1.2 kOhms
FL Wheel Speed Sensor Resistance	Off	24 + 25	kOhms	1.0-1.2 kOhms
RA Speed Sensor Resistance	Off	21 + 22	kOhms	0.8-1.4 kOhms
Motor Speed Sensor Resistance	Off	37 + 38	Hz	Greater than 150 Hz, pump motor ON Less than 70 Hz, pump motor OFF
Sensor Output: Rotate Front Wheels and Rear Axle 80 rpm				
FR	Off	24 + 25	Hz and mV	3.4 mV/Hz, or greater
FL	Off	21 + 22	Hz and mV	6 mV/Hz, or greater
RA	Off	37 + 38	Hz and mV	6 mV/Hz, or greater
Diode	Off	18 (Meter Polarity +) or 17 (Meter Polarity -)	Diode Check	0.5 Volts
Remove System Relay	Off	18 (Meter Polarity +) or 17 (Meter Polarity -)	Diode Check	Infinity mOhms

NOTE: Check for continuity between Pin 60 and chassis ground or invalid results may be obtained. Results not matching specification indicate either a wiring or component concern. Further analysis is needed before any component replacement. Refer to pinpoint tests for proper diagnostic procedures.

SERVICE CODE INDEX

Service Code	Component	Pinpoint Test Step
11	ECU Failure	Replace ECU
16	System OK	—
17	Reference Voltage	A
22	Front Left Inlet Valve	B
23	Front Left Outlet Valve	C
24	Front Right Inlet Valve	D
25	Front Right Outlet Valve	E

(Continued)

SERVICE CODE INDEX (Cont'd)

Service Code	Component	Pinpoint Test Step
26	Rear Axle Inlet Valve	F
27	Rear Axle Outlet Valve	G
31	Front Left Sensor	H
32	Front Right Sensor	J
33	Rear Axle Sensor	K
35	Front Left Sensor	H
36	Front Right Sensor	J

(Continued)

DIAGNOSIS AND TESTING (Continued)

SERVICE CODE INDEX (Cont'd)

Service Code	Component	Pinpoint Test Step
37	Rear Axle Sensor	K
41	Front Left Sensor	H
42	Front Right Sensor	J
43	Rear Axle Sensor	K
55	Front Left Sensor	H
56	Front Right Sensor	J
57	Rear Axle Sensor	K

(Continued)

SERVICE CODE INDEX (Cont'd)

Service Code	Component	Pinpoint Test Step
51	Front Left Outlet Valve	L
52	Front Right Outlet Valve	M
53	Rear Axle Outlet Valve	N
63	Pump Motor	P
65	G Switch	Q
67	Pump Motor	R
No Code Obtained	No ECU Initialization	S

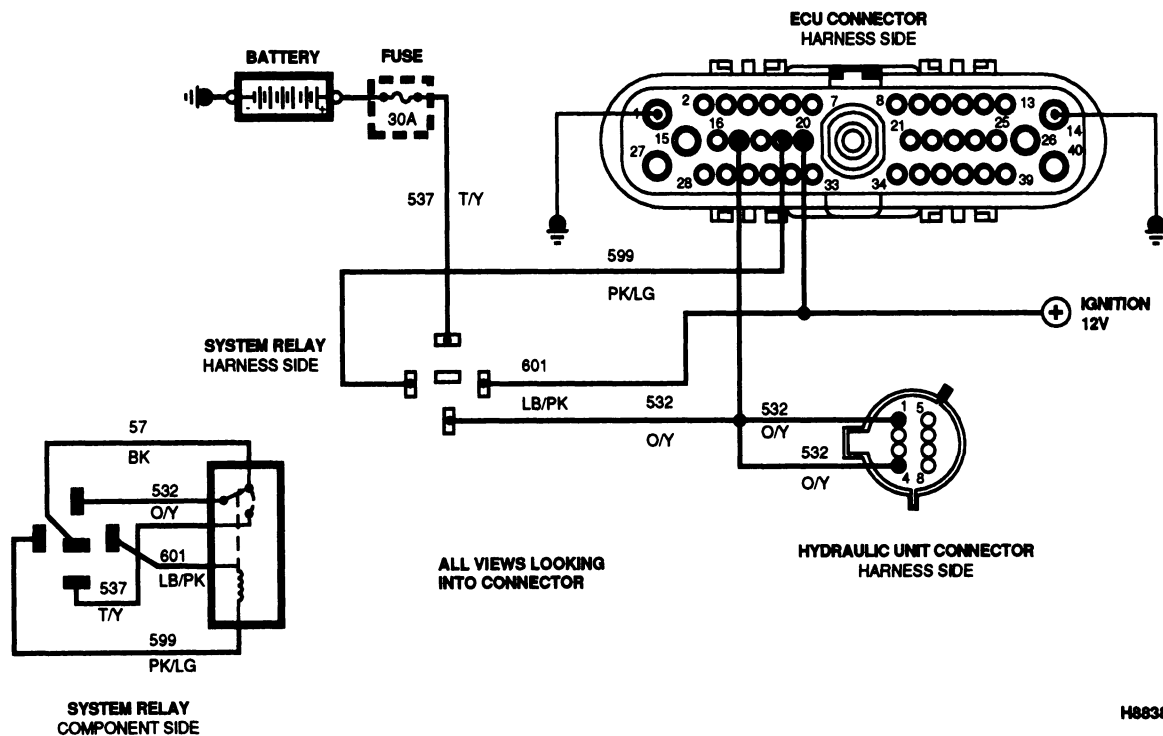
TH8756A

Pinpoint Test A — Code 17

Possible Code(s)

17 — Open circuit from battery, main relay open or 30 amp fuse open.

Affected Circuit(s)/Electrical Component(s)



H8838-A

Description

Code 17 is generated by the ECU indicating a loss of system reference voltage.

Possible Contributing Component/Vehicle Wiring Concerns

- 30 amp fuse open
- Intermittent connections to battery, main relay or ground
- Main relay coil or contacts open

DIAGNOSIS AND TESTING (Continued)

- Open or short to ground in Circuit 532 (O/Y)
- Open or short to ground in Circuit 599 (PK/LG)
- Open or short to ground in Circuit 601 (LB/PK)

CODE 17 REFERENCE VOLTAGE — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	INSTALL PINOUT BOX AND CHECK CONNECTIONS		
	<ul style="list-style-type: none"> ● Install pinout box. ● Check connections to battery, power network box battery feed lugs, and grounds. ● Are all connections clean and secure? 	Yes No	GO to A2. SECURE all connections. GO to A2.
A2	INSPECT 30A FUSE IN POWER NETWORK BOX		
	<ul style="list-style-type: none"> ● Open power network box and locate 30A fuse for Circuit 537 (T/Y). ● Check fuse for continuity. ● Verify fuse terminals are clean and secure in the power network box. ● Is the fuse blown? 	Yes No	REPLACE fuse. GO to A12. REINSTALL fuse. GO to A3.
A3	CHECK GROUND CONNECTIONS TO ECU		
	<ul style="list-style-type: none"> ● Key OFF. ● Verify ground eyelets at left hand radiator support are free of excessive dirt and corrosion and securely fastened. ● Check for continuity between Pin 60 and Pin 14 on pinout box. ● If OK, check for continuity between Pin 60 on pinout box and chassis ground at left-hand radiator support ground stud. ● Is there continuity? 	Yes No, continuity between Pins 60 and 14 does not exist No, continuity between Pin 60 and chassis ground does not exist	GO to A4. SERVICE open circuit immediately behind ECU connector. REPEAT A3. SERVICE open circuit in ground between ECU connector and left-hand radiator support ground stud. REPEAT A3.
A4	CHECK FOR PROPER VOLTAGE AT ECU CONNECTOR		
	<ul style="list-style-type: none"> ● Connect a jumper wire between Pins 19 and 60 on the pinout box. ● Check for terminal backout on 40-way connector. ● Key ON. ● Measure voltage between Pins 17 and 14 on the pinout box. ● Is there at least 8V? 	Yes No	Key OFF. REMOVE jumper. REPLACE ECU. GO to A12. Key OFF; REMOVE jumper. GO to A5.
A5	VERIFY WIRING TO ECU CONNECTOR IS INTACT		
	<ul style="list-style-type: none"> ● Disconnect battery negative cable. ● Remove ABS system relay from power network box. ● Connect a jumper wire between pins for Circuits 537 (T/Y) and 532 (O/Y) in the power network box. ● Reconnect battery negative cable. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> ● Key ON. ● Measure voltage between Pins 17 and 60 on the pinout box. ● Is there at least 8V? 	Yes No	Key OFF. GO to A9. DISCONNECT battery negative cable. REMOVE jumper. RECONNECT battery negative cable. Key OFF. GO to A6.

DIAGNOSIS AND TESTING (Continued)

CODE 17 REFERENCE VOLTAGE — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A6	VERIFY VOLTAGE PRESENT AT RELAY CONTACTS		
	<ul style="list-style-type: none"> ● Key ON. ● Measure voltage between pins for Circuits 537 (T/Y) and 57 (Bk) in the power network box. ● Is there at least 8V? 	<p>Yes</p> <p>No, no voltage is present</p> <p>No, voltage is less than 8V but greater than 0V</p>	<p>▶ Key OFF. GO to A8.</p> <p>▶ Key OFF. GO to A7.</p> <p>▶ Key OFF. ECU does not have enough reference voltage to function. ABS system is working as intended. RE-INSTALL ABS system relay. Refer to the appropriate section in Group 14 to resolve low battery voltage condition.</p>
A7	CHECK FOR OPEN CIRCUIT BETWEEN BATTERY POSITIVE VOLTAGE (B+) AND RELAY		
	<ul style="list-style-type: none"> ● Check for continuity between Battery Positive Voltage (B+) terminal and pin for Circuit 537 (T/Y) in power network box. ● Is there continuity? 	<p>Yes</p> <p>No</p>	<p>▶ REPEAT A6, looking for loose or intermittent connections / circuits (see Intermittent Diagnosis).</p> <p>▶ SERVICE open circuit in battery feed to power network box or relay. RE-INSTALL ABS system relay. GO to A12.</p>
A8	CHECK FOR PROPER VOLTAGE AT 8-WAY VALVE BLOCK CONNECTOR		
	<ul style="list-style-type: none"> ● Disconnect 8-way connector from valve block. ● Connect a jumper wire between pins for Circuits 537 (T/Y) and 532 (O/Y) in the power network box. ● Key ON. ● Measure voltage between 8-way harness connector Pin 1 or Pin 4 and Pin 60 on pinout box. ● Is there at least 8V? 	<p>Yes</p> <p>No</p>	<p>▶ Key OFF. SERVICE open circuit or short to ground in circuit 532 (O/Y) between valve block and ECU. REMOVE jumper. GO to A12.</p> <p>▶ Key OFF. SERVICE open circuit or short to ground in Circuit 532 (O/Y) between relay and valve block connector. REMOVE jumper. GO to A12.</p>
A9	VERIFY CIRCUITS TO SYSTEM RELAY COIL ARE INTACT		
	<ul style="list-style-type: none"> ● Check continuity between pin for Circuit 599 (PK/LG) in the power network box and Pin 19 on the pinout box. ● Check continuity between pin for Circuit 601 (LB/PK) in the power network box and Pin 20 on the pinout box. ● Is there continuity? 	<p>Yes</p> <p>No</p>	<p>▶ GO to A10.</p> <p>▶ SERVICE open Circuits in 599 (PK/LG) or 601 (LB/PK). RE-INSTALL ABS system relay. GO to A12.</p>
A10	CHECK CIRCUITS TO SYSTEM RELAY COIL FOR SHORTS TO GROUND		
	<ul style="list-style-type: none"> ● Check continuity between pin for Circuit 599 (PK/LG) in the power network box and Pin 60 in the pinout box. ● Check continuity between pin for Circuit 601 (LB/PK) in the power network box and Pin 60 in the pinout box. ● Is there continuity? 	<p>Yes</p> <p>No</p>	<p>▶ SERVICE short to ground in Circuits 599 (PK/LG) or 601 (LB/PK). RE-INSTALL ABS system relay. GO to A12.</p> <p>▶ REPLACE ABS system relay. GO to A12.</p>

DIAGNOSIS AND TESTING (Continued)**CODE 17 REFERENCE VOLTAGE — TEST A (Continued)**

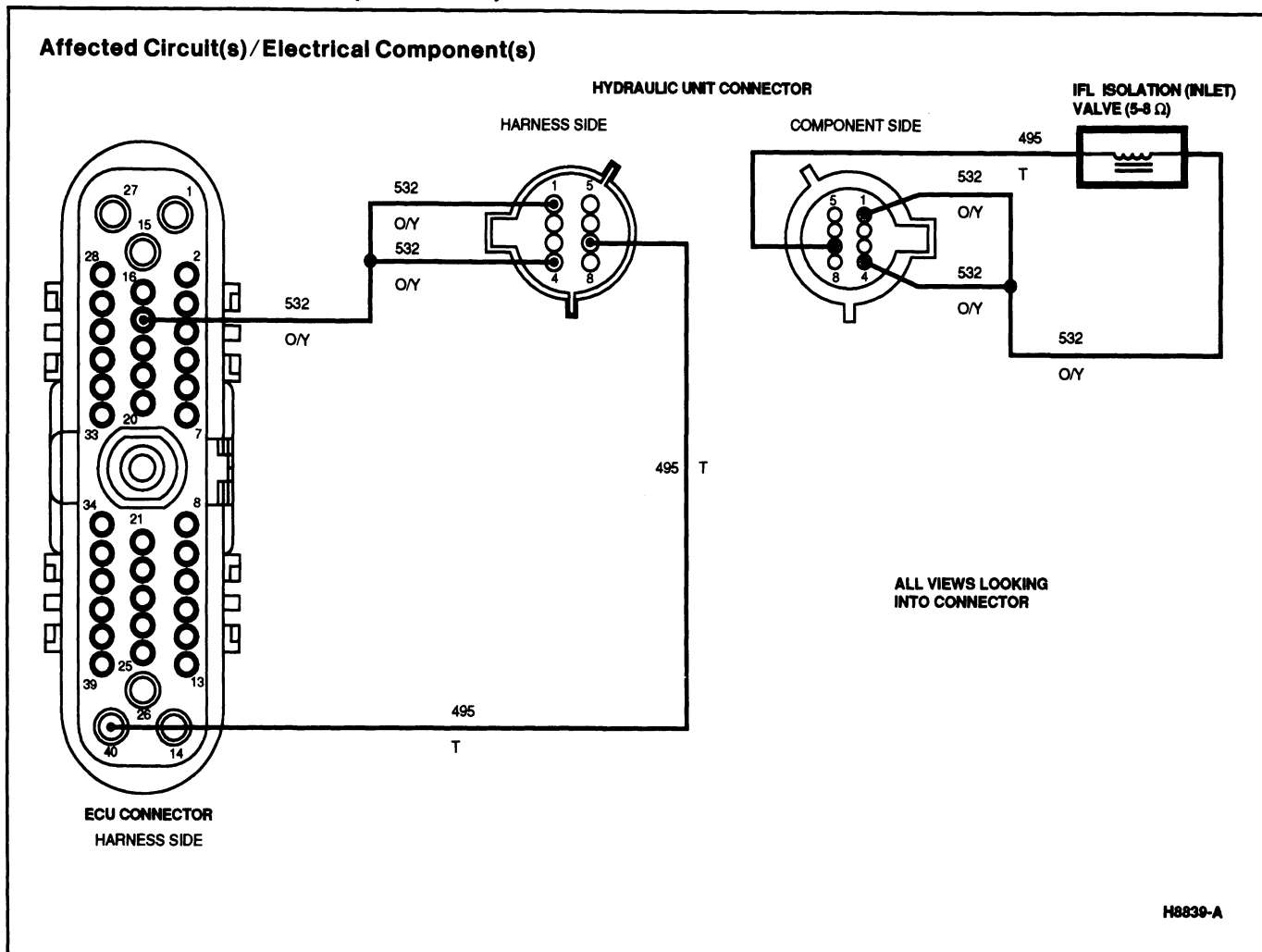
TEST STEP		RESULT	ACTION TO TAKE
A11	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained. ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 		Yes	▶ REPLACE ECU. GO to A12.
		No	▶ GO to last diagnostic step completed and continue.
A12	VERIFY CONDITION RESOLVED		
<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 		Yes	▶ STOP. Concern has been corrected.
		No, Code 17 still exists	▶ GO to next pinpoint step.
		No, different code is set	▶ GO to appropriate pinpoint test.
		No, Code 17 still exists and Step A10 is completed	▶ GO to A13.
A13	VERIFY INTEGRITY OF VEHICLE WIRING		
<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 		Yes	▶ STOP. Repair is complete.
		No	▶ GO to A11.

TH8856A

Pinpoint Test B — Code 22**Possible Code(s)**

22 — Open circuit to valve block or ECU, open or shorted valve coil or internal ECU defect.

DIAGNOSIS AND TESTING (Continued)

**Description**

Code 22 is generated by the ECU's detection of an open or shorted Circuit 495 (T) and by an open or shorted inlet front left (IFL) valve coil or an open or shorted driver in the ECU.

Possible Contributing Component / Vehicle Wiring Concerns

- Intermittent open Circuit 495 (T)
- Terminal backout in ECU connector Pins 17 and 40
- Terminal backout in valve block connector Pins 1, 4 and 7
- Open or shorted inlet front left (IFL) valve coil
- Open or shorted driver in ECU

FRONT LEFT INLET SOLENOID VALVE CONCERN DIAGNOSIS — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	SERVICE CODE 22: CHECK VALVE COIL, CIRCUIT 495 (T) AND THE ECU		
	<ul style="list-style-type: none"> ● Ignition OFF. ● Install pinout box. ● Verify terminals at Pins 17 and 40 are clean and secure in the ECU connector. ● Measure resistance between Pins 17 and 40. ● Is reading between 5 and 8 ohms? 	Yes No	GO to B4. GO to B2.

DIAGNOSIS AND TESTING (Continued)

FRONT LEFT INLET SOLENOID VALVE CONCERN DIAGNOSIS — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B2	CHECK VALVE COIL		
	<ul style="list-style-type: none"> Disconnect 8-pin valve block connector. Verify terminals on both halves of the 8-way connector are clean and secure. Measure resistance between Pins 1 and 7 and Pins 1 and 4 on the valve block. Are both readings between 5 and 8 ohms? 	<p>Yes</p> <p>No</p>	<p>SERVICE open or short to ground in Circuits 495 (T) or 532 (O/Y) between valve block harness connector and ECU connector. GO to B4.</p> <p>REPLACE valve block. GO to B4.</p>
B3	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 	<p>Yes</p> <p>No</p>	<p>REPLACE ECU. GO to B4.</p> <p>GO to last diagnostic step completed and continue.</p>
B4	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 	<p>Yes</p> <p>No, Code 22 still exists</p> <p>No, different code is set</p> <p>No, Code 22 still exists and Step B2 is completed</p>	<p>STOP. Concern has been corrected.</p> <p>GO to next pinpoint step.</p> <p>GO to appropriate pinpoint test.</p> <p>GO to B5.</p>
B5	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 	<p>Yes</p> <p>No</p>	<p>STOP. Repair is complete.</p> <p>GO to B3.</p>

TH8758A

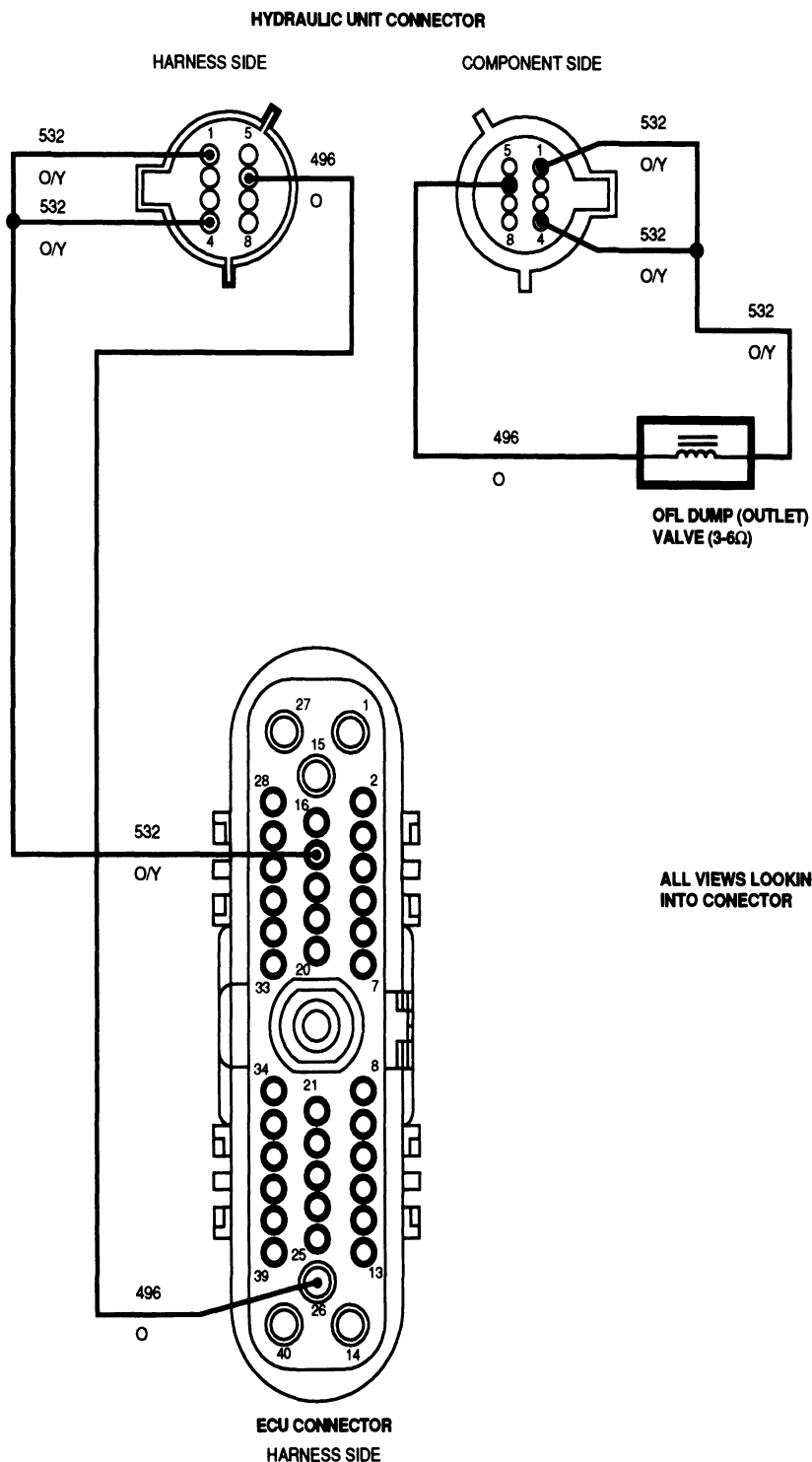
Pinpoint Test C — Code 23

Possible Code(s)

23 — Open circuit to valve block or ECU, open or shorted valve coil or internal ECU damage.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s)/Electrical Component(s)



H8841-A

DIAGNOSIS AND TESTING (Continued)

Description

Code 23 is generated by the ECU's detection of an open or shorted Circuit 496 (O) and by an open or shorted outlet front left (OFL) valve coil or an open or shorted driver in the ECU.

Possible Contributing Component / Vehicle Wiring Concerns

- Intermittent open Circuit 496 (O)
- Terminal backout in ECU connector Pins 17 and 26
- Terminal backout in valve block connector Pins 1 and 6
- Open or shorted outlet front left (OFL) valve coil
- Open or shorted driver in ECU

FRONT LEFT OUTLET SOLENOID CONCERN DIAGNOSIS — TEST C

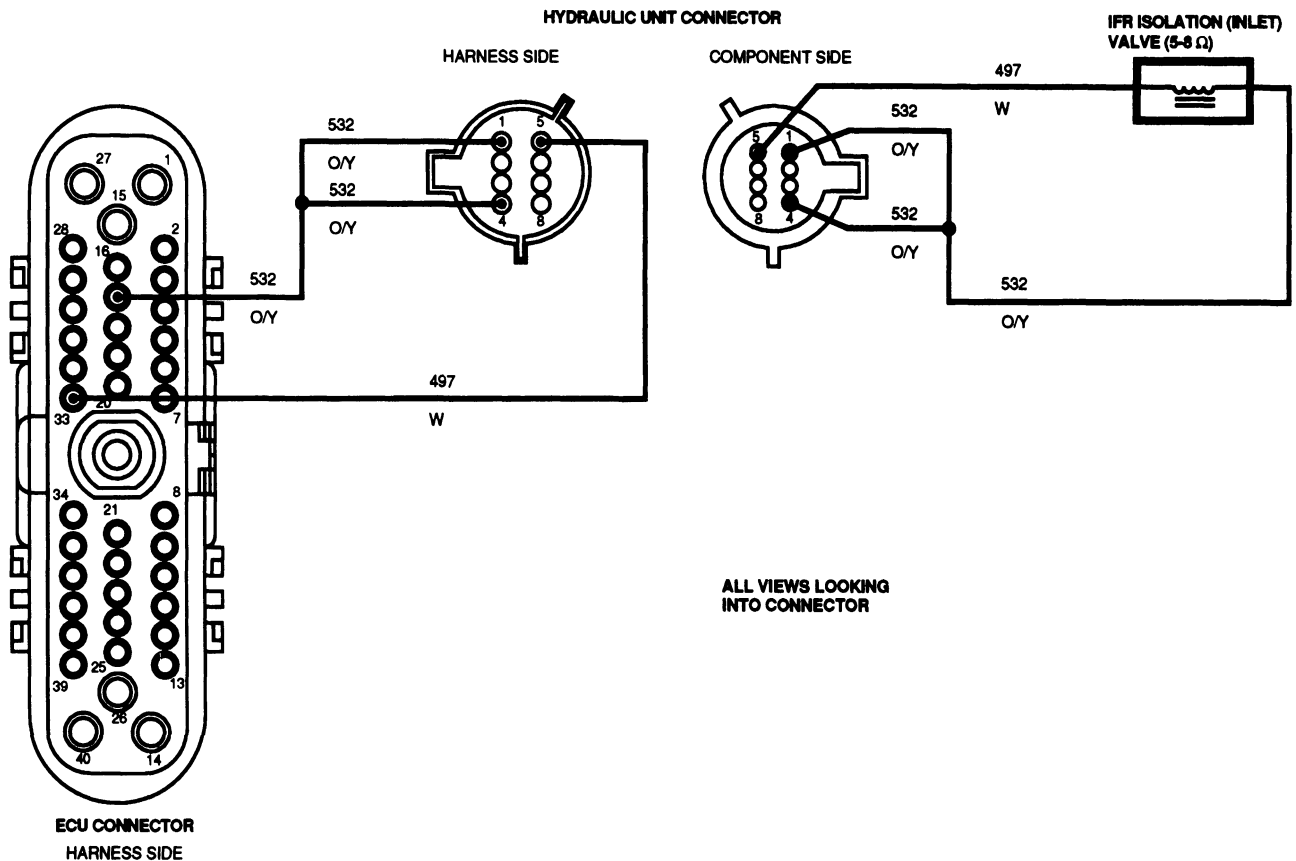
TEST STEP		RESULT	ACTION TO TAKE
C1	SERVICE CODE 23: CHECK VALVE COIL, CIRCUIT 496 AND THE ECU		
	<ul style="list-style-type: none"> ● Ignition OFF. ● Install pinout box. ● Verify terminals at Pins 17 and 26 are clean and secure in the ECU connector. ● Measure resistance between Pins 17 and 26. ● Is reading between 5 and 8 ohms? 	Yes No	GO to C4 . GO to C2 .
C2	CHECK VALVE COIL		
	<ul style="list-style-type: none"> ● Disconnect 8-pin valve block connector. ● Verify terminals on both halves of the valve block 8-way connector are clean and secure. ● Measure resistance between Pins 1 and 6 on the valve block. ● Is reading between 3 and 6 ohms? 	Yes No	SERVICE open or short to ground in Circuits 496 (O) or 532 (O/Y) between valve block harness connector and ECU connector. GO to C4 . REPLACE valve block. GO to C4 .
C3	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
	<ul style="list-style-type: none"> ● This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> ● Have all prior diagnostic steps been completed as described above? 	Yes No	REPLACE ECU. GO to C4 . GO to last diagnostic step completed and continue.
C4	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> ● Clear all codes. ● Key OFF. ● Retrieve code. ● Is Code 16 set? 	Yes No, Code 23 still exists No, different code is set No, Code 23 still exists and Step C2 is completed	STOP. Concern has been corrected. GO to next pinpoint step. GO to appropriate pinpoint test. GO to C5 .
C5	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> ● Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. ● Does wiring check OK? 	Yes No	STOP. Repair is complete. GO to C3 .

TH8760A

DIAGNOSIS AND TESTING (Continued)

Pinpoint Test D — Code 24**Possible Code(s)**

24 — Open circuit to valve block or ECU, open or shorted valve coil or internal ECU damage.

Affected Circuit(s)/Electrical Component(s)

H8842-A

Description

Code 24 is generated by the ECU's detection of an open or shorted Circuit 497 (W) and by an open or shorted inlet front right (IFR) valve coil or an open or shorted driver in the ECU.

Possible Contributing Component/Vehicle Wiring Concerns

- Intermittent open Circuit 497 (W)
- Terminal backout in ECU connector Pins 17 and 34

- Terminal backout in valve block connector Pins 1 and 5
- Open or shorted inlet front right (IFR) valve coil
- Open or shorted driver in ECU

DIAGNOSIS AND TESTING (Continued)

FRONT RIGHT INLET SOLENOID VALVE CONCERN DIAGNOSIS — TEST D

TEST STEP		RESULT	ACTION TO TAKE
D1	SERVICE CODE 24: CHECK VALVE COIL CIRCUIT 497 AND THE ECU		
	<ul style="list-style-type: none"> Ignition OFF. Install pinout box. Verify terminals at Pins 17 and 34 are clean and secure in the ECU connector. Measure resistance between Pins 17 and 34. Is reading between 5 and 8 ohms? 	Yes No	GO to D4 . GO to D2 .
D2	CHECK VALVE COIL		
	<ul style="list-style-type: none"> Disconnect 8-pin valve block connector. Verify terminals on both halves of the valve block 8-way connector are clean and secure. Measure resistance between Pins 1 and 5 on the valve block. Is reading between 5 and 8 ohms? 	Yes No	SERVICE open or short to ground in Circuits 497 (W) or 532 (O/Y) between valve block harness connector and ECU connector. GO to D4 . REPLACE valve block. GO to D4 .
D3	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 	Yes No	REPLACE ECU. GO to D4 . GO to last diagnostic step completed and continue.
D4	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 	Yes No, Code 24 still exists No, different code is set No, Code 24 still exists and Step D2 is completed	STOP. Concern has been corrected. GO to next pinpoint step. GO to appropriate pinpoint test. GO to D5 .
D5	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 	Yes No	STOP. Repair is complete. GO to D3 .

TH8762A

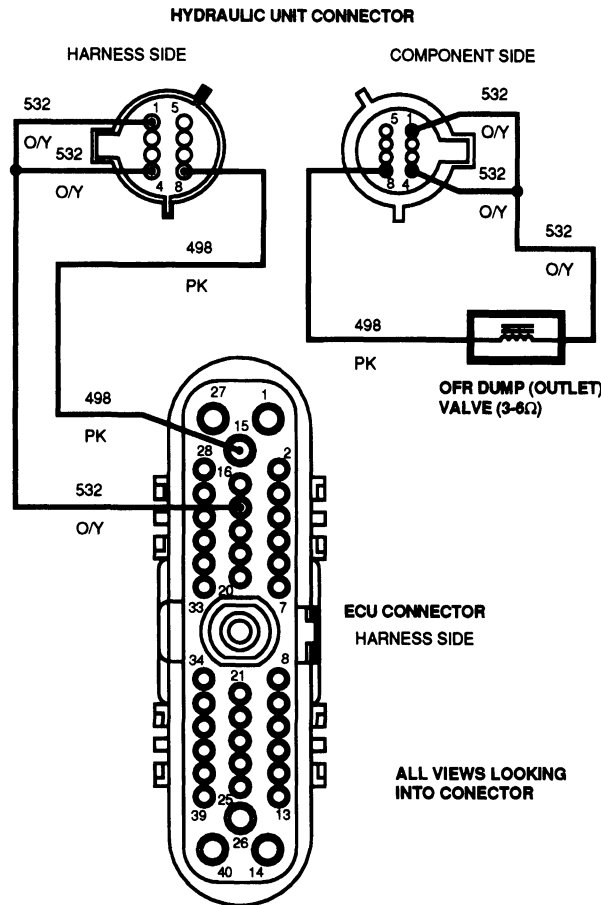
Pinpoint Test E — Code 25

Possible Code(s)

25 — Open circuit to valve block or ECU, open or shorted valve coil or internal ECU damage.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s) / Electrical Component(s)



H8843-A

Description

Code 25 is generated by the ECU's detection of an open or shorted Circuit 498 (PK) and by an open or shorted outlet front right (OFR) valve coil or an open or shorted driver in the ECU.

Possible Contributing Component / Vehicle Wiring Concerns

- Intermittent open Circuit 498 (PK)
- Terminal backout in ECU connector Pins 17 and 15
- Terminal backout in valve block connector Pins 1 and 8
- Open or shorted outlet front right (OFR) valve coil
- Open or shorted driver in ECU

FRONT RIGHT OUTLET SOLENOID VALVE CONCERN DIAGNOSIS — TEST E

TEST STEP		RESULT	ACTION TO TAKE
E1	SERVICE CODE 25: CHECK VALVE COIL, CIRCUIT 498 AND THE ECU		
	<ul style="list-style-type: none"> ● Ignition OFF. ● Install pinout box. ● Verify terminals at Pins 17 and 15 are clean and secure in the ECU connector. ● Measure resistance between Pins 17 and 15. ● Is reading between 5 and 8 ohms? 	Yes No	GO to E4 . GO to E2 .
E2	CHECK VALVE COIL		
	<ul style="list-style-type: none"> ● Disconnect 8-pin valve block connector. ● Verify terminals on both halves of the valve block 8-way connector are clean and secure. ● Measure resistance between Pins 1 and 8 on the valve block. ● Is reading between 5 and 8 ohms? 	Yes No	SERVICE open or short to ground in Circuits 498 (PK) or 532 (O/Y) between valve block harness connector and ECU connector. GO to E4 . REPLACE valve block. GO to E4 .

DIAGNOSIS AND TESTING (Continued)

FRONT RIGHT OUTLET SOLENOID VALVE CONCERN DIAGNOSIS — TEST E (Continued)

TEST STEP		RESULT	ACTION TO TAKE
E3	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 		Yes	▶ REPLACE ECU. GO to E4.
		No	▶ GO to last diagnostic step completed and continue.
E4	VERIFY CONDITION RESOLVED		
<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 		Yes	▶ STOP. Concern has been corrected.
		No, Code 25 still exists	▶ GO to next pinpoint step.
		No, different code is set	▶ GO to appropriate pinpoint test.
		No, Code 25 still exists and Step E2 is complete	▶ GO to E5.
E5	VERIFY INTEGRITY OF VEHICLE WIRING		
<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 		Yes	▶ STOP. Repair is complete.
		No	▶ GO to E3.

TH8764A

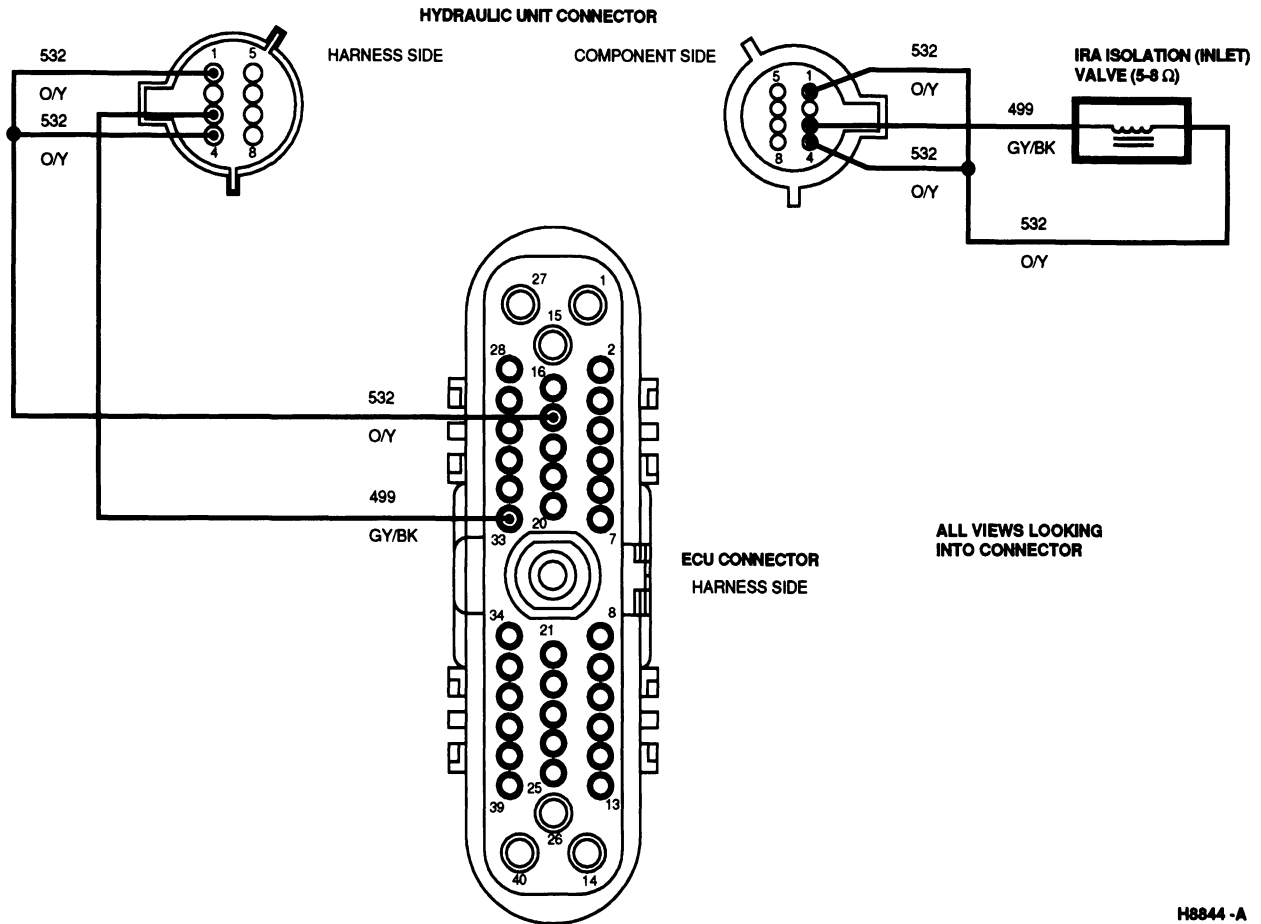
Pinpoint Test F — Code 26

Possible Code(s)

26 — Open circuit to valve block or ECU, open or shorted valve coil or internal ECU damage.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s) / Electrical Component(s)



Description

Code 26 is generated by the ECU's detection of an open or shorted Circuit 499 (GY / BK) and by an open or shorted inlet rear axle (IRA) valve coil or an open or shorted driver in the ECU.

Possible Contributing Component / Vehicle Wiring Concerns

- Intermittent open Circuit 499 (GY / BK)
- Terminal backout in ECU connector Pins 17 and 33
- Terminal backout in valve block connector Pins 1 and 3
- Open or shorted inlet rear axle (IRA) valve coil
- Open or shorted driver in ECU

REAR AXLE INLET SOLENOID VALVE CONCERN DIAGNOSIS — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	SERVICE CODE 26: CHECK VALVE COIL, CIRCUIT 499 AND THE ECU		
	<ul style="list-style-type: none"> ● Ignition OFF. ● Install pinout box. ● Verify terminals at Pins 17 and 33 are clean and secure in the ECU connector. ● Measure resistance between Pins 17 and 33. ● Is reading between 5 and 8 ohms? 	Yes No	GO to F4. GO to F2.

DIAGNOSIS AND TESTING (Continued)

REAR AXLE INLET SOLENOID VALVE CONCERN DIAGNOSIS — TEST F (Continued)

TEST STEP		RESULT	ACTION TO TAKE
F2	CHECK VALVE COIL		
	<ul style="list-style-type: none"> Disconnect 8-pin valve block connector. Verify terminals in both halves of the valve block 8-way connector are clean and secure. Measure resistance between Pins 1 and 3 on the valve block. Is reading between 5 and 8 ohms? 	<p>Yes</p> <p>No</p>	<p>SERVICE open or short to ground in Circuits 499 (GY/BK) or 532 (O/Y) between the valve block harness connector and the ECU connector. GO to F4.</p> <p>REPLACE valve block. GO to F4.</p>
F3	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 	<p>Yes</p> <p>No</p>	<p>REPLACE ECU. GO to F4.</p> <p>GO to last diagnostic step completed and continue.</p>
F4	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 	<p>Yes</p> <p>No, Code 26 still exists</p> <p>No, different code is set</p> <p>No, Code 26 still exists and Step F2 is complete</p>	<p>STOP. Concern has been corrected.</p> <p>GO to next pinpoint step.</p> <p>GO to appropriate pinpoint test.</p> <p>GO to F5.</p>
F5	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 	<p>Yes</p> <p>No</p>	<p>STOP. Repair is complete.</p> <p>GO to F3.</p>

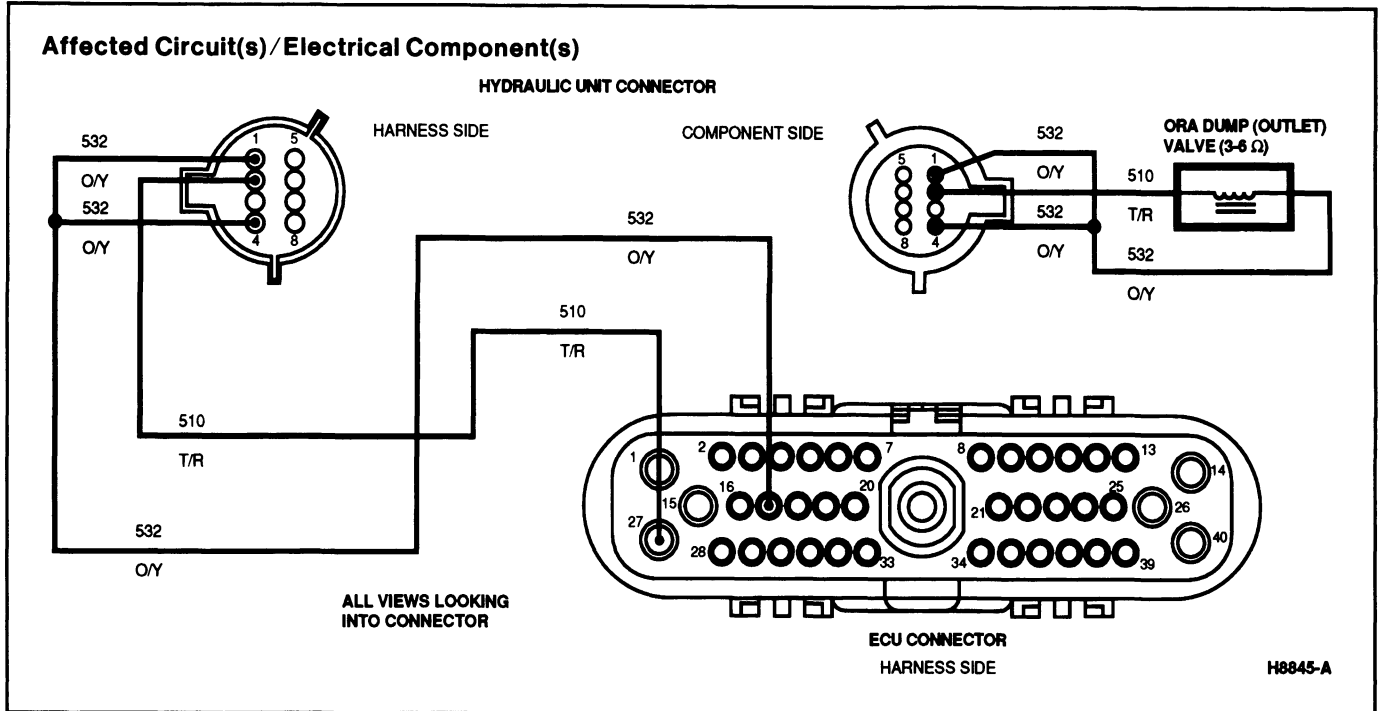
TH8766A

Pinpoint Test G — Code 27

Possible Code(s)

27 — Open circuit to valve block or ECU, open or shorted valve coil or internal ECU damage.

DIAGNOSIS AND TESTING (Continued)

**Description**

Code 27 is generated by the ECU's detection of an open or shorted Circuit 510 (T/R) and by an open or shorted outlet rear axle (ORA) valve coil or an open or shorted driver in the ECU.

Possible Contributing Component / Vehicle Wiring Concerns

- Intermittent open Circuit 510 (T/R)
- Terminal backout in ECU connector Pins 17 and 27
- Terminal backout in valve block connector Pins 1 and 2
- Open or shorted outlet rear axle (ORA) valve coil
- Open or shorted driver in ECU

REAR AXLE OUTLET SOLENOID CONCERN DIAGNOSIS — TEST G

TEST STEP		RESULT	ACTION TO TAKE
G1	SERVICE CODE 27: CHECK VALVE COIL, CIRCUIT 510 AND THE ECU		
	<ul style="list-style-type: none"> ● Ignition OFF. ● Install pinout box. ● Verify terminals at Pins 17 and 27 are clean and secure in the ECU connector. ● Measure resistance between Pins 17 and 27. ● Is reading between 5 and 8 ohms? 	Yes No	GO to G4. GO to G2.
G2	CHECK VALVE COIL		
	<ul style="list-style-type: none"> ● Disconnect 8-pin valve block connector. ● Verify terminals on both halves of the valve block 8-way connector are clean and secure. ● Measure resistance between Pins 1 and 2 on the valve block. ● Is reading between 3 and 6 ohms? 	Yes No	SERVICE open or short to ground in Circuits 510 (T/R) or 532 (O/Y) between valve block harness connector and ECU connector. REPLACE valve block.

DIAGNOSIS AND TESTING (Continued)

REAR AXLE OUTLET SOLENOID CONCERN DIAGNOSIS — TEST G (Continued)

TEST STEP		RESULT	ACTION TO TAKE
G3	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
<ul style="list-style-type: none"> This step requires that a valid diagnostic, trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 		Yes	▶ REPLACE ECU. GO to G4.
		No	▶ GO to last diagnostic step completed and continue.
G4	VERIFY CONDITION RESOLVED		
<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 		Yes	▶ STOP. Concern has been corrected.
		No, Code 27 still exists	▶ GO to next pinpoint step.
		No, different code is set	▶ GO to appropriate pinpoint test.
		No, Code 27 still exists and Step G2 is complete	▶ GO to G5.
G5	VERIFY INTEGRITY OF VEHICLE WIRING		
<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related:</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 		Yes	▶ STOP. Repair is complete.
		No	▶ GO to G3.

TH8768A

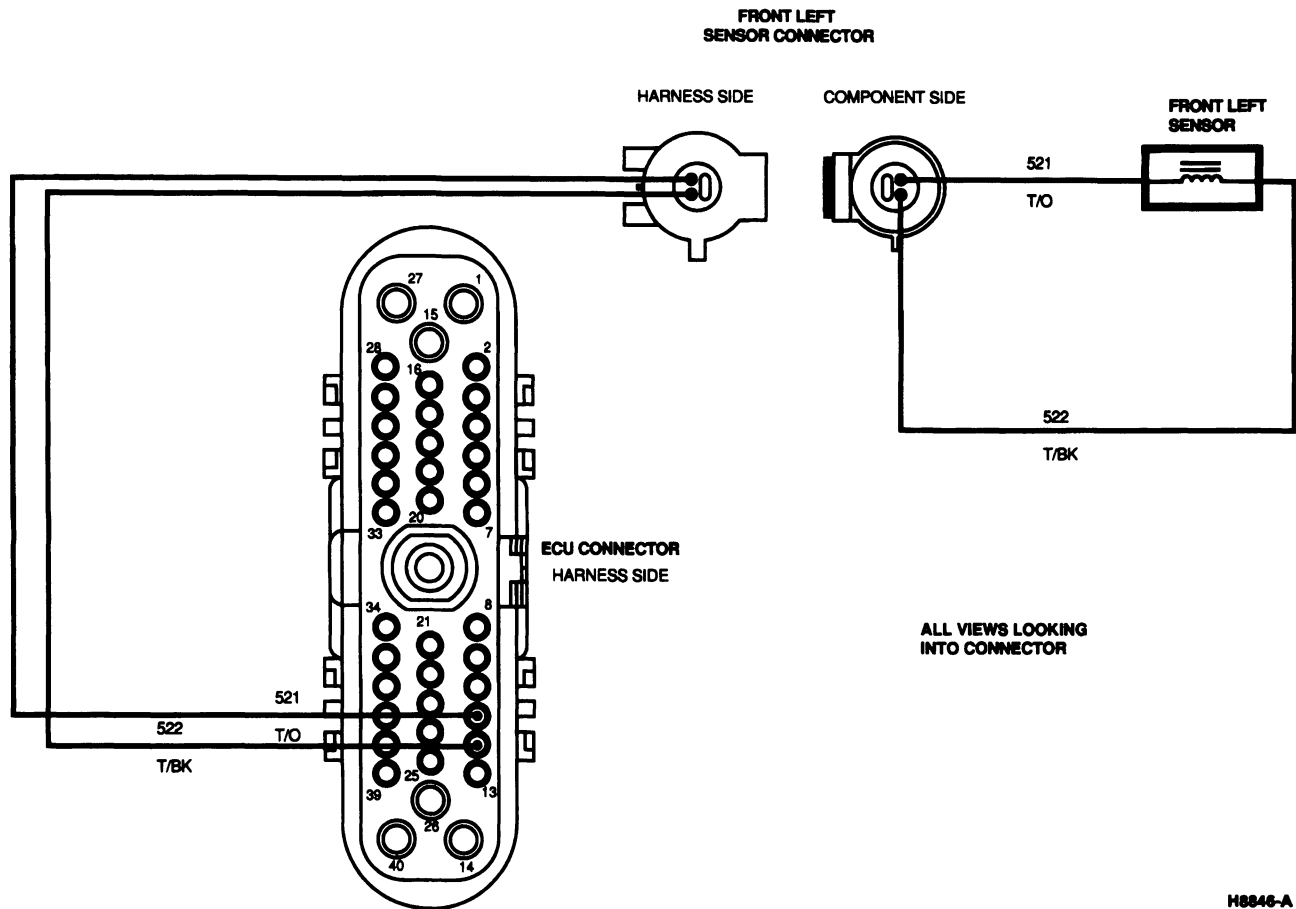
Pinpoint Test H — Codes 31, 35, 41 or 55

Possible Code(s)

31, 35, 41 or 55 — Interrupted sensor signal, missing short term and long term sensor signal or radio frequency interference.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s) / Electrical Component(s)



Description

Codes 31, 35, 41 or 55 are generated by the ECU's detection of an open or intermittent Circuit 521 (T/O) or 522 (T/BK); by misadjusted, loose or improperly installed sensor components; and by external interference or internal ECU concerns.

Possible Contributing Component/Vehicle Wiring Concerns

- Poor connection at front left wheel sensor
- Terminal backout on ECU connector pins

- Open or shorted front left sensor coil
- Open or shorted Circuit 521 (T/O) or 522 (T/BK)
- Damaged or missing tone rings
- Air gap too small or too large
- Excessive axle vibration
- Disturbances caused by ignition or RFI
- Defective trigger circuit in ECU

FRONT LEFT WHEEL SPEED SENSOR DIAGNOSIS — TEST H

TEST STEP		RESULT	ACTION TO TAKE
H1	SERVICE CODES: 31, 35, 41 OR 55 CHECK FRONT LEFT SENSOR		
	<ul style="list-style-type: none"> ● Ignition OFF. ● Install pinout box. ● Measure resistance between Pins 24 and 25. ● Is reading between 800 and 1400 ohms? 	Yes	GO to H7.
		No	GO to H2.

DIAGNOSIS AND TESTING (Continued)

FRONT LEFT WHEEL SPEED SENSOR DIAGNOSIS — TEST H (Continued)

TEST STEP		RESULT	ACTION TO TAKE
H2	CHECK RESISTANCE AT FRONT LEFT WHEEL SENSOR		
	<ul style="list-style-type: none"> ● Disconnect left front sensor connector. ● Measure resistance between the two pins on the sensor. ● Is reading between 800 and 1400 ohms? 	Yes No	<ul style="list-style-type: none"> ▶ GO to H3. ▶ REPLACE sensor. GO to H10.
H3	CHECK CIRCUIT 521 (T/O) CONTINUITY		
	<ul style="list-style-type: none"> ● Measure resistance between pinout box Pin 24 and wheel sensor harness connector Pin 2. ● Is there continuity (zero or near zero ohms)? 	Yes No	<ul style="list-style-type: none"> ▶ GO to H4. ▶ REPAIR open or high resistance on Circuit 521 (T/O). GO to H10.
H4	CHECK CIRCUIT 522 (T/BK) CONTINUITY		
	<ul style="list-style-type: none"> ● Measure resistance between pinout box Pin 25 and wheel sensor harness connector Pin 1. ● Is there continuity (zero or near zero ohms)? 	Yes No	<ul style="list-style-type: none"> ▶ GO to H5. ▶ REPAIR open or high resistance on Circuit 522 (T/BK). GO to H10.
H5	CHECK CIRCUIT 521 (T/O) SHORT TO GROUND		
	<ul style="list-style-type: none"> ● Disconnect left front wheel sensor connector. ● Measure resistance between Pins 60 and 24 on pinout box. ● Is there continuity? 	Yes No	<ul style="list-style-type: none"> ▶ REPAIR short to ground on Circuit 521 (T/O). GO to H10. ▶ GO to H6.
H6	CHECK CIRCUIT 522 (T/BK) SHORT TO GROUND		
	<ul style="list-style-type: none"> ● Measure resistance between Pins 60 and 25 on pinout box. ● Is there continuity? 	Yes No	<ul style="list-style-type: none"> ▶ REPAIR short to ground on Circuit 522 (T/BK). GO to H10. ▶ GO to H7.
H7	CHECK FL SENSOR OUTPUT AT ECU		
	<ul style="list-style-type: none"> ● Key OFF. ● Install pinout box. ● Raise vehicle so that left front wheel is off the ground. ● Remove left front wheel. Knock back the caliper so that the wheel can move as freely as possible. Remount the wheel. ● Place transfer case in 4x4 LOW. Key ON and allow wheel to spin at engine idle speed. ● Set the Hand-Held Automotive Meter, Rotunda 105-00053 or equivalent to the frequency counter (Hz) setting. Measure and record the frequency between pinout box Pins 24 and 25. ● Change the meter to the A/C mV setting. Measure and record the voltage output between pinout box Pins 24 and 25. ● Determine the sensor output in mV/Hz: Output = Voltage / Frequency ● Is the sensor output greater than 3.4 mV/Hz? 	Yes No	<ul style="list-style-type: none"> ▶ GO to H10. ▶ GO to H8.
H8	CHECK FL SENSOR OUTPUT AT SENSOR		
	<ul style="list-style-type: none"> ● Key OFF. ● Place the transfer case in 4x4 LOW. Key ON and allow wheel to spin at engine idle speed. ● Set the Hand-Held Automotive Meter, Rotunda 105-00053 or equivalent to the frequency counter (Hz) setting. Measure and record the frequency across the two pins of the sensor component connector. ● Change the meter to the A/C mV setting. Measure and record the voltage output across the two pins of the sensor component connector. ● Determine the sensor output in mV/Hz: Output = Voltage / Frequency ● Is the sensor output greater than 3.4 mV/Hz? 	Yes No	<ul style="list-style-type: none"> ▶ Sensor is OK. REPAIR open or short to ground on Circuits 521 (T/O) or 522 (T/BK). GO to H10. ▶ REPLACE sensor. GO to H10.

DIAGNOSIS AND TESTING (Continued)**FRONT LEFT WHEEL SPEED SENSOR DIAGNOSIS — TEST H (Continued)**

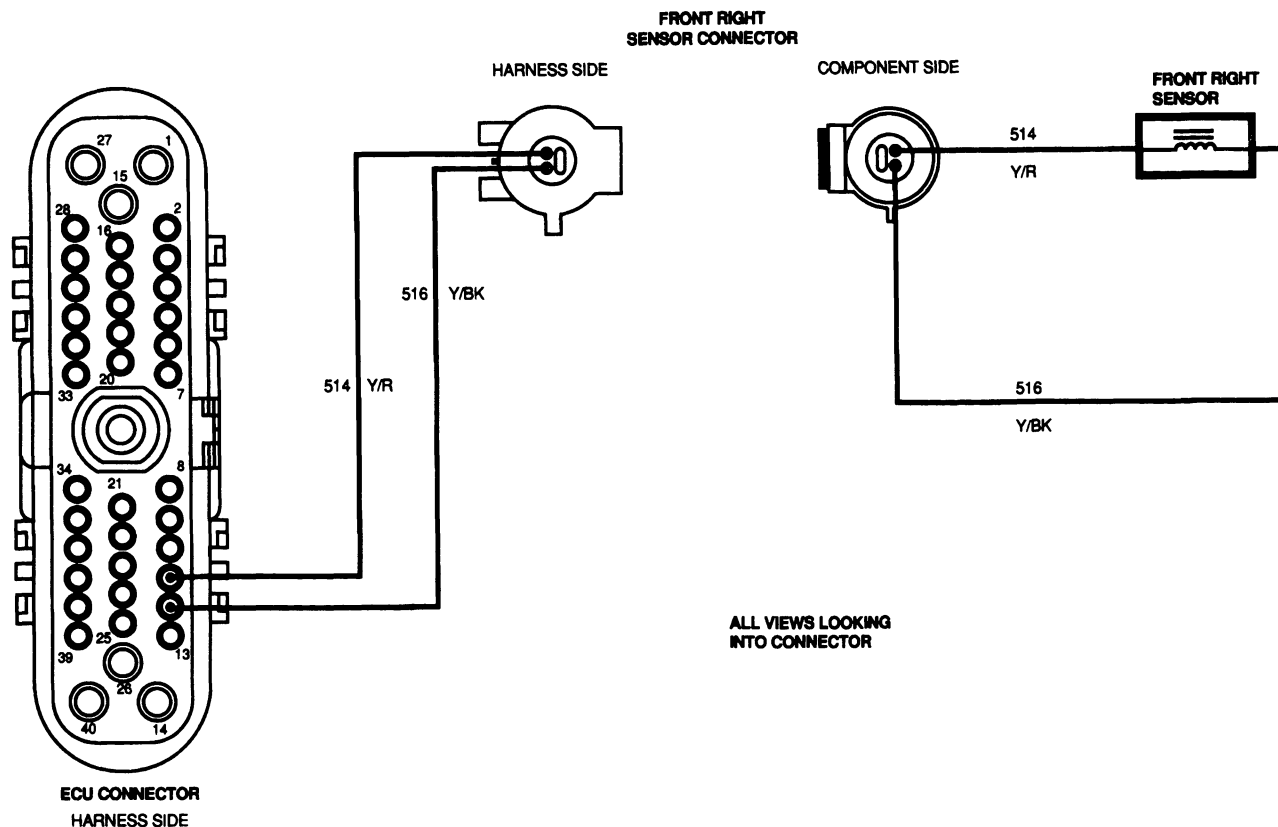
TEST STEP		RESULT	ACTION TO TAKE
H9	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 		Yes	▶ REPLACE sensor. GO to H10. If no resolution, REPLACE ECU. GO to H10.
		No	▶ GO to last diagnostic step completed and continue.
H10	VERIFY CONDITION RESOLVED		
<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 		Yes	▶ STOP. Concern has been corrected.
		No, code being serviced still exists	▶ GO to next pinpoint step.
		No, different code is set	▶ GO to appropriate pinpoint test.
		No, code being serviced still exists and Step H8 is completed	▶ GO to H11.
H11	VERIFY INTEGRITY OF VEHICLE WIRING		
<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 		Yes	▶ STOP. Repair is complete.
		No	▶ GO to H9.

Pinpoint Test J — Codes 32, 36, 42 or 56**Possible Code(s)**

32, 36, 42 or 56 — Interrupted sensor signal missing short term and long term sensor signal or radio frequency interference.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s)/Electrical Component(s)



H8847-A

Description

Codes 32, 36, 42 or 56 are generated by the ECU's detection of an open or intermittent Circuit 516 (Y / BK) or 514 (Y / R); by misadjusted, loose or improperly installed sensor components; and by external interference or internal ECU concerns.

Possible Contributing Component/ Vehicle Wiring Concerns

- Poor connection at front right wheel sensor
- Terminal backout in ECU connector pins

- Open or shorted front right sensor coil
- Open or shorted Circuit 516 (Y / BK) or 514 (Y / R)
- Damaged or missing tone rings
- Air gap too small or too large
- Excessive axle vibration
- Disturbances caused by ignition or RFI
- Defective trigger circuit in ECU

FRONT RIGHT WHEEL SPEED SENSOR DIAGNOSIS — TEST J

TEST STEP		RESULT	ACTION TO TAKE
J1	SERVICE CODES: 32, 36, 42 OR 56 CHECK FRONT RIGHT SENSOR		
	<ul style="list-style-type: none"> ● Ignition OFF. ● Install pinout box. ● Measure resistance between Pins 23 and 36. ● Is reading between 800 and 1400 ohms? 	Yes No	GO to J7. GO to J2.

DIAGNOSIS AND TESTING (Continued)**FRONT RIGHT WHEEL SPEED SENSOR DIAGNOSIS — TEST J (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
J2	CHECK RESISTANCE AT FRONT RIGHT WHEEL SENSOR		
	<ul style="list-style-type: none"> ● Disconnect right front sensor connector. ● Measure resistance between the two pins on the sensor. ● Is reading between 800 and 1400 ohms? 	Yes No	GO to J3. REPLACE sensor. GO to J10.
J3	CHECK CIRCUIT 516 (Y/BK) CONTINUITY		
	<ul style="list-style-type: none"> ● Measure resistance between pinout box Pin 23 and wheel sensor harness connector Pin 2. ● Is there continuity (zero or near zero ohms)? 	Yes No	GO to J4. REPAIR open or high resistance on Circuit 516 (Y/BK). GO to J10.
J4	CHECK CIRCUIT 514 (Y/R) CONTINUITY		
	<ul style="list-style-type: none"> ● Measure resistance between pinout box Pin 36 and wheel sensor harness connector Pin 1. ● Is there continuity (zero or near zero ohms)? 	Yes No	REVERIFY symptoms. REPAIR open or high resistance on Circuit 514 (Y/R). GO to J10.
J5	CHECK CIRCUIT 516 (Y/BK) SHORT TO GROUND		
	<ul style="list-style-type: none"> ● Disconnect right front wheel sensor connector. ● Measure resistance between Pins 60 and 23 on pinout box. ● Is there continuity? 	Yes No	REPAIR short to ground on Circuit 516 (Y/BK). GO to J10. GO to J6.
J6	CHECK CIRCUIT 514 (Y/R) SHORT TO GROUND		
	<ul style="list-style-type: none"> ● Measure resistance between Pins 60 and 36 on pinout box. ● Is there continuity? 	Yes No	REPAIR short to ground on Circuit 514 (Y/R). GO to J10. GO to J7.
J7	CHECK FR SENSOR OUTPUT AT ECU		
	<ul style="list-style-type: none"> ● Key OFF. ● Install pinout box. ● Raise vehicle so that right front wheel is off the ground. ● Remove left front wheel. Knock back the caliper so that the wheel can move as freely as possible. Remount the wheel. ● Place transfer case in 4x4 LOW. Key ON and allow wheel to spin at engine idle speed. ● Set the Hand-Held Automotive Meter, Rotunda 105-00053 or equivalent to the frequency counter (Hz) setting. Measure and record the frequency between pinout box Pins 23 and 36. ● Change the meter to the A/C mV setting. Measure and record the voltage output between pinout box Pins 23 and 36. ● Determine the sensor output in mV/Hz: Output = Voltage/Frequency ● Is the sensor output greater than 3.4 mV/Hz? 	Yes No	GO to J10. GO to J8.
J8	CHECK FR SENSOR OUTPUT AT SENSOR		
	<ul style="list-style-type: none"> ● Key OFF. ● Place transfer case in 4x4 LOW. Key ON and allow wheel to spin at engine idle speed. ● Set the Hand-Held Automotive Meter, Rotunda 105-00053 or equivalent to the frequency counter (Hz) setting. Measure and record the frequency across the two pins of the sensor component connector. ● Change the meter to the A/C mV setting. Measure and record the voltage output across the two pins of the sensor component connector. ● Determine the sensor output in mV/Hz: Output = Voltage/Frequency ● Is the sensor output greater than 3.4 mV/Hz? 	Yes No	Sensor is OK. REPAIR open or short to ground on Circuits 514 (Y/R) or 516 (Y/BK). GO to J10. REPLACE sensor. GO to J10.

DIAGNOSIS AND TESTING (Continued)**FRONT RIGHT WHEEL SPEED SENSOR DIAGNOSIS — TEST J (Continued)**

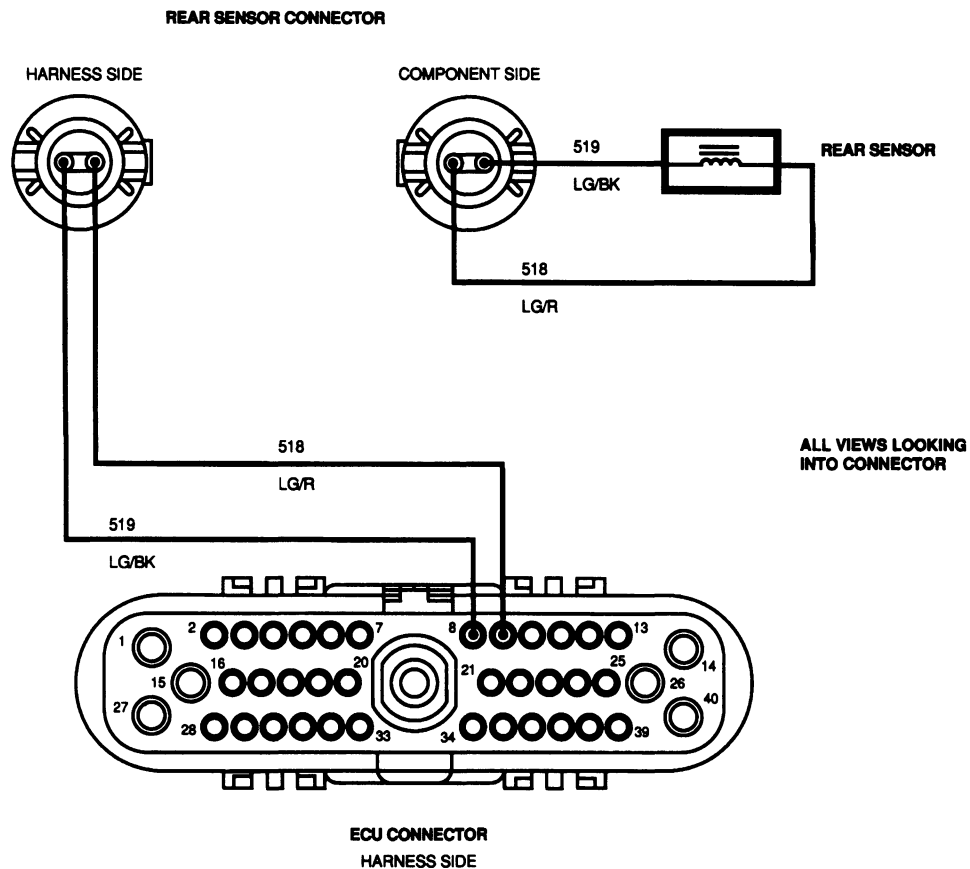
TEST STEP		RESULT	ACTION TO TAKE
J9	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 		Yes	▶ REPLACE sensor. GO to J10. If no resolution, REPLACE ECU. GO to J10.
		No	▶ GO to last diagnostic step completed and continue.
J10	VERIFY CONDITION RESOLVED		
<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 		Yes	▶ STOP. Concern has been corrected.
		No, code being serviced still exists	▶ GO to next pinpoint step.
		No, different code is set	▶ GO to appropriate pinpoint test.
		No, code being serviced still exists and Step J8 is complete	▶ GO to J11.
J11	VERIFY INTEGRITY OF VEHICLE WIRING		
<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 		Yes	▶ STOP. Repair is complete.
		No	▶ GO to J9.

Pinpoint Test K — Codes 33, 37, 43 or 57**Possible Code(s)**

33, 37, 43 or 57 — Interrupted sensor signal, missing short term and long term sensor signal or radio frequency interference.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s)/Electrical Component(s)



H8848-A

Description

Codes 33, 37, 43 or 57 are generated by the ECU's detection of an open or intermittent Circuit 518 (LG/R) or 519 (LG/BK); by misadjusted, loose or improperly installed sensor components; and by external interference or internal ECU concerns.

Possible Contributing Component/Vehicle Wiring Concerns

- Poor connection at rear axle wheel sensor
- Terminal backout in ECU connector pins
- Open or shorted front left sensor coil
- Open or shorted Circuit 519 (LG/BK) or 518 (LG/R)
- Damaged or missing tone rings
- Air gap too small or too large
- Excessive axle vibration
- Disturbances caused by ignition or RFI
- Defective trigger circuit in ECU

REAR AXLE WHEEL SPEED SENSOR DIAGNOSIS — TEST K

TEST STEP		RESULT	ACTION TO TAKE
K1	SERVICE CODES 33, 37, 43 OR 57: CHECK REAR AXLE SENSOR		
<ul style="list-style-type: none"> ● Ignition OFF. ● Install pinout box. ● Measure resistance between Pins 21 and 22. ● Is reading between 1300 and 1550 ohms? <p>NOTE: Rear differential reading can be between 1300-2100 ohms.</p>		Yes	GO to K7.
		No	GO to K2.

DIAGNOSIS AND TESTING (Continued)

REAR AXLE WHEEL SPEED SENSOR DIAGNOSIS — TEST K (Continued)

TEST STEP		RESULT	ACTION TO TAKE
K2	CHECK RESISTANCE AT REAR AXLE SENSOR		
	<ul style="list-style-type: none"> Disconnect rear axle sensor connector. Measure resistance between the two pins on the sensor. Is reading between 800 and 1400 ohms? 	Yes No	<ul style="list-style-type: none"> GO to K3. REPLACE sensor. GO to K10.
K3	CHECK CIRCUIT 519 (LG/BK) CONTINUITY		
	<ul style="list-style-type: none"> Measure resistance between pinout box Pin 21 and wheel speed sensor harness connector Pin 2. Is there continuity (zero or near zero ohms)? 	Yes No	<ul style="list-style-type: none"> GO to K4. REPAIR open or high resistance on Circuit 519 (LG/BK). GO to K10.
K4	CHECK CIRCUIT 518 (LG/R) CONTINUITY		
	<ul style="list-style-type: none"> Measure resistance between pinout box Pin 22 and wheel speed sensor harness connector Pin 1. Is there continuity (zero or near zero ohms)? 	Yes No	<ul style="list-style-type: none"> REVERIFY symptoms. REPAIR open or high resistance on Circuit 518 (LG/R). GO to K10.
K5	CHECK CIRCUIT 519 (LG/BK) SHORT TO GROUND		
	<ul style="list-style-type: none"> Disconnect rear axle sensor connector. Measure resistance between Pins 60 and 21 on pinout box. Is there continuity? 	Yes No	<ul style="list-style-type: none"> REPAIR short to ground on Circuit 519 (LG/BK). GO to K10. GO to K6.
K6	CHECK CIRCUIT 518 (LG/R) SHORT TO GROUND		
	<ul style="list-style-type: none"> Measure resistance between Pins 60 and 22 on pinout box. Is there continuity? 	Yes No	<ul style="list-style-type: none"> REPAIR short to ground on Circuit 518 (LG/R). GO to K10. GO to K7.
K7	CHECK REAR AXLE SENSOR OUTPUT AT ECU		
	<ul style="list-style-type: none"> Key OFF. Install pinout box. Raise vehicle so that the rear wheels are off the ground. Place transfer case in 4x4 LOW. Key ON and allow wheels to spin at engine idle speed. Set the Hand-Held Automotive Meter, Rotunda 105-00053 or equivalent to the frequency counter (Hz) setting. Measure and record the frequency between pinout box Pins 23 and 36. Change the meter to the A/C mV setting. Measure and record the voltage output between pinout box Pins 23 and 36. Determine the sensor output in mV / Hz: Output = Voltage / Frequency Is the sensor output greater than 6 mV / Hz? 	Yes No	<ul style="list-style-type: none"> GO to K10. GO to K8.
K8	CHECK REAR AXLE SENSOR OUTPUT AT SENSOR		
	<ul style="list-style-type: none"> Key OFF. Place transfer case in 4x4 LOW. Key ON and allow wheels to spin at engine idle speed. Set the Hand-Held Automotive Meter, Rotunda 105-00053 or equivalent to the frequency counter (Hz) setting. Measure and record the frequency across the two pins of the sensor component connector. Change the meter to the A/C mV setting. Measure and record the voltage output across the two pins of the sensor component connector. Determine the sensor output in mV / Hz: Output = Voltage / Frequency Is the sensor output greater than 6 mV / Hz? 	Yes No	<ul style="list-style-type: none"> Sensor is OK. REPAIR open or short to ground on Circuits 519 (LG/BK) or 523 (R/PK). GO to K10. REPLACE sensor. GO to K10.

DIAGNOSIS AND TESTING (Continued)

REAR AXLE WHEEL SPEED SENSOR DIAGNOSIS — TEST K (Continued)

TEST STEP		RESULT	ACTION TO TAKE
K9	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 	<p>Yes</p> <p>No</p>	<p>REPLACE sensor. GO to K10. If no resolution, REPLACE ECU. GO to K10.</p> <p>GO to last diagnostic step completed and continue.</p>
K10	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 	<p>Yes</p> <p>No, code being serviced still exists</p> <p>No, different code is set</p> <p>No, code being serviced still exists and Step K8 is complete</p>	<p>STOP. Concern has been corrected.</p> <p>GO to next pinpoint step.</p> <p>GO to appropriate pinpoint test.</p> <p>GO to K11.</p>
K11	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 	<p>Yes</p> <p>No</p>	<p>STOP. Repair is complete.</p> <p>GO to K9.</p>

Pinpoint Test L — Code 51

Possible Code(s)

51 — Hydraulically inoperative front left outlet valve, pinched or closed brake line or hose, worn or clogged valve.

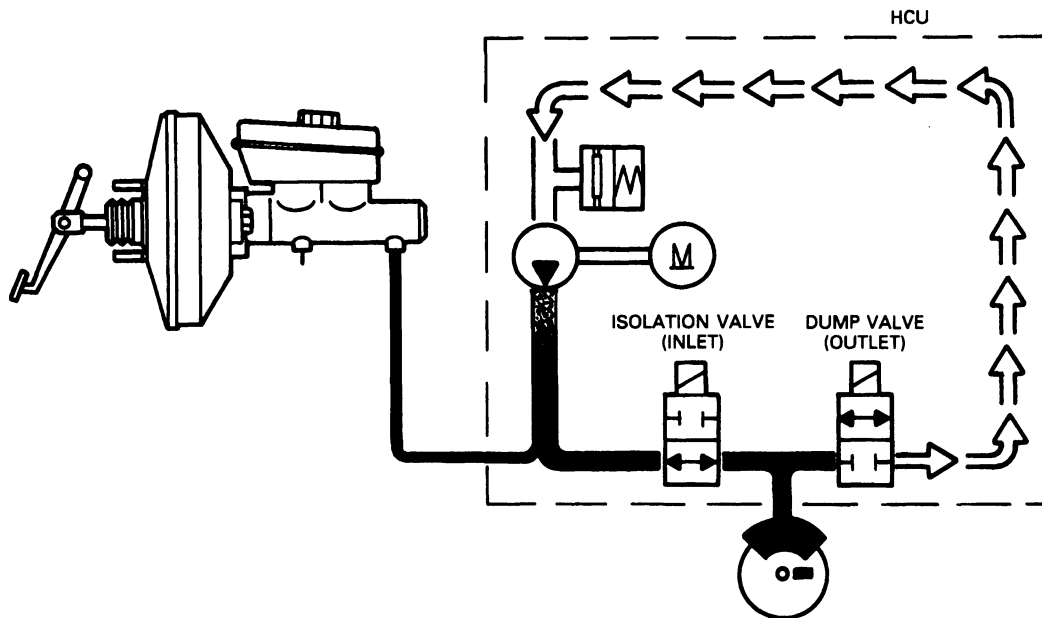
DIAGNOSIS AND TESTING (Continued)**HYDRAULICALLY INOPERATIVE FRONT LEFT OUTLET VALVE OR SENSOR DISTURBANCE DETECTED DIAGNOSIS — TEST L (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
L3	CHECK FRONT LEFT OUTLET VALVE OPERATION		
<ul style="list-style-type: none"> Apply brake pedal force, turn ignition on and have assistant try to turn wheel. <p>CAUTION: Do not leave ignition on for more than 30 seconds with the jumper installed.</p> <ul style="list-style-type: none"> Does wheel turn now? 		Yes	▶ VALVE is OK. GO to Drive Test — Code 16 Step DT1.1.
		No	▶ REPLACE valve block.
L4	VERIFY CONDITION RESOLVED		
<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 		Yes	▶ STOP. Concern has been corrected.
		No, code being serviced still exists	▶ GO to next pinpoint step.
		No, different code is set	▶ GO to appropriate pinpoint test.

TH8774A

Pinpoint Test M — Code 52**Possible Code(s)**

52 — Hydraulically inoperative front right outlet valve, pinched or closed brake line or hose, worn or clogged valve.

Affected Circuit(s)/Electrical Component(s)

H8866-A

DIAGNOSIS AND TESTING (Continued)

Description

Code 52 is generated by the ECU's detection of a hydraulically inoperative right front outlet valve.

Possible Contributing Component/Vehicle Wiring Concerns

- Pinched or closed brake line or hose
- Worn or clogged front right outlet valve

HYDRAULICALLY INOPERATIVE RIGHT FRONT OUTLET VALVE OR SENSOR DISTURBANCE DETECTED DIAGNOSIS — TEST M

TEST STEP		RESULT	ACTION TO TAKE
M1	CHECK BRAKE LINES/HOSES		
	<ul style="list-style-type: none"> ● Visually inspect brake lines from valve block to right front wheel. ● Are lines damaged? 	Yes No	REPAIR/REPLACE lines. GO to M2.
M2	SERVICE CODE 52: CHECK FRONT RIGHT OUTLET VALVE		
	<ul style="list-style-type: none"> ● Key OFF. ● Install pinout box. ● Jumper pinout box Pins 15, 19, 34, and 60 together. ● Raise vehicle so front right wheel is just off the ground. ● Press hard on the brake pedal and have an assistant try to turn the wheel. ● Does wheel turn or the pedal drop slowly? <p>NOTE: This condition is similar to the master cylinder bypass condition. It is important that the pedal be quickly and forcefully applied to rule out master cylinder bypass as the cause if a hydraulic leak is detected. Typically, master cylinder bypass only occurs at low line pressures.</p>	Yes No	REPLACE HCU. BLEED Brake System. GO to M4. GO to M3.
M3	CHECK FRONT RIGHT OUTLET VALVE OPERATION		
	<ul style="list-style-type: none"> ● Apply brake pedal force, turn ignition ON and have assistant try to turn wheel. <p>CAUTION: Do not leave ignition on for more than 30 seconds with the jumper installed.</p> <ul style="list-style-type: none"> ● Does wheel turn now? 	Yes No	VALVE is OK. GO to Drive Test — Code 16, Step DT1.1. REPLACE valve block.
M4	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> ● Clear all codes. ● Key OFF. ● Retrieve code. ● Is Code 16 set? 	Yes No, code being serviced still exists No, different code is set	STOP. Concern has been corrected. GO to next pinpoint step. GO to appropriate pinpoint test.

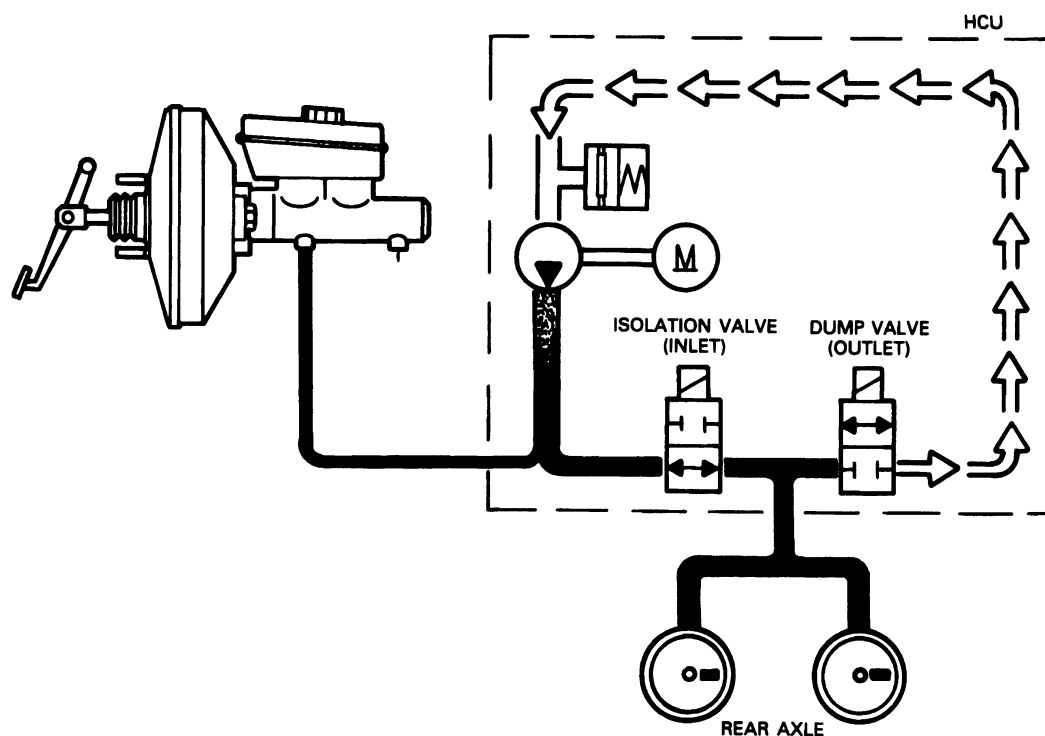
TH8775A

Pinpoint Test N — Code 53**Possible Code(s)**

53 — Hydraulically inoperative rear axle outlet valve, pinched or closed brake line or hose, worn or clogged valve.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s)/Electrical Component(s)



H8867-A

Description

Code 53 is generated by the ECU's detection of a hydraulically inoperative rear axle outlet valve.

Possible Contributing Component/Vehicle Wiring Concerns

- Pinched or closed brake line or hose
- Worn or clogged rear axle outlet valve

HYDRAULICALLY INOPERATIVE REAR AXLE OUTLET VALVE OR SENSOR DISTURBANCE DETECTED DIAGNOSIS — TEST N

TEST STEP		RESULT	ACTION TO TAKE
N1	CHECK BRAKE LINES		
	<ul style="list-style-type: none"> ● Visually inspect brake lines from valve block to rear wheel. ● Are lines damaged? 	Yes No	REPAIR / REPLACE lines. GO to N2.
N2	SERVICE CODE 53: CHECK REAR AXLE OUTLET VALVE		
	<ul style="list-style-type: none"> ● Key OFF. ● Install pinout box. ● Jumper pinout box Pins 19, 27, 33, and 60 together. ● Raise vehicle so rear wheels are just off the ground. ● Press hard on the brake pedal and have an assistant try to turn a rear wheel. ● Does the wheel turn or the pedal drop slowly? <p>NOTE: This condition is similar to the master cylinder bypass condition. It is important that the pedal be quickly and forcefully applied to rule out master cylinder bypass as the cause if a hydraulic leak is detected. Typically, master cylinder bypass only occurs at low line pressures.</p>	Yes No	REPLACE HCU. BLEED - Brake System. GO to N4. GO to N3.

DIAGNOSIS AND TESTING (Continued)

HYDRAULICALLY INOPERATIVE REAR AXLE OUTLET VALVE OR SENSOR DISTURBANCE DETECTED DIAGNOSIS —
TEST N (Continued)

TEST STEP		RESULT	ACTION TO TAKE
N3	CHECK REAR AXLE OUTLET VALVE OPERATION		
	<ul style="list-style-type: none"> ● Apply brake pedal force, turn ignition on and have assistant try to turn wheel. <p>CAUTION: Do not leave ignition on for more than 30 seconds with the jumper installed.</p> <ul style="list-style-type: none"> ● Does wheel turn now? 	<p>Yes</p> <p>No</p>	<p>▶ Valve is OK. GO to Drive Test — Code 16, Step DT 1.1.</p> <p>▶ REPLACE valve block.</p>
N4	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> ● Clear all codes. ● Key OFF. ● Retrieve code. ● Is Code 16 set? 	<p>Yes</p> <p>No, code being serviced still exists</p> <p>No, different code is set</p>	<p>▶ STOP. Concern has been corrected.</p> <p>▶ GO to next pinpoint step.</p> <p>▶ GO to appropriate pinpoint test.</p>

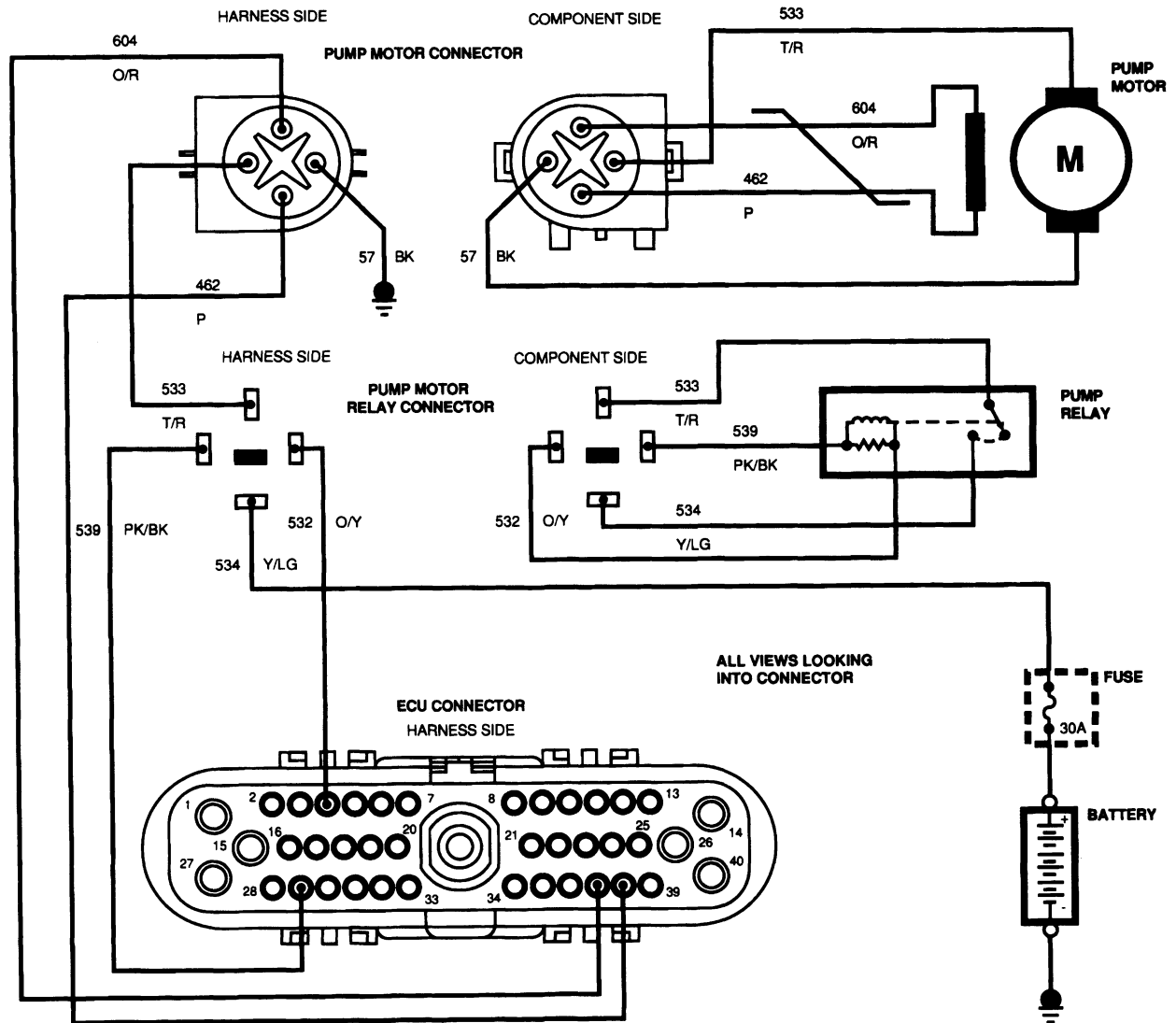
TH8776A

Pinpoint Test P — Code 63**Possible Code(s)**

63 — Open or intermittent connection to relay pump motor, damaged relay coil or contacts, damaged pump motor.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s) / Electrical Component(s)

**Description**

Code 63 is generated by the ECU when the pump motor is triggered but does not run.

Possible Contributing Component/Vehicle Wiring Concerns

- Damaged pump motor.
- Terminal backout in ECU harness connector Pins 17 and 29, 37 and 38

- Open or shorted pump motor relay coil
- Open contacts in pump motor relay
- Terminal backout in pump motor 4-way, Pins 1, 2, 3 or 4.

DIAGNOSIS AND TESTING (Continued)**MOTOR TRIGGERED BUT DID NOT RUN (CODE 63) — TEST P**

TEST STEP		RESULT	ACTION TO TAKE
P1	VISUAL INSPECTION AND EQUIPMENT HOOK-UP		
	<ul style="list-style-type: none"> ● Make sure the battery is OK. Refer to Section 14-01. ● Inspect ECU pins, 30 amp fuse, battery and ground connections, relay connections and pump motor connections. ● Remove ECU, install breakout box and verify ground. ● Jumper Pins 60 and 19 together. ● Key ON (energize system relay). ● Jumper Pins 60 and 29 together (energize pump motor relay). ● Is pump motor running? 	Yes No	GO to P8 . GO to P2 .
P2	VOLTAGE CHECK, PINS 1 AND 4		
	<ul style="list-style-type: none"> ● Disconnect 4-pin pump motor connector. ● Measure voltage between Pins 1 and 4. ● Is there at least 8 volts? 	Yes No	REPLACE HCU. GO to P11. GO to P3 .
P3	CHECK PIN 1 GROUND		
	<ul style="list-style-type: none"> ● Check for continuity between Pin 1 and a known good chassis ground. ● Is there continuity? 	Yes No	GO to P4. REPAIR open in Circuit 57 (BK). GO to P11.
P4	CONTINUITY CHECK, CIRCUIT 533 (T/R)		
	<ul style="list-style-type: none"> ● Key OFF. ● Disconnect pump motor relay. ● Check continuity on Circuit 533 (T/R). ● Is there continuity? 	Yes No	GO to P5 . REPAIR open in Circuit 532 (O/Y). GO to P11.
P5	CONTINUITY CHECK, PUMP MOTOR RELAY TO SYSTEM RELAY		
	<ul style="list-style-type: none"> ● Remove system relay. ● Check continuity between pump motor relay Circuit 532 (O/Y) and system relay Circuit 533 (T/R). ● Is there continuity? 	Yes No	GO to P6 . REPAIR Circuit 532 (O/Y). GO to P11.
P6	CONTINUITY CHECK, PUMP MOTOR RELAY CIRCUIT 534 (Y/LG)		
	<ul style="list-style-type: none"> ● Check continuity from pump motor relay Circuit 534 (Y/LG) to battery connection point. ● Is there continuity? 	Yes No	GO to P7 . REPAIR open in Circuit 534 (Y/LG) or REPLACE 30A fuse. GO to P11.
P7	CONTINUITY CHECK, PUMP MOTOR RELAY CIRCUIT 539 (PK/BK)		
	<ul style="list-style-type: none"> ● Check continuity from pump motor relay Circuit 539 (PK/BK) to breakout box Pin 29. ● Is there continuity? 	Yes No	REPLACE pump motor relay. GO to P11. REPAIR open in Circuit 539 (PK/BK). GO to P11.
P8	CHECK MOTOR SPEED SENSOR RESISTANCE		
	<ul style="list-style-type: none"> ● Key OFF. ● Connect digital volt-ohmmeter to pinout box Pins 37 and 38 and measure resistance. ● Is resistance between 5-40 ohms? 	Yes No	GO to P9 . REPLACE HCU. BLEED brake system. GO to P11.
P9	CHECK MOTOR SPEED SENSOR OUTPUT		
	<ul style="list-style-type: none"> ● Switch Rotunda Hand-Held Automotive Meter 105-00053, or equivalent, to frequency (Hz). ● Key ON. ● Measure motor speed sensor output. ● Is output between 70-150 Hz? 	Yes No	GO to P11. REPLACE HCU. BLEED brake system. GO to P11.

DIAGNOSIS AND TESTING (Continued)

MOTOR TRIGGERED BUT DID NOT RUN (CODE 63) — TEST P (Continued)

TEST STEP		RESULT	ACTION TO TAKE
P10	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 		Yes	▶ REPLACE ECU. GO to P11.
		No	▶ GO to last diagnostic step completed and continue.
P11	VERIFY CONDITION RESOLVED		
<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 		Yes	▶ STOP. Concern has been corrected.
		No, Code 63 still exists	▶ GO to next pinpoint step.
		No, different code is set	▶ GO to appropriate pinpoint test.
		No, Code 63 still exists and Step P9 is complete	▶ GO to P12.
P12	VERIFY INTEGRITY OF VEHICLE WIRING		
<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 		Yes	▶ STOP. Repair is complete.
		No	▶ GO to P10.

TH8857A

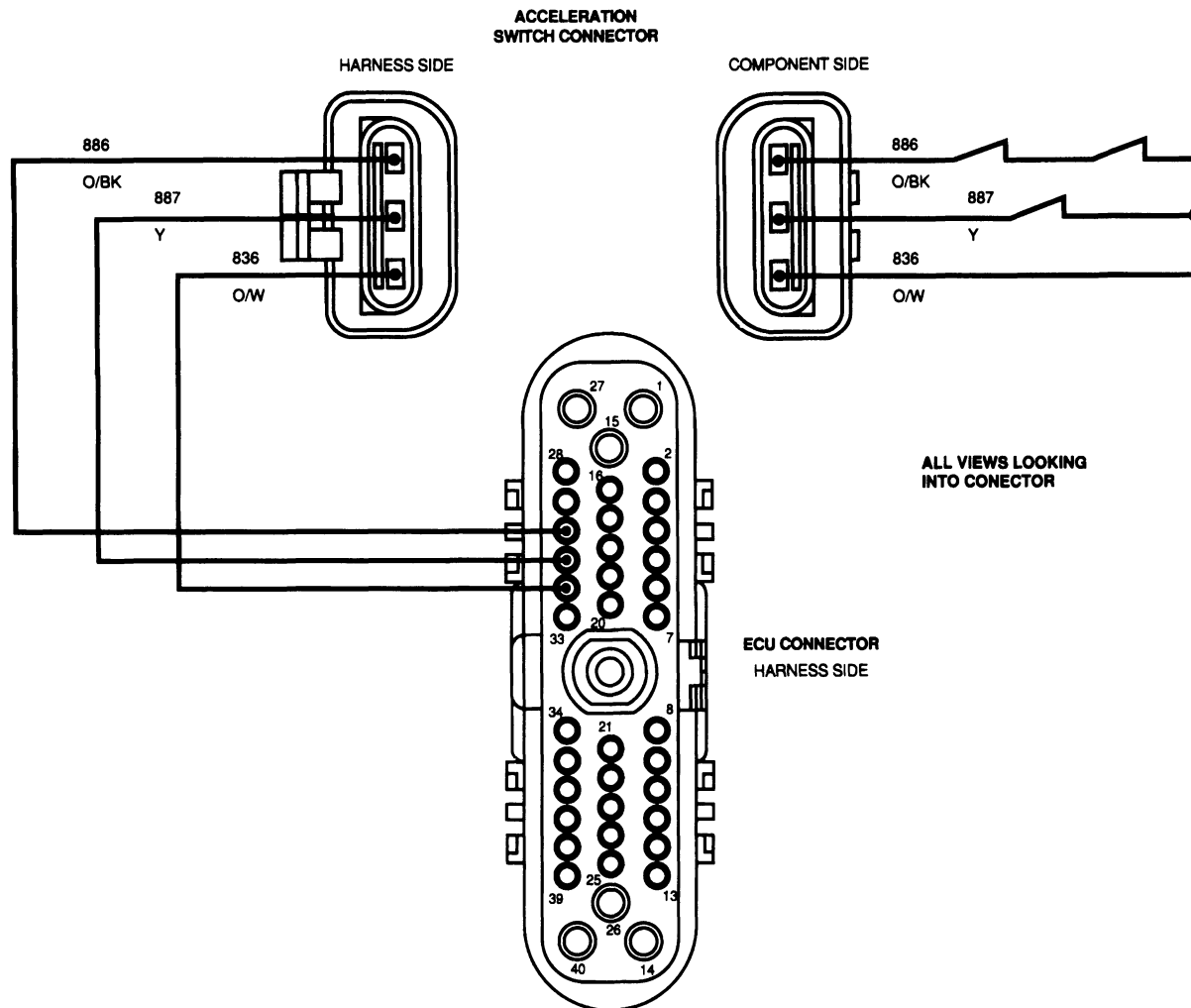
Pinpoint Test Q — Code 65

Possible Code(s)

65 — Intermittent or open connection between ECU and acceleration switch, damaged acceleration switch or circuit in ECU.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s) / Electrical Component(s)



H8850-A

Description

Code 65 is generated by the ECU's detection of an open circuit between the ECU and the acceleration switch and by a failed acceleration switch or internal ECU damage.

Possible Contributing Component/Vehicle Wiring Concerns

- Terminal backout in ECU wiring harness connector Pins 30, 31 and 32.

- Worn or damaged acceleration switch.
- Worn or damaged ECU.
- Acceleration switch terminal backout, Pins 1, 2 and 3.
- Short to ground in Circuits 836 (O/W), 886 (O/BK) and 887 (Y).

DIAGNOSIS AND TESTING (Continued)

ACCELERATION SENSOR (CODE 65) — TEST Q

TEST STEP		RESULT	ACTION TO TAKE
Q1	RESISTANCE CHECK, SENSOR RAISED 38MM (1.5 IN)		
	<ul style="list-style-type: none"> Disconnect acceleration sensor harness connector. Remove the acceleration sensor from vehicle. Check for water or terminal corrosion. Service as necessary. Place acceleration sensor on a level surface and raise the front of the sensor 38mm (1.5 in). Measure the resistance between Circuits 836 (O/W) and 886 (O/BK). Is the resistance greater than 5 ohms (open circuit)? 	Yes No	GO to Q2 . REPLACE the sensor. GO to Q12 .
Q2	RESISTANCE CHECK, SENSOR RAISED 25.4MM (1.0 IN)		
	<ul style="list-style-type: none"> Place acceleration sensor on a level surface and raise the front of the sensor 25.4mm (1.0 in). Measure the resistance between Circuits 836 (O/W) and 887 (Y). Is the resistance greater than 5 ohms (open circuit)? 	Yes No	Acceleration switch OK. GO to Q3 . REPLACE the sensor. GO to Q12 .
Q3	RESISTANCE CHECK ECU PIN 32 AND ACCELERATION SENSOR PIN 1		
	<ul style="list-style-type: none"> Disconnect ECU. Disconnect acceleration sensor. Measure resistance between ECU Pin 32 and acceleration sensor Pin 1. Is resistance less than 5 ohms? 	Yes No	GO to Q4 . REPAIR Circuit 836 (O/W) between ECU and acceleration sensor. GO to Q12 .
Q4	RESISTANCE CHECK ECU PIN 31 AND ACCELERATION SENSOR PIN 2		
	<ul style="list-style-type: none"> Measure resistance between ECU Pin 31 and acceleration sensor Pin 2. Is resistance less than 5 ohms? 	Yes No	GO to Q5 . REPAIR Circuit 887 (Y) between ECU and acceleration sensor. GO to Q12 .
Q5	RESISTANCE CHECK ECU PIN 30 AND ACCELERATION SENSOR PIN 3		
	<ul style="list-style-type: none"> Measure resistance between ECU Pin 30 and acceleration sensor Pin 3. Is resistance less than 5 ohms? 	Yes No	RECONNECT acceleration switch. GO to Q6 . REPAIR Circuit 886 (O/BK) between ECU and acceleration sensor. GO to Q12 .
Q6	RESISTANCE CHECK, ECU PIN 32 TO GROUND		
	<ul style="list-style-type: none"> Measure resistance between ECU Pin 32 and ground. Is resistance greater than 5 ohms? 	Yes No	GO to Q7 . REPAIR Circuit 836 (O/W) between ECU and acceleration sensor. GO to Q12 .
Q7	RESISTANCE CHECK, ECU PIN 31 TO GROUND		
	<ul style="list-style-type: none"> Measure resistance between ECU Pin 31 and ground. Is resistance greater than 5 ohms? 	Yes No	GO to Q8 . REPAIR Circuit 887 (Y) between ECU and acceleration sensor. GO to Q12 .
Q8	RESISTANCE CHECK, ECU PIN 30 TO GROUND		
	<ul style="list-style-type: none"> Measure resistance between ECU Pin 30 and ground. Is resistance greater than 5 ohms? 	Yes No	GO to Q9 . REPAIR Circuit 886 (O/BK) between ECU and acceleration sensor. GO to Q12 .

DIAGNOSIS AND TESTING (Continued)

ACCELERATION SENSOR (CODE 65) — TEST Q (Continued)

TEST STEP		RESULT	ACTION TO TAKE
Q9	LEVEL SURFACE RESISTANCE CHECK, CIRCUITS 836 (O/W) AND 886 (O/BK)		
	<ul style="list-style-type: none"> Remove acceleration sensor from vehicle. Place sensor on a level surface. Measure the resistance between Circuits 836 (O/W) and 886 (O/BK). Is the resistance less than 5 ohms? 	Yes No	GO to Q10 . REPLACE acceleration sensor. GO to Q12 .
Q10	LEVEL SURFACE RESISTANCE CHECK, CIRCUITS 836 (O/W) AND 887 (Y)		
	<ul style="list-style-type: none"> Measure the resistance between Circuits 836 (O/W) and 887 (Y). Is the resistance less than 5 ohms? 	Yes No	REPLACE the acceleration sensor. GO to Q12 . GO to Q12 .
Q11	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 	Yes No	REPLACE acceleration sensor. GO to Q12 . If no resolution, REPLACE ECU. GO to Q12 . GO to last diagnostic step completed and continue.
Q12	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is Code 16 set? 	Yes No, Code 65 still exists No, different code is set No, Code 65 still exists and Step Q10 is complete	STOP. Concern has been corrected. GO to next pinpoint step. GO to appropriate pinpoint test. GO to Q13 .
Q13	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 	Yes No	STOP. Repair is complete. GO to Q11 .

TH8858A

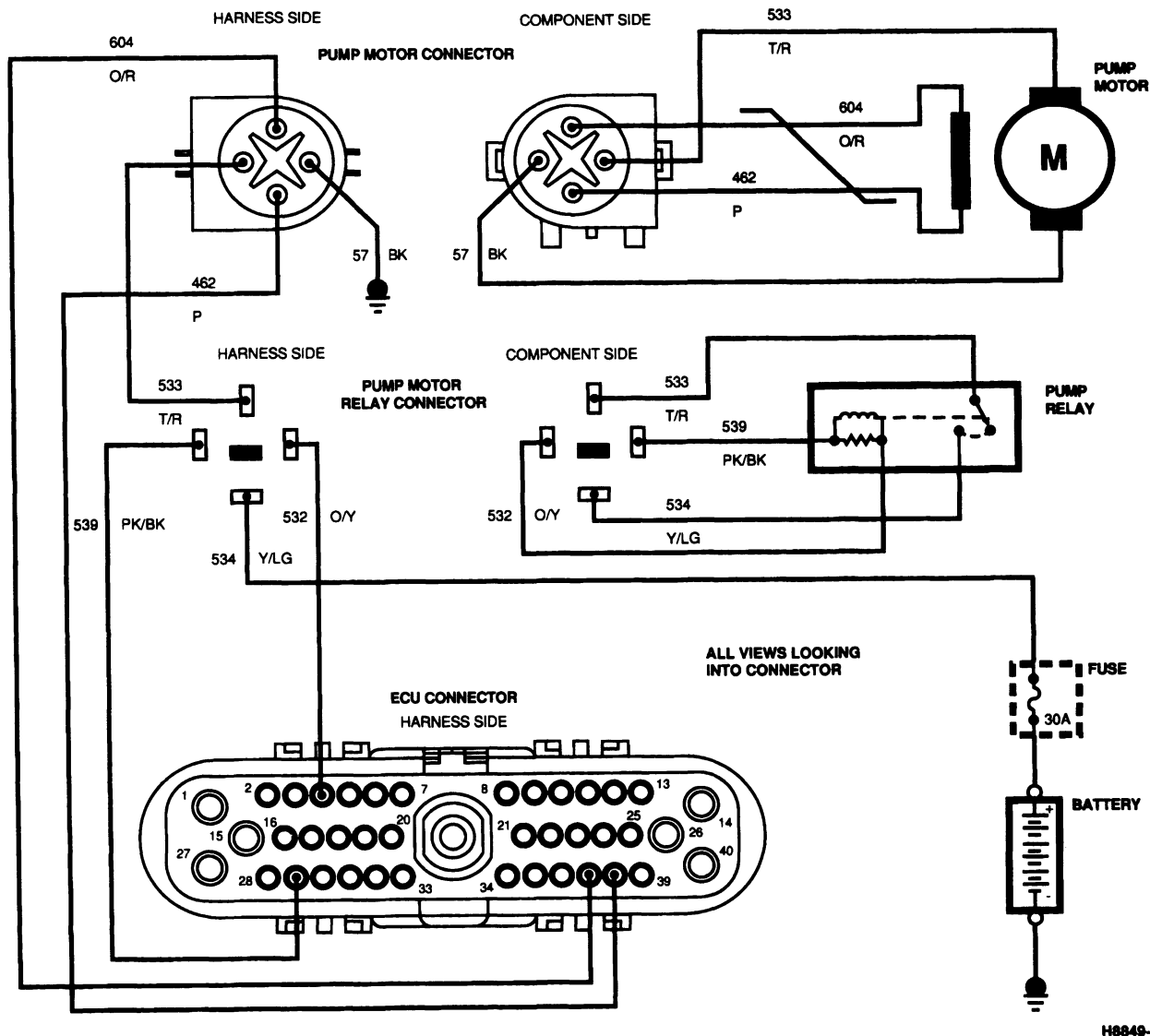
Pinpoint Test R — Code 67

Possible Code(s)

67 — Intermittent or open connection on ECU connector and/or motor speed sensor, damaged motor speed sensor or trigger circuit in ECU.

DIAGNOSIS AND TESTING (Continued)

Affected Circuit(s) / Electrical Component(s)



H6849-A

Description

Code 67 is generated by the ECU when the pump motor is running but is not triggered.

Possible Contributing Component/Vehicle Wiring Concerns

- Damaged motor speed sensor.
- Damaged trigger circuit in ECU.
- Terminal backout in ECU harness connector Pins 2 and 3.

MOTOR RUNNING BUT NOT TRIGGERED (CODE 67) — TEST R

TEST STEP		RESULT	ACTION TO TAKE
R1	MOTOR CHECK, KEY OFF		
	<ul style="list-style-type: none"> ● Make sure the battery is OK. Refer to Section 14-01. ● Key OFF. ● Is the motor running? 	Yes	REPLACE motor relay. GO to R4.
		No	GO to R2.

DIAGNOSIS AND TESTING (Continued)

MOTOR RUNNING BUT NOT TRIGGERED (CODE 67) — TEST R (Continued)

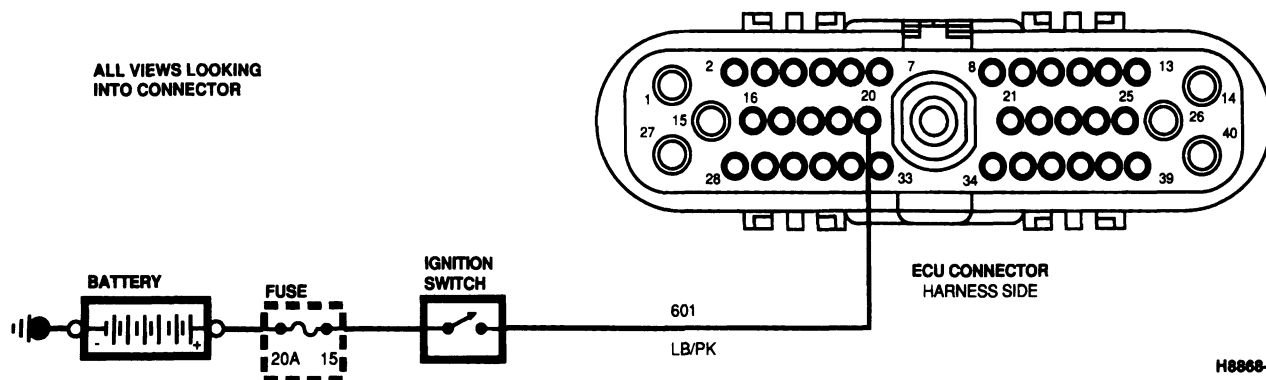
TEST STEP		RESULT	ACTION TO TAKE
R2	CHECK CIRCUIT 539 (PK/LB)		
	<ul style="list-style-type: none"> Remove ECU, install breakout box and verify Pin 60 is ground. Key ON. Jumper Pins 60 and 19 to energize main relay. Is motor running? 	Yes	REPAIR short to ground in Circuit 539 (PK/LB). GO to R4.
		No	GO to R4.
R3	CHECK IF ALL STEPS HAVE BEEN COMPLETED		
	<ul style="list-style-type: none"> This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified. <p>CAUTION: If the above is not complete, changes are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.</p> <ul style="list-style-type: none"> Have all prior diagnostic steps been completed as described above? 	Yes	REPLACE ECU. GO to R4.
		No	GO to last diagnostic step completed and continue.
R4	VERIFY CONDITION RESOLVED		
	<ul style="list-style-type: none"> Clear all codes. Key OFF. Retrieve code. Is code 16 set? 	Yes	STOP. Concern has been corrected.
		No, Code 67 still exists	GO to next pinpoint step.
		No, different code is set	Go to appropriate pinpoint test.
		No, Code 67 still exists and Step R2 is complete	GO to R5.
R5	VERIFY INTEGRITY OF VEHICLE WIRING		
	<p>NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.</p> <ul style="list-style-type: none"> Refer to the Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic. Does wiring check OK? 	Yes	STOP. Repair is complete.
		No	GO to R3.

TH8859A

Pinpoint Test S — No Code

Hard Light — No Code

Affected Circuit(s)/Electrical Components



DIAGNOSIS AND TESTING (Continued)**Description**

If no vehicle battery voltage is available to the ECU, or the voltage available is less than 8 volts, the ECU cannot initialize. As a result, the system relay cannot be energized and the ABS warning light remains on. No diagnostics are possible; no codes can be read.

Possible Contributing Base Brake Component / Vehicle Wiring Concerns

- Worn or damaged ignition switch
- Open ignition feed circuit to ECU
- Low battery voltage (less than 8V)
- Blown ignition fuse
- Open system ground

NO CODE — TEST S

TEST STEP		RESULT	ACTION TO TAKE
S1	INSTALL PINOUT BOX		
	<ul style="list-style-type: none"> ● Install pinout box. ● Open power network box and locate ignition fuse 15 (20A). ● Check fuse for continuity. ● Verify both fuse terminals in the power network box are clean and secure. ● Is there continuity and are terminals clean and secure? 	Yes No	REINSTALL fuse. GO to S2 . REPLACE fuse or SERVICE terminal as appropriate. GO to PC3 .
S2	VERIFY ECU GROUND		
	<ul style="list-style-type: none"> ● Key OFF. ● Inspect ground eyelet at left radiator support for excessive dirt, corrosion, or looseness. Clean and tighten as necessary. ● Check for continuity between Pin 60 and the ground stud at left radiator support. ● Check for continuity between Pin 14 and the ground stud at left radiator support. ● Is there continuity at both pins? 	Yes No	GO to S3 . SERVICE open circuit in ground between ECU harness connector and ground stud. GO to PC3 .
S3	VERIFY PROPER IGNITION VOLTAGE AT ECU HARNESS CONNECTOR		
	<ul style="list-style-type: none"> ● Key ON. ● Measure voltage between Pins 20 and 60. ● Is there at least 8 volts? 	Yes No, there is voltage greater than 0 volts but less than 8 volts No, there is 0 volts	REPLACE ECU. GO TO PC3 . ECU cannot initialize due to insufficient ignition voltage. Problem is NOT in ABS system. REFER to Section 14-00. SERVICE open circuit between ignition and ECU harness connector in 601 (LB/PK). GO to PC3 .

TH8860A

Drive Test**Purpose**

This drive test will be used when either of two conditions exists.

1. Required Repair Verification — This drive procedure will be used after all vehicle repairs. Once a vehicle has been repaired it is necessary to verify the repair by driving the vehicle. This is because the ABS module is unable to detect some system concerns until the vehicle is being driven a certain way. Therefore the drive verification test is a very important step.

2. Symptom Evaluation Drive — When a vehicle is brought to the dealer, the customer may only have a general concern about the way the vehicle is braking. In these situations there may not be a clear system concern to troubleshoot. This drive test is designed to produce common system concern symptoms. Use this drive test to determine a symptom. Once a symptom is found, a symptom troubleshooting procedure can be followed to repair the vehicle.

Drive Description

This is designed to be a generic drive test that is used for three purposes listed below.

1. To verify a repair of the ABS system on a vehicle.

DIAGNOSIS AND TESTING (Continued)

2. To attempt to recreate an intermittent concern.

3. To attempt to detect a symptom when a diagnostic trouble code or a concern symptom is not known.

DRIVE TEST — CODE 16

TEST STEP		RESULT	ACTION TO TAKE
DT1.1	LOW SPEED ABS STOP		
NOTE: Wetting down the area where stop is to be performed will aid this test. <ul style="list-style-type: none"> ● Drive vehicle at approximately 10 mph. ● Press on brake pedal hard enough to lock all four wheels. ● Does one wheel lock consistently? NOTE: Momentary lock up is permissible. NOTE: An assistant should be used to monitor the wheels during the ABS stop.		Yes, and ABS light is not on Yes, and ABS light comes on and stays on No, but other symptoms are detected No, and ABS light is not on	GO to Symptom B, Wheel Lock-Up. GO to DT1.7. GO to DT1.6. GO to DT1.2.
DT1.2	CHECK FOR UNWARRANTED ABS ACTIVITY		
<ul style="list-style-type: none"> ● Drive vehicle at approximately 20 mph. ● Perform a light to medium (normal traffic) stop. ● Turn off the windshield wipers if they are on. Feel for pulsation in the brake pedal. ● Does the pump motor turn on and are brake pedal pulsations felt any time during the stop? NOTE: In this event, the vehicle may pull as soon as the pump motor begins to run. If the vehicle does pull when the pump motor turns on, the front sensor opposite the pull should be checked using the UNWARRANTED ABS ACTIVITY Symptom, Sensor. If the pump motor turns on and no pull is felt, the rear sensor should be checked using the UNWARRANTED ABS ACTIVITY Symptom, Sensor. If a vehicle pulls immediately upon braking and the pump motor does not run, use the VEHICLE PULLS WHILE BRAKING Symptom to diagnose the concern.		Yes, and ABS light is not on Yes, and ABS light comes on and stays on No, but other symptoms are detected No, and ABS light is not on	GO to Symptom A, Unwarranted ABS Activity. GO to DT1.7. GO to DT1.6. GO to DT1.3.
DT1.3	CHECK FOR marginally HIGH SENSOR GAP		
<ul style="list-style-type: none"> ● Clear all codes. ● Key OFF. ● Start vehicle and select Drive Low (Automatic) or 1st forward gear (Manual). ● Allow vehicle to creep forward at idle for at least 45 seconds. ● Does the ABS warning light come on? 		Yes No	GO to DT1.8. GO to DT1.4.
DT1.4	CHECK FOR marginally HIGH SENSOR GAP		
<ul style="list-style-type: none"> ● Clear all codes. ● Key OFF. ● Start vehicle and accelerate slowly to 25 mph. Let at least 45 seconds elapse before reaching 25 mph. ● Does the ABS warning light come on? 		Yes No	GO to DT1.8. GO to DT1.5.
DT1.5	DETERMINE DRIVE TEST IS COMPLETE		
<ul style="list-style-type: none"> ● Has customer concern been addressed and corrected by previous actions? 		Yes No	STOP. Vehicle RABS function has been verified. REFER to Symptom Chart.

DIAGNOSIS AND TESTING (Continued)

DRIVE TEST — CODE 16 (Continued)			
TEST STEP		RESULT	ACTION TO TAKE
DT1.6	DETERMINE NEXT DIAGNOSTIC STEP BASED ON BRAKE SYMPTOM		
	<ul style="list-style-type: none"> Are any of the following symptoms present? <ul style="list-style-type: none"> Hard or soft brake pedal. Lack of sufficient vehicle deceleration upon brake application. Vehicle pulls during braking and pump motor does NOT run. 	Yes No	GO to Symptom Chart. Concern is NOT in the ABS system. REFER to Base Brake Section 06-00-10 for diagnosis.
DT1.7	OBTAIN DIAGNOSTIC TROUBLE CODE		
	<ul style="list-style-type: none"> Obtain ABS diagnostic trouble code. Is the diagnostic trouble code the same as before and the ENTIRE pinpoint test for the code completed? 	Yes No, pinpoint test is NOT complete No, code obtained is NOT the same No, no code or Code 16 is obtained	PERFORM intermittent diagnosis. RETURN to the last step completed in the pinpoint test. GO to the pinpoint for the code obtained. GO to System Pre-Check.
DT1.8	DETERMINE WHICH SENSOR SIGNAL IS INCORRECT		
	<ul style="list-style-type: none"> Obtain diagnostic trouble code. Is code obtained 31-33/35-37/41-43/55-57? 	Yes No, and Code 16 is not obtained No, no code or Code 16 is obtained	GO to DT1.9. GO to the pinpoint test for the code obtained. GO to System Pre-Check.
DT1.9	RESOLVE SENSOR SIGNAL CONCERN		
	<ul style="list-style-type: none"> For the code received, perform the following checks on the appropriate wheel end or rear axle (refer to Service Code Index). Check for metal chips or ferrous debris on the sensor pole piece or can. Verify that the gap between the sensor can or pole piece and speed sensor ring is less than 0.070 inch for the front sensors and less than 0.050 inch for the rear axle sensor. Inspect the speed sensor ring for damaged or missing teeth. FRONT SENSORS ONLY — Inspect the speed sensor ring for ferrous material built up between the teeth. Are any of the above conditions present? 	Yes, chips or ferrous debris on the sensor No, the gap is greater than specified Yes, speed sensor ring teeth are missing or damaged Yes, material is built up between the sensor ring teeth No, none of the above conditions are present	REMOVE debris from sensor. If rear axle sensor, DRAIN and CLEAN rear carrier. GO to DT1.3. GO to DT1.10. REPLACE speed sensor ring. GO to DT1.3. CLEAN speed sensor ring. GO to DT1.3. PERFORM intermittent diagnosis.
DT1.10	DETERMINE FRONT OR REAR SENSOR		
	<ul style="list-style-type: none"> Is the affected sensor a front wheel sensor or the rear axle sensor? 	Front Wheel Rear Axle	REPLACE sensor. Make sure mounting area is clean. GO to DT1.11.

DIAGNOSIS AND TESTING (Continued)

DRIVE TEST — CODE 16 (Continued)

TEST STEP		RESULT	ACTION TO TAKE
DT1.11	IMPROPER SENSOR GAP RESOLUTION		
REAR AXLE SENSOR ONLY		Yes	GO to DT1.3.
<ul style="list-style-type: none"> Remove speed sensor from the rear axle carrier bore. Clean axle housing and remove all debris from mounting area. Inspect the sensor mounting flange and clean as required. Install a new speed sensor O-ring onto the sensor. Reinstall the speed sensor. Make sure the sensor is fully seated in the bore and the hold-down bolt is torqued to specification. Measure the gap between the sensor and ring. Is the gap less than 0.050 inch? 		No	REPLACE rear axle.

TH8923A

SYMPTOM DIAGNOSTIC CHART

Symptom Description	Refer To
Unwarranted ABS Activity	Symptom A
Wheels Lockup	Symptom B
Hard / Soft Brake Pedal	Symptom C
Lack of Decel (Med / Hard Braking)	Symptom D
Vehicle Pulls During Braking	Symptom E

TH8924A

WARNING: PERFORM INDICATED PINPOINT TEST OR DRIVE TEST STEPS ONLY — DO NOT PERFORM OTHER STEPS (ALTHOUGH WITHIN THE TEST BOX, YOU MAY APPEAR TO BE DIRECTED TO DO SO). ALWAYS RETURN TO THE SYMPTOM CONDITION CHART IF NO RESOLUTION IS REACHED BY PERFORMING A PARTICULAR TEST.

NOTE: Ignore directions to CALL Hotline within pinpoint and drive tests until all Symptom options are exhausted.

SYMPTOM A: UNWARRANTED ABS ACTIVITY

CONDITION	POSSIBLE SOURCE	ACTION
Premature loss of sensor signal during vehicle deceleration.	<ul style="list-style-type: none"> Sensor signal is weak or erratic. 	<ul style="list-style-type: none"> Refer to Drive Test — Code 16, Step DT1.3.
Intermittent sensor signal to ECU during decel.	<ul style="list-style-type: none"> Intermittent open or shorted sensor circuit. Intermittent open sensor circuit at intermediate connections especially bulkhead. Chafed wire insulation or pinched wire due to improper routing causing intermittent short. 	<ul style="list-style-type: none"> Perform Intermittent Diagnosis for Circuits 514 (Y/R), 516 (Y/BK), 521 (T/O), 522 (T/BK), 519 (LG/BK), and 523 (R/PK). Perform Intermittent Diagnosis for Circuit 514 (Y/R), 516 (Y/BK), 521 (T/O), 522 (T/BK), 519 (LG/BK), and 523 (R/PK) at intermediate connectors. Inspect wiring harness from front sensor on knuckle to the frame and from the rear axle to the frame for worn or chafed wire insulation.
Maladjusted rear brakes or "grabby" brake shoe or pad linings	<ul style="list-style-type: none"> Rear brake adjustment too tight. Linings are "grabby". 	<ul style="list-style-type: none"> Refer to Section 06-00, Brake System Diagnosis. Refer to Section 06-00, Brake System Diagnosis.

TH8925A

DIAGNOSIS AND TESTING (Continued)**SYMPTOM B: WHEELS LOCK UP**

CONDITION	POSSIBLE SOURCE	ACTION
ABS valve failure.	<ul style="list-style-type: none"> Hydraulic outlet (dump) valve. 	<ul style="list-style-type: none"> Left front wheel — Refer to pinpoint test L, Step L2-L3 ONLY. Right front wheel — Refer to pinpoint test M, Step M2-M3 ONLY. Rear axle — Refer to pinpoint test N, Step N2-N3 ONLY.
Base brake mechanical concern.	<ul style="list-style-type: none"> Damp or contaminated rear brake shoe linings, stuck / leaking wheel cylinder, overadjusted rear brakes. Hung-up parking brake. Leaking rear axle seal. 	<ul style="list-style-type: none"> Refer to Section 06-00, Brake Diagnosis Chart. Refer to Section 06-05, Parking Brake Service. Refer to the appropriate section in Group 05.

TH8926A

SYMPTOM C: HARD OR SOFT BRAKE PEDAL

CONDITION	POSSIBLE SOURCE	ACTION
ABS valve inoperative (hard / soft).	<ul style="list-style-type: none"> Stuck shut inlet (isolation) valve (hard) or leaky outlet (dump) valve (soft). Leaky inlet (isolation) valve during ABS (soft). 	<ul style="list-style-type: none"> Left front wheel — Refer to pinpoint test L, Step L2-L3 ONLY. Right front wheel — Refer to pinpoint test M, Step M2-M3 ONLY. Rear axle — Refer to pinpoint test N, Step N2-N3 ONLY. Left front wheel — Refer to pinpoint test L, Step L2-L3 ONLY. Right front wheel — Refer to pinpoint test M, Step M2-M3 ONLY. Rear axle — Refer to pinpoint test N, Step N2-N3 ONLY.
Base brake hydraulic concern (soft).	<ul style="list-style-type: none"> Hydraulic leak in brake line or hose, fitting, master cylinder, wheel cylinder, or caliper. Air in brake system. 	<ul style="list-style-type: none"> Refer to Section 06-00, Brake System Diagnosis. Refer to Section 06-00, Brake System Bleed Procedure.
Base brake mechanical concern (hard).	<ul style="list-style-type: none"> Little or no vacuum boost. Stuck or inoperative wheel cylinder or caliper. Pinched or crimped brake line or hose. 	<ul style="list-style-type: none"> Refer to Section 06-00, Brake System Diagnosis.

TH8927A

SYMPTOM D: LACK OF DECELERATION DURING MEDIUM/HARD BRAKE APPLICATIONS

CONDITION	POSSIBLE SOURCE	ACTION
ABS valve inoperative.	<ul style="list-style-type: none"> Stuck shut inlet (isolation) valve or leaky outlet (dump) valve — rear axle ONLY. 	<ul style="list-style-type: none"> Rear axle — Refer to pinpoint test N, Step N2-N3 ONLY.
Base brake hydraulic concern.	<ul style="list-style-type: none"> Hydraulic leak in brake line or hose, fitting, master cylinder, wheel cylinder, or caliper. Air in brake system. 	<ul style="list-style-type: none"> Refer to Section 06-00, Brake System Diagnosis. Refer to Section 06-00, Brake System Bleed Procedure.

DIAGNOSIS AND TESTING (Continued)

SYMPTOM D: LACK OF DECELERATION DURING MEDIUM/HARD BRAKE APPLICATIONS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Base brake mechanical concern.	<ul style="list-style-type: none"> ● Little or no vacuum boost. ● Stuck or inoperative wheel cylinder or caliper. ● Pinched or crimped brake line or hose. ● Ineffective brake shoe or pad linings. 	<ul style="list-style-type: none"> ● Refer to Section 06-00, Brake System Diagnosis.

TH8928A

SYMPTOM E: VEHICLE PULLS DURING BRAKING

CONDITION	POSSIBLE SOURCE	ACTION
ABS valve inoperative. Vehicle pulls to the left.	<ul style="list-style-type: none"> ● Fully or partially blocked right front inlet (isolation) valve. 	<ul style="list-style-type: none"> ● Right front wheel — Refer to pinpoint test M, Step M2-M3 ONLY.
ABS valve inoperative. Vehicle pulls to the right.	<ul style="list-style-type: none"> ● Fully or partially blocked left front inlet (isolation) valve. 	<ul style="list-style-type: none"> ● Left front wheel — Refer to pinpoint test L, Step L2-L3 ONLY.
Base brake mechanical concern.	<ul style="list-style-type: none"> ● Improperly adjusted rear brake. ● Frozen or binding caliper (one side of vehicle). ● Uneven brake pad or shoe wear. 	<ul style="list-style-type: none"> ● Refer to Section 06-00, Brake System Diagnosis. ● Refer to Section 06-00, Brake System Diagnosis. ● Refer to Section 06-00, Brake System Diagnosis.
Base brake hydraulic concern.	<ul style="list-style-type: none"> ● Pinched or crimped brake line or hose. 	<ul style="list-style-type: none"> ● Refer to Section 06-00, Brake System Diagnosis.

TH8929A

REMOVAL AND INSTALLATION

Brake Booster Assembly

Removal and Installation

Refer to Section 06-06 for brake booster removal and installation procedures.

Master Cylinder

Removal and Installation

Refer to Section 06-06 for master cylinder removal and installation procedures.

Hydraulic Control Unit

Removal

1. Disconnect positive battery cable.
2. Disconnect 8-pin connector attaching HCU to wire harness, and disconnect 4-pin connector attaching pump motor to harness.
3. Remove two tubes from inlet ports and three tubes from outlet ports of HCU. Plug each port to prevent brake fluid from spilling on paint and wiring.

4. Remove three nuts retaining HCU assembly to mounting bracket and remove assembly from vehicle.

Installation

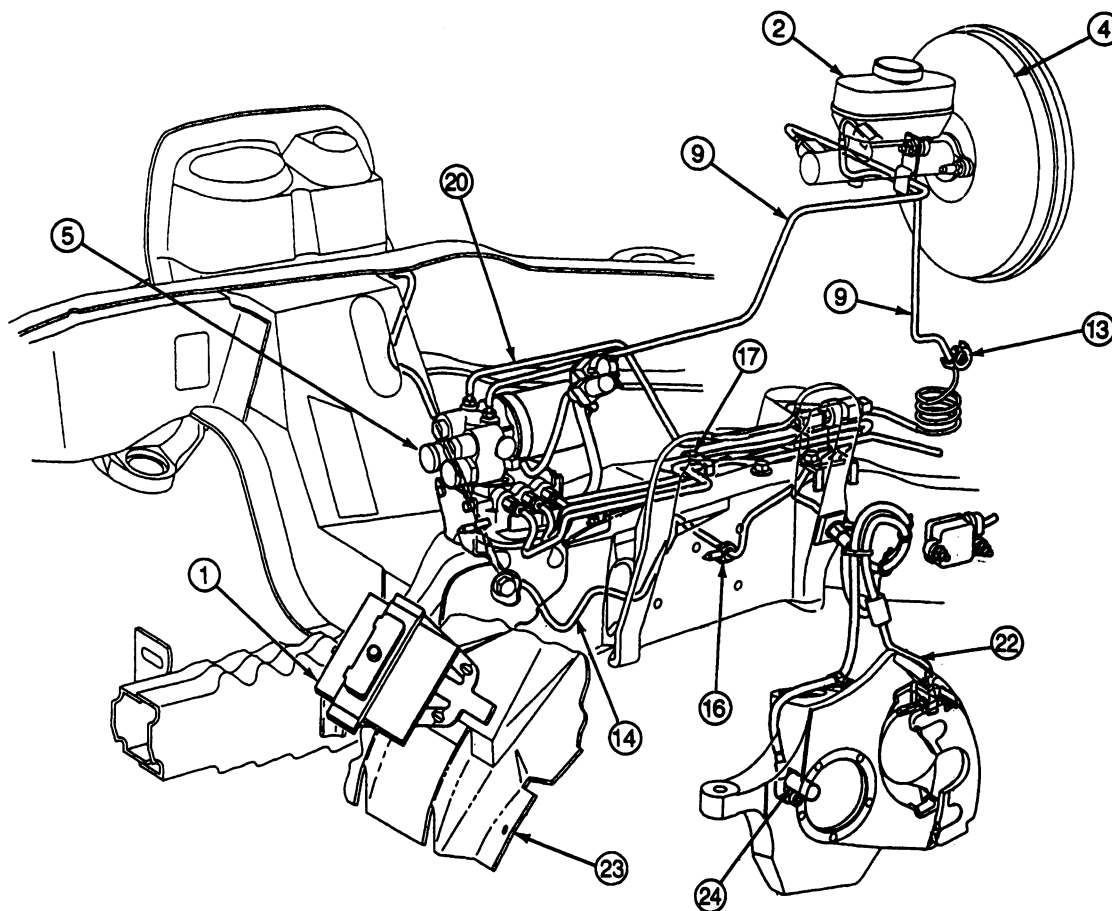
1. Insert HCU assembly into mounting bracket. Install three retaining nuts and tighten to 16-24 N·m (12-18 lb-ft).

CAUTION: Bronco HCU is not interchangeable with other units. Be sure to replace with correct part.

2. Connect three tubes to outlet ports on side of HCU and two tubes to inlet ports on front of HCU. Tighten tube fittings to 14-24 N·m (10-18 lb-ft).
3. Connect 8-pin connector and 4-pin connector to harness.
4. Connect positive battery cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

5. Bleed brake system as outlined. Check for fluid leaks.

REMOVAL AND INSTALLATION (Continued)**Hydraulic Control Unit**

H8784-A

Item	Part Number	Description
1	2C279	Electronic Control Unit (ECU)
2	—	Brake Fluid Reservoir
5	2C215	Hydraulic Control Unit (HCU)
9	2234	Tube
13	N806880	Clip

(Continued)

Item	Part Number	Description
14	2263	Tube
16	N806816	Clip
17	2250	Clip
20	2B112	Tube
22	2B557	Hose
23	—	Fender Apron
24	—	Wheel Speed Sensor

Electronic Control Unit**Removal**

1. Disconnect positive battery cable.
2. Locate ECU at left front fender apron. Disconnect 40-pin connector from ECU.
3. Remove screws retaining ECU to mounting bracket.
4. Gently slide ECU along bracket and remove ECU.

Installation

1. Insert rivet into large hole portion of teardrop. Gently slide ECU along bracket to engage rivet.

2. Install retaining screw and tighten to 7-9 N·m (5.2-6.6 ft-lb).
3. Connect 40-pin connector and tighten bolt to 5.2-7.2 N·m (3.9-5.3 ft-lb).
4. Connect positive battery cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

REMOVAL AND INSTALLATION (Continued)**Wheel Speed Sensor, Front****Removal**

1. From inside engine compartment, disconnect sensor assembly two-pin connector from wiring harness.
2. Separate sensor cable from brake hose clips.
3. Remove sensor retaining bolt from front spindle and slide sensor out of mating hole.

Installation

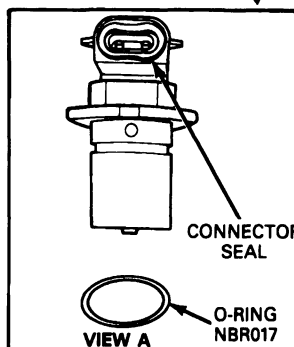
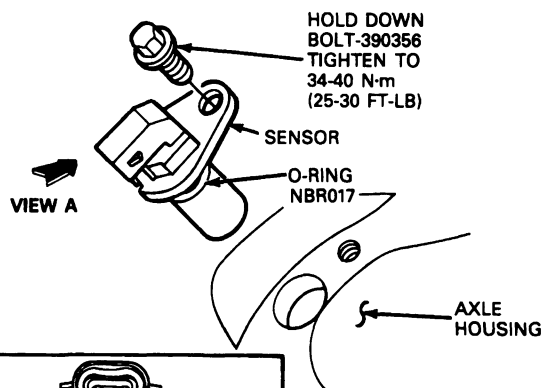
For installation, follow removal procedures in reverse order. Tighten retaining bolt to 4.5-6.8 N·m (40-60 lb-in).

Speed Sensor, Rear**Removal**

1. Pull the wiring harness connector from the sensor.
2. Remove the sensor hold down bolt and remove the sensor from the axle housing.

Installation

1. Clean the axle mounting surface. Use care to prevent dirt from entering the axle housing.
2. Inspect and clean the magnetized sensor pole piece to make sure that it is free from loose metal particles which could cause erratic system operation. Replace the sensor O-ring.
3. Lightly lubricate the sensor O-ring with motor oil, align the sensor bolt hole, and install. Do not apply force to the plastic sensor connector. The sensor flange should slide to the mounting surface. This will make sure the air gap setting is between 0.127-1.14mm (0.005-0.045 inches).
4. Install the hold down bolt and tighten to 34-40 N·m (25-30 ft-lb).
5. Push the connector on the sensor.



H6309-C

Speed Sensor Ring, Front**Removal**

1. Raise vehicle on hoist. Refer to Section 00-02.
2. Remove wheel and tire assembly.
3. Remove caliper, rotor and hub assemblies. Refer to Sections 04-01B and 06-03.
4. Using a 3-jaw puller, remove speed sensor ring from hub.

CAUTION: Discard old speed sensor ring. Do not reuse.

Installation

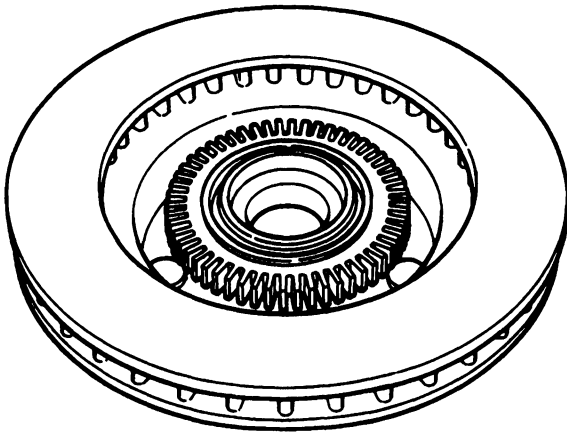
1. Support center of hub so that wheel studs do not rest on work surface.
2. Position new speed sensor ring on hub. Using a cylinder with 98mm (3.9 in) ID and 106mm (4.2 in) OD, press the ring on to the hub. The ring must be fully seated against the shoulder in the hub.

CAUTION: Make sure indicator ring is pressed on straight.

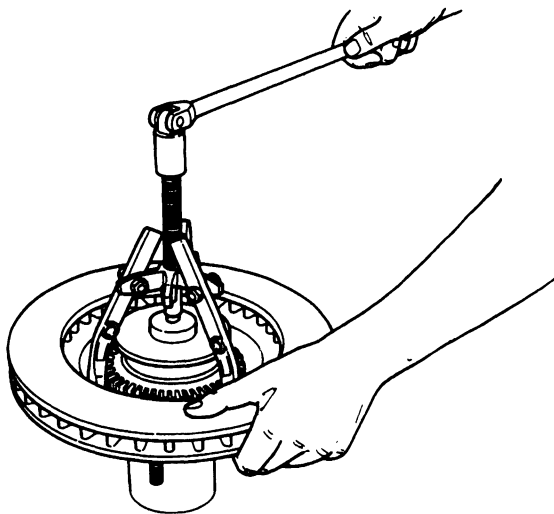
3. Install hub, rotor and caliper assemblies. Refer to Sections 04-01B and 06-03.

REMOVAL AND INSTALLATION (Continued)

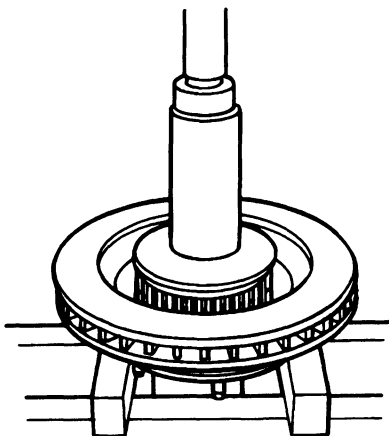
4. Install wheel and tire assembly. Tighten wheel lugnuts to 115-142 N·m (85-105 lb-ft).



H8932-A



H8933-A



H8934-A

Speed Sensor Ring, Rear**Inspection**

1. Remove the sensor as described above.
2. View the speed sensor ring teeth through the sensor hole. Rotate the rear axle and check the speed sensor ring teeth for damage or breakage. Dented or broken teeth could cause the ABS system to function when not required.

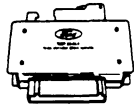

Removal

To service the speed sensor ring, the differential case must be removed from the axle housing, and the speed sensor ring pressed off the case. **UPON REMOVAL, THE SPEED SENSOR RING IS TO BE DISCARDED. IT IS NOT TO BE REUSED.** For service procedures, refer to the appropriate axle section in Group 05.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	Lb·Ft
Booster-to-Dash Panel Nut	18-34	13-25
Brake Tube-to-Master Cylinder Fitting	14-24	10-18
Master Cylinder-to-Booster Nut	18-34	13-25
Hydraulic Control Unit-to-Bracket Nut	16-24	12-18
Brake Tube Fitting	14-24	10-18
Electronic Control Unit Screw	4.5-6.8	40-60 (Lb-In)
Wheel Speed Sensor Bolt	4.5-6.8	40-60 (Lb-In)
Wheel Lug Nuts	115-142	85-105
Mounting Bracket Through Bolt	40-60	30-44
Mounting Bracket Bolt	16-27	12-20
Mounting Clip Retaining Bolt	16-27	12-20
Mounting Bracket Screw	17-27	14-19
Reservoir Screw	2-3	18-26 (Lb-In)
Radiator Screw	9-13	80-115 (Lb-In)
Bracket Nut	24-34	14-24

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number/ Description	Illustration
T90P-50-ALA Anti-Lock Brake Adapter (Bleeder Box)	 T90P-50-ALA
T93T-50-ALA Anti-Lock Brake Adapter (Jumper)	 T93T-50-ALA

ROTUNDA EQUIPMENT

Tool Number	Description
007-0041A	SUPER STAR II Tester
014-00322	EEC-IV 60-Pin Breakout Box
007-00001	Digital Volt Ohmmeter
105-00053	Hand-Held Automotive Meter

GROUP

STEERING

11

(3000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
STEERING COLUMN.....	11-04A-1	STEERING GEAR, POWER, FORD XR-50.....	11-02C-1
STEERING COLUMN, MOTORHOME AND COMMERCIAL CHASSIS.....	11-04B-1	STEERING, GENERAL.....	11-00-1
STEERING COLUMN SWITCHES.....	11-05-1	STEERING LINKAGE.....	11-03-1
STEERING GEAR, POWER, BENDIX, COMPACT C-300N.....	11-02B-1	STEERING PUMP, POWER, C-II.....	11-02A-1
		STEERING PUMP, POWER, SAGINAW.....	11-02D-1
		STEERING PUMP, POWER, ZF.....	11-02E-1

SECTION 11-00 Steering, General

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DIAGNOSIS AND TESTING (Cont'd.)	
Clear Vision Adjustment.....	11-00-18	E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco.....	11-00-5
CLEANING AND INSPECTION		F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles.....	11-00-6
Power Steering Gear.....	11-00-18	Power Steering Tests.....	11-00-5
Power Steering Pump, Ford C-II, Saginaw and ZF.....	11-00-19	Purging Power Steering System of Air.....	11-00-6
DESCRIPTION AND OPERATION		Vacuum Fill Process.....	11-00-7
Steering Gear Model Identification.....	11-00-1	SPECIAL SERVICE TOOLS / EQUIPMENT.....	11-00-22
DIAGNOSIS AND TESTING		SPECIFICATIONS.....	11-00-20
Diagnosis Guides.....	11-00-7	VEHICLE APPLICATION.....	11-00-1
Power Steering System Test.....	11-00-5		

VEHICLE APPLICATION

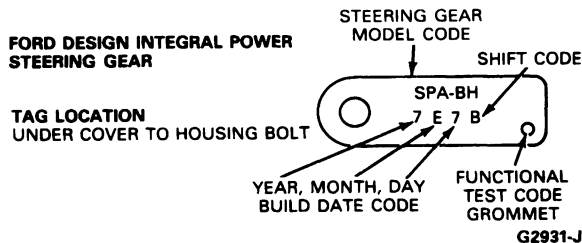
All E-150-250-350, F-150-250-350, Bronco and
F-Super Duty Series Vehicles

DESCRIPTION AND OPERATION

Steering Gear Model Identification

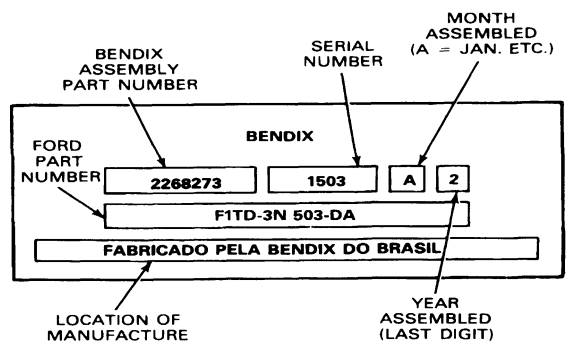
Steering gears are identified by a service identification tag fastened to the assembly. Tags contain information as shown in the illustrations. F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles use Bendix steering gears.

Steering Gear Identification, Ford



DESCRIPTION AND OPERATION (Continued)

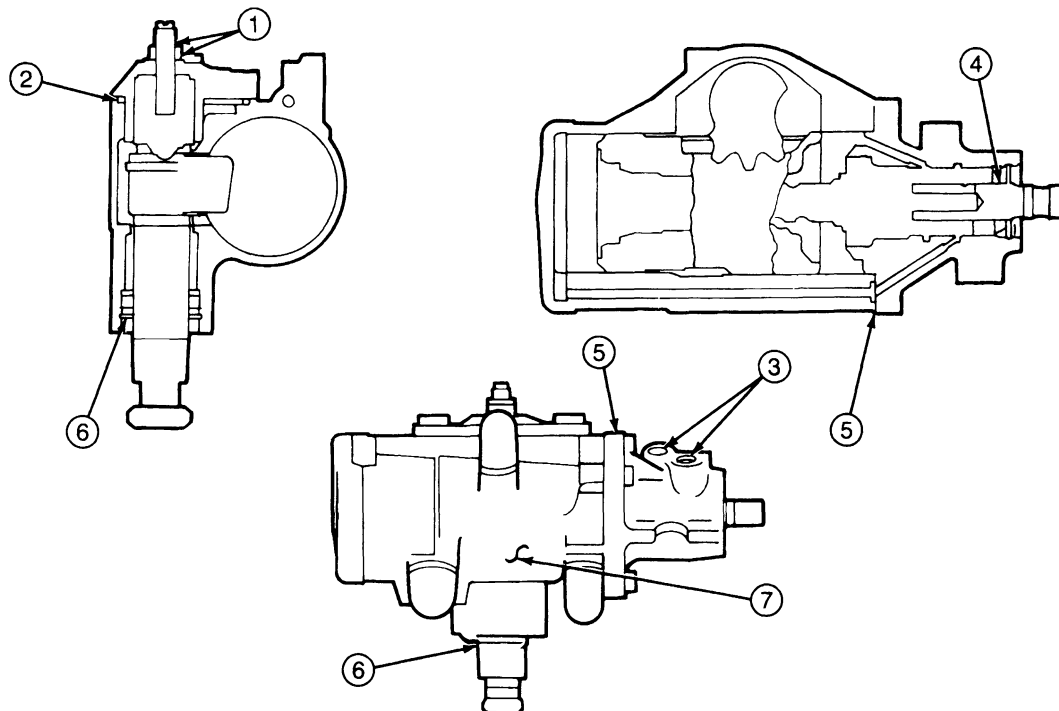
Steering Gear Identification, Bendix



G6280-D

DIAGNOSIS AND TESTING

Power Steering Gear Leak Inspection

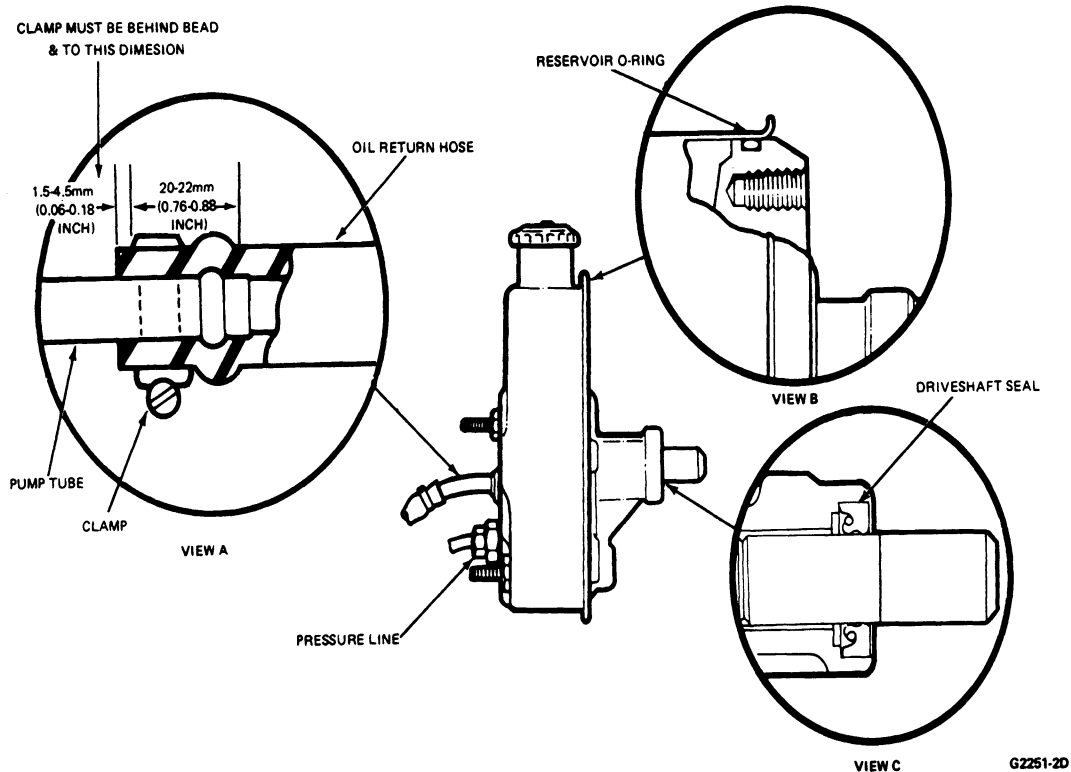


G4192-D

NOTE: For repair and replacement procedure in the following Diagnostic and Testing Chart, refer to Section 11-02C.

DIAGNOSIS AND TESTING (Continued)

Leak Category	Part Required to Service
1. Sector adjuster	Tighten locknut to 48-61 N-m (35-45 ft-lb). Replace nut if leakage continues. Check the cover surface for damage.
2. Sector shaft cover	Tighten bolts to 75-94 N-m (50-70 ft-lb). Replace seal. Examine cover and housing for damage when replacing seal.
3. Hose connections	Tighten fitting nuts to 30-40 N-m (22-30 ft-lb). If leakage continues, remove hose and clean interface area. If tube nut threads are damaged, replace hose. If tube seats are damaged, replace tube seat. If housing threads are badly stripped, replace the valve housing only.
4. Input shaft seals	Replace input shaft seals and snap ring. Check shaft surface for damage. Check housing seal bore for damage.
5. Control valve housing mounting face	Tighten control valve housing bolts to 42-62 N-m (30-45 ft-lb). If leak continues, replace O-ring. Examine sealing surface for damage.
6. Sector shaft seals and snap ring	Replace sector shaft seals. Check seal bore, shaft, and snap ring groove for damage. Check sector housing roller bearing for damage.
7. Gear housing casting	Replace gear housing.

Saginaw Pump**Reservoir and Pump Leakage Areas, Discharge Line, O-Ring and Driveshaft, Saginaw Power Steering Pump**

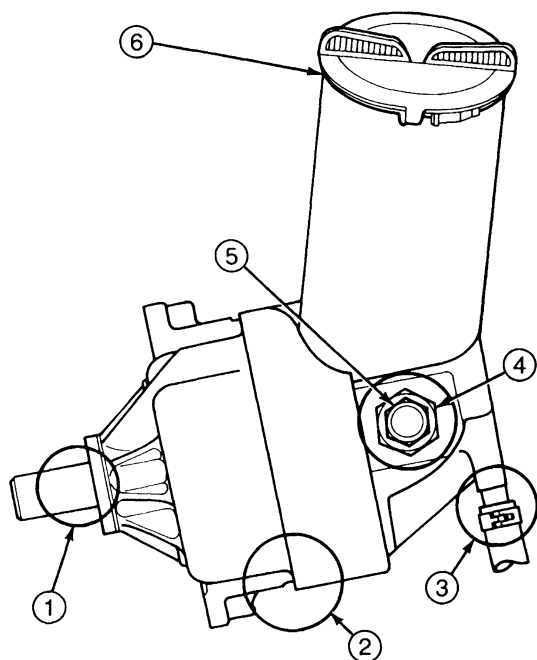
NOTE: For repair and replacement procedure in the following Diagnostic and Testing Chart, refer to Section 11-02D.

DIAGNOSIS AND TESTING (Continued)

Leak Category	Part Required for Service
Pressure hose fitting nut and hose tube	Tighten nut to 30-40 N-m (22-30 ft-lb). If leak persists, remove pump pressure line fitting, reface the hose tube flare, replace O-rings, or replace hose as required.
Pump pressure discharge fitting and pump body	Tighten fitting to 38 N-m (28 ft-lb). If leak persists, replace the O-ring seals.
Reservoir	Replace reservoir O-ring.
Pump driveshaft	Replace driveshaft seal.
Return hose and pump	Check location of clamp and reposition if required (as shown in illustration). Tighten or replace clamp. If leak persists, replace return hose.
Filler cap	Check oil level and correct as required. Tighten cap. If leak persists, replace cap.
Inlet line	Replace reservoir.

Filler Cap Fitting and Connection Leakage Areas, Ford C-II Pump

NOTE: For Repair and Replacement Procedures in the following Diagnostic and Testing Chart, refer to Section 11-02A.



G2933-D

Leak Category	Part Required for Service
1. Rotor shaft seal	Replace rotor shaft seal.
2. Reservoir O-ring seal	Replace O-ring seal.
3. Return hose	Reposition or replace return hose clamp.
4. Outlet fitting	Tighten outlet fitting 35-54 N-m (25-40 ft-lb). If leak continues: <ul style="list-style-type: none"> • replace O-ring seal • check for damaged threads (cross-threaded) • replace outlet fitting • check for stripped housing cover threads; replace pump housing cover

(Continued)

DIAGNOSIS AND TESTING (Continued)

Leak Category	Part Required for Service
5. Hose tube nut	<p>Tighten pressure hose tube nut to 41-54 N·m (30-40 ft-lb).</p> <p>CAUTION: Do not over-tighten.</p> <ul style="list-style-type: none"> ● If leak continues, remove tube nut and inspect Teflon® washer. Replace if required. <p>NOTE: Use of a tapered shaft may be required to stretch Teflon® washer to allow for installation onto tube nut.</p> <ul style="list-style-type: none"> ● If leak is due to pressure hose assembly O-ring, replace hose assembly.
6. Filler cap	<p>Check for damaged or missing reservoir cap or dipstick. Check oil level, and correct as required. If leak continues:</p> <ul style="list-style-type: none"> ● replace filler cap O-ring seal.

Power Steering Tests

The pump flow and pressure tests will confirm or rule out the pump as the cause of steering system problems.

Prior to performing the pump flow and pressure tests, perform the Preliminary Inspection and Leak Tests — Test A in this section.

If the system tests OK, or the concerns have been corrected, and the loss of assist still exists, test the power steering pump flow and pressure to determine whether the trouble is in the pump, power steering gear, or control valve using the following test equipment.

Test Equipment, E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco

1. Engine tachometer
2. Thermometer — -17°C to 140°C (0°F to 300°F).
3. One Power Steering Analyzer D79L-336 10-A or equivalent.
4. One set of adapter fittings.

1. System backpressure
2. Pump flow
3. Steering gear internal leakage
4. Power steering control valve and cylinder internal leakage

CAUTION: Possible contamination of the power steering system fluid may cause permanent damage to gauges and instruments incorporated in the analyzer.

The interpretation of the above readouts will determine which of the following conditions or components are the cause of the problem:

1. Restriction in hoses or fittings
2. Control valve and cylinder
3. Sticking gear valve
4. Inefficient pump cam pack
5. Sticking relief valve
6. Binding in suspension

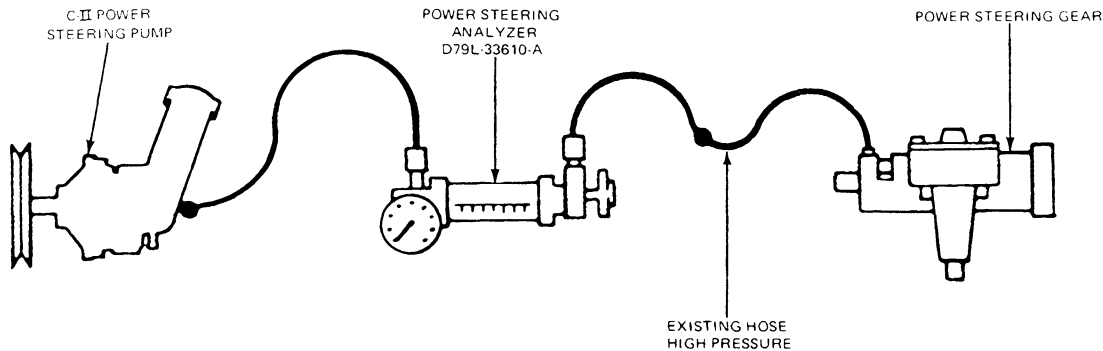
Refer to Diagnosis Guides for testing procedures.

Power Steering System Test**E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco**

The following test procedure used in conjunction with Power Steering Analyzer D79L-336 10-A (Rotunda Model 014-00207) or equivalent provides a method for checking the complete power steering system. The Flow / Pressure Power Steering Analyzer can be used to determine the cause of hard steering and / or lack of assist problems. The analyzer provides readouts for the following:

DIAGNOSIS AND TESTING (Continued)

Power Steering Analyzer Hook-Up, Typical Installation



G2934-2C

F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles

The pump flow and pressure tests will confirm or rule out the pump as the cause of steering system problems.

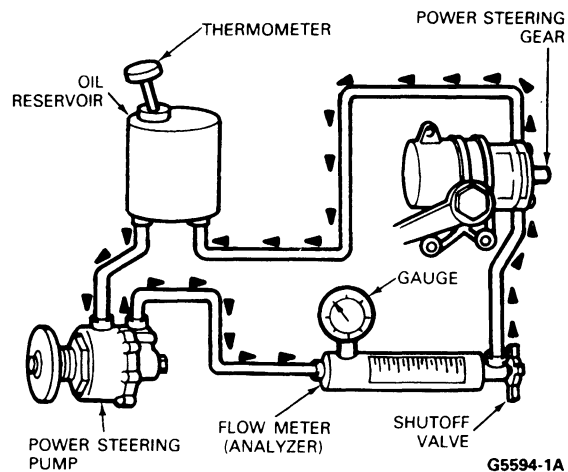
Prior to performing the pump flow and pressure test, perform the Preliminary Checks above.

If all preliminary items are to specification, or have been corrected, and the loss of assist still exists, use the following procedure to test the power steering pump flow and pressure to determine whether the trouble is in the pump, power steering gear, or the pressure relief valve.

Preparation for Hydraulic Pressure/Flow Tests

The power steering analyzer is to be used when the power steering system is suspected of erratic steering operation or insufficient power assist, and neither pump nor gear have sustained failure or internal damage that may contaminate the fluid in the steering system. The Rotunda Power Steering Analyzer Kit 014-00230 consists of a pressure gauge, flow meter, shutoff valve, thermometer, hose and adapter attachments. Refer to Diagnosis Guides for testing procedures.

CAUTION: Possible contamination of the power steering system fluid may cause permanent damage to gauges and instruments incorporated in the analyzer.



Purging Power Steering System of Air

Air trapped in the power steering system, which causes a whine-type noise between 17-39 km/h (20-45 mph) on light acceleration, can be removed by using a power steering pump air evacuator assembly (DEVAC Tool) or the Vacuum Fill Process in this section.

Devac System

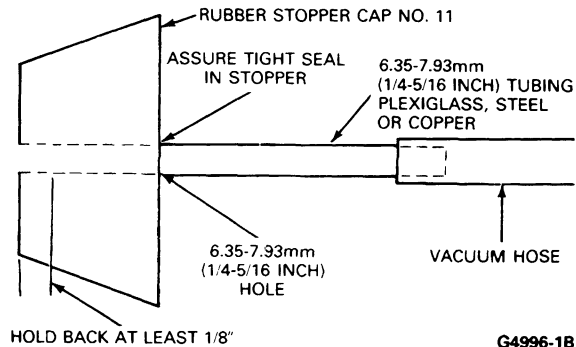
Fabricate a DEVAC purging tool as shown for Ford C-II pump, or for Saginaw pump.

The procedure for removing entrapped air is as follows:

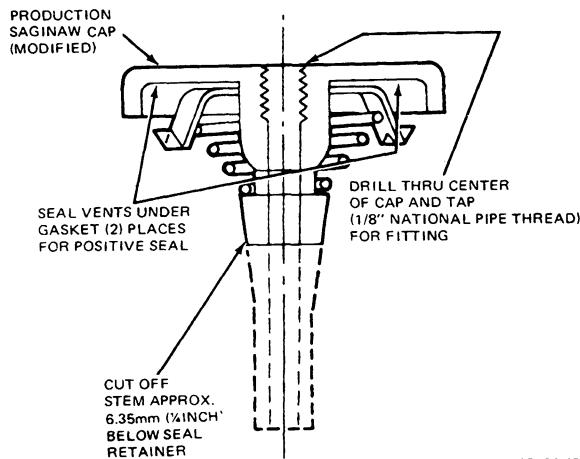
1. Check the pump reservoir oil level to make certain the fluid level is correct (add fluid if low, siphon out fluid if level is above full mark).
2. Insert the rubber stopper end of the air evacuator assembly tightly into the filler tube.
3. Connect a suitable length of hose from the other end of the air evacuator to a distributor machine or air-conditioner vacuum pump. **Do not use engine vacuum.**

DIAGNOSIS AND TESTING (Continued)

4. Let the engine idle for approximately 15 minutes. Turn steering wheel one full cycle every five minutes. Do not hit the stops. This assists in removing air trapped in the system.
5. Disconnect and remove the evacuator and reinstall the filler tube dipstick.

Power Steering System Purging Tool, For Ford C-II Pump

G4996-1B

Modified Pump Reservoir Cap, Saginaw Pump

G2401-1B

Vacuum Fill Process**Start-Up Procedure (After Power Steering Pump or Gear Overhaul)**

Upon initial engine start-up after a power steering pump or gear overhaul (particularly the pump), there is very frequently much noise and aeration. This is due to air trapped in the overhauled unit which mixes with the surging fluid and causes aeration. The problem can be minimized by following the procedure below.

Diesel Engines

1. Fill the reservoir and start the engine.
2. Cycle the steering wheel from stop to stop.
3. Shut the engine off and add fluid to bring the reservoir to the FULL mark.

Gasoline Engines

1. Disconnect the ICM connector to prevent engine from starting.
2. Fill the reservoir.
3. Crank the engine with the starter and continue adding fluid until the level remains constant.

NOTE: Be careful to avoid prolonged cranking as the battery may be drained and the starter damaged.

4. Rotate the steering wheel approximately 30 degrees each side of center while continuing to crank the engine.
5. Re-check the fluid level and fill as required.
6. Reconnect the ICM connector.
7. To clear fault codes, disconnect battery for one minute and then reconnect battery.
8. Start the engine and allow it to run for several minutes.
9. Rotate the steering wheel from stop to stop.
10. Shut off the engine and re-check the fluid level, add as required.

Diagnosis Guides

The diagnosis guides in this section can be used as an aid in diagnosing steering system problems. For additional diagnosis procedure, refer to Section 00-05.

NOTE: Refer to Specification Guide for correct lubricant.

DIAGNOSIS AND TESTING (Continued)

STEERING SYSTEM PROBLEMS		
CONDITION	POSSIBLE SOURCE	ACTION
Power steering pump leaks.	<ul style="list-style-type: none"> Leaking cap and dipstick or over-filled reservoir. Loose or damaged hose connections. Leakage between reservoir and housing. Leakage at pump shaft seal area. 	<ul style="list-style-type: none"> Check for indications of false leakage — overfilled reservoir, improperly installed, damaged or lost cap or dipstick. Repair or replace as required. Repair or replace as required. Replace shaft seal or pump.
Noise in steering column. • Squeak or creak	<ul style="list-style-type: none"> Steering column cover interference. Steering column out of alignment. Lack of lubrication where horn brush contacts rub plate of steering wheel. Loose steering column mounting bolts. 	<ul style="list-style-type: none"> Adjust or reposition as required. Align or adjust as required. Lube or adjust as required. Tighten to specification.
• Clunk	<ul style="list-style-type: none"> Flex coupling bottoming. Loose pot coupling to steering column bolt. Improper steering gear mesh load. 	<ul style="list-style-type: none"> Align or adjust as required. Tighten to specification. Readjust to specification.
Excessive steering effort.	<ul style="list-style-type: none"> Improper oversized tires. Tires not uniform. Improper tire pressure. Misaligned flexible coupling (if so equipped) to gear interference. Improperly adjusted steering wheel to column interference. Improperly adjusted steering column alignment. Binding condition in steering linkage or front axle pins, or lack of lubrication. Bind in front axle spindle thrust bearings. Improperly adjusted steering gear. Power steering pump belt loose, glazed or broken. Low power steering pump fluid level and possible leak in system. Power steering pump pressure and flow below specification. Air in power steering system. Contaminated fluid, incorrect fluid. Obstruction within steering gear or lines (including bent or kinked steel tubing). Steering gear valve binding (integral power steering). Excessive internal gear leakage. 	<ul style="list-style-type: none"> Install correct tire and wheel combination. Refer to Section 04-04. Install correct tire and wheel combination. Adjust air pressure in tires. Align or adjust as required. Align or adjust as required. Refer to Section 11-04. Align or adjust as required (E-150-250-350). Refer to Section 11-04. Lube, inspect, adjust or replace as required. Refer to Section 11-03. Lube, inspect, adjust or replace as required. Refer to Group 05. Adjust to specification (meshload only). Refer to Section 11-02. Inspect, adjust belt tension or replace as required. Refer to Section 03-05 of the Powertrain / Drivetrain Manual. Add fluid, tighten connections and correct as necessary. Conduct pump flow and relief pressure tests and adjust or repair as necessary. Add fluid, tighten connections and bleed system. Replace with correctly specified fluid. Inspect, remove obstruction(s) and repair or replace as required. Inspect, repair or replace as required. Inspect, repair or replace as required.

DIAGNOSIS AND TESTING (Continued)**STEERING SYSTEM PROBLEMS (Continued)**

CONDITION	POSSIBLE SOURCE	ACTION
Wanders side to side — loose steering.	<ul style="list-style-type: none"> ● Vehicle overloaded or unevenly loaded. ● Improper (mismatched) tires and wheels. ● Improper tire pressure. ● Loose steering gear mounting. ● Front and rear suspension components for looseness, wear or damage. ● Loose, worn or damaged steering linkage connections. ● Loose wheel lugnuts. ● Spindle pin (king pin) binding. ● Improperly adjusted front wheel bearing. ● Flexible coupling fractured. ● Incorrect toe setting. ● Improperly adjusted steering gear. ● Steering column misaligned. ● Steering column components loose or exhibit excessive play. 	<ul style="list-style-type: none"> ● Correct as required. ● Install correct tire and wheel combination. Refer to Section 04-04. ● Adjust air pressure in tires. ● Adjust to 73-89 N-m (54-68 ft-lb). ● Tighten or replace as necessary. Refer to Group 04. ● Tighten or replace as necessary. Refer to Section 11-03. ● Tighten to specifications. ● Lubricate suspension. Refer to Group 05. ● Adjust to specification. ● Replace as required. ● Set to specifications. Refer to Section 00-04. ● Adjust to specification. ● Realign steering column. Refer to Section 11-04. ● Repair as required.
Pulls to one side.	<ul style="list-style-type: none"> ● Improperly sized tires. ● Improper tire pressure. ● Unevenly loaded vehicle. ● Improper brake operation or adjustment. ● Improperly adjusted front wheel bearing, or worn or damaged rear wheel bearing. ● Broken or sagging springs on front and / or rear suspension. ● Loose steering gear mountings. ● Loose, worn or damaged steering linkage. ● Bent spindle or spindle arm. ● Bent rear axle housing and / or loose, worn or damaged spring, shock absorber and suspension arm attaching points. ● Frame or underbody out of alignment. ● Misaligned front wheel. ● Belts on tires misaligned. ● Steering gear valve binding or out of balance. 	<ul style="list-style-type: none"> ● Install correct tire and wheel combination. ● Adjust air pressure in tire. Refer to Section 04-04. ● Correct as required. ● Inspect, adjust and correct as required. Refer to Group 06. ● Adjust or replace as required. Refer to Group 05 of the Powertrain / Drivetrain Manual. ● Inspect and replace as required. Refer to Group 04. ● Tighten to specification. Refer to Section 11-02. ● Tighten and replace as required. Refer to Section 11-03. ● Inspect and replace as required. ● Inspect, tighten and replace as required. Refer to Group 04. ● Correct as required. Refer to Section 02-01. ● Set to specification. Refer to Section 04-00. ● Replace as required. Refer to Section 04-04. ● Clean and replace as necessary. Refer to Section 11-02C.

DIAGNOSIS AND TESTING (Continued)

STEERING SYSTEM PROBLEMS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Returnability poor.	<ul style="list-style-type: none"> ● Improper tire pressure. ● Improperly aligned steering column. ● Binding steering linkage or lack of lubrication. ● Spindle pin (king pin) binding. ● Tight front axle spindles. ● Bind in front axle spindle bolt thrust bearings. ● Improperly adjusted toe. ● Improperly adjusted steering gear. ● Kinked return hose or tube. ● Obstruction with steering gear or lines. 	<ul style="list-style-type: none"> ● Adjust air pressure in tires. Refer to Section 04-04. ● Align or adjust as required. ● Lube, adjust or replace as required. Refer to Section 11-03. ● Lubricate suspension. Refer to Group 04. ● Lube, correct as required. ● Lube, correct as required. Refer to Group 05 of the Powertrain / Drivetrain Manual. ● Adjust as required. ● Adjust to specification. Refer to 11-02. ● Inspect and repair or replace as required. ● Inspect, remove obstructions and repair or replace as required.
Shaking shift lever — manual steering column.	<ul style="list-style-type: none"> ● Engine out of tune. ● Worn or damaged steering column, adjacent sheet metal, shift tube bushing or shift linkage. ● Alignment and movement — engine and transmission insulators and mounts. ● Improper detent torque loading in transmission shift lever(s). 	<ul style="list-style-type: none"> ● Tune engine. Refer to Group 03 of the Powertrain / Drivetrain Manual. ● Repair or replace the column and / or components as required. Refer to Section 11-04. ● Repair, replace or adjust as required. Refer to Section 02-03. ● Repair or replace transmission shift components as required. Refer to Section 07-07.
Clear vision complaint — steering wheel spokes obscure view of instrument panel with wheels in straight ahead position.	<p>E-150-250-350</p> <ul style="list-style-type: none"> ● Steering wheel mis-indexed on steering column. ● Toe out of adjustment. <p>F-150-250-350 and Bronco</p> <ul style="list-style-type: none"> ● Toe out of adjustment. ● Damaged or twisted sector shaft. 	<ul style="list-style-type: none"> ● Remove steering wheel and align on column. Refer to Section 11-04. ● Adjust toe setting. Refer to Section 04-00. ● Replace sector shaft. ● Adjust toe setting. Refer to Section 04-00. ● Replace sector shaft.
Power steering or accessory belt squealing.	<ul style="list-style-type: none"> ● Check belt for proper tension or glazing. 	<ul style="list-style-type: none"> ● Tighten or replace belt as required. Refer to Section 03-05 of the Powertrain / Drivetrain Manual.
Pump noisy.	<ul style="list-style-type: none"> ● Low fluid level and possible leakage. 	<ul style="list-style-type: none"> ● Refill to specified level. Purge air from system. Check for leaks. Repair as required.
Swish type noise.	<ul style="list-style-type: none"> ● Fluid flow into the bypass valve of the pump valve housing with fluid temperature below 54°C (130°F). 	<ul style="list-style-type: none"> ● Normal noise.
Whine type noise.	<ul style="list-style-type: none"> ● Aerated fluid or cam contour damaged. ● Worn or damaged valve cover O-ring seal. 	<ul style="list-style-type: none"> ● Purge system of air. If condition not resolved, replace rotor assembly. ● Replace valve cover O-ring seal.
Clicking mechanical type noise.	<ul style="list-style-type: none"> ● Pump slippers too long, excessive wear of pumping elements, excessive slipper to slot clearance, or out of square slipper springs. 	<ul style="list-style-type: none"> ● Replace rotor assembly. Refer to Section 06-03.
Chatter type noise.	<ul style="list-style-type: none"> ● Chipped corners on rotor outside diameter or distorted slipper spring. 	<ul style="list-style-type: none"> ● Replace rotor assembly. Refer to Section 06-03.

DIAGNOSIS AND TESTING (Continued)

STEERING SYSTEM PROBLEMS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Other cause of noise.	<ul style="list-style-type: none"> Improper assembly of components such as slippers. Imperfections on rotor outside diameter or rotor end surface. Damaged rotor splines. Hairline crack on cam inner surface. Interference between rotor and cam. Excessively worn or scored pumping elements and pressure plates. 	<ul style="list-style-type: none"> Rebuild pump and replace components as required. Replace rotor assembly. Refer to Section 06-03. Replace rotor assembly. Replace rotor assembly. Replace rotor assembly. Replace rotor assembly. Replace rotor assembly and pressure plates.

TG3859E

Description	Test
Preliminary Inspection and Leak Tests	Test A
Automatic Transmission Selector Shifter Hard to Rotate (Exceeding 37.8 N-m (8.5 Lbs.) at Shift Lever Knob)	Test B

(Continued)

Description	Test
Power Steering System Tests, E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco	Test C
Power Steering System Tests, F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles	Test D

TG8070A

PRELIMINARY INSPECTION AND LEAK TESTS — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	PRELIMINARY CHECK		
	<ul style="list-style-type: none"> Check the power steering pump belt tension. Check the tire air pressure. Check pump for correct model and vehicle application. Do components check OK? 	<p>Yes</p> <p>No</p>	<p>▶ Ford C-II Pumps: GO to A2. Saginaw Pumps: GO to A3. ZF Pumps: GO to A4.</p> <p>▶ ADJUST or REPLACE as required. REFER to Section 03-05 of the Powertrain/Drivetrain Manual.</p>
A2	FLUID LEVEL CHECK, FORD C-II PUMP		
	<p>NOTE: Fluid level may be checked when fluid is either hot or cold.</p> <ul style="list-style-type: none"> If fluid is cold (approximately 24°C [75°F]), use cold full mark on dipstick. If fluid is hot (approximately 77°C [177°F]), use hot full mark on dipstick. Is fluid level correct without any signs of air bubbles in fluid? <p>NOTE: After any major power steering system or component overhaul, the system should be purged of all old fluid and replaced with new fluid.</p>	<p>Yes</p> <p>No</p>	<p>▶ GO to A6.</p> <p>▶ ADD Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent. Do not overfill the reservoir. GO to A5 for bleed procedure if bubbles are still present.</p>

DIAGNOSIS AND TESTING (Continued)

PRELIMINARY INSPECTION AND LEAK TESTS — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A3	FLUID LEVEL CHECK, SAGINAW PUMPS		
<ul style="list-style-type: none"> Run engine until power steering fluid reaches operating temperature 74-79°C (165-175°F). Turn the steering wheel all the way to the left and right several times without hitting stops. Shut off engine. Remove the reservoir filler cap and check the HOT level on the dipstick. Is the level OK without any signs of air bubbles in fluid? <p>NOTE: After any major power steering system or component overhaul, the old fluid should be purged and replaced with new fluid.</p>		Yes	▶ GO to A6.
		No	▶ ADD Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent. Do not overfill the reservoir. GO to A5 for bleed procedure if bubbles are present.
A4	FLUID LEVEL CHECK, ZF PUMP		
<ul style="list-style-type: none"> Key OFF. Remove the reservoir filler cap and check the level on the dipstick. Use the COLD marking if fluid is at room temperature, 20°C (70°F). Use the HOT marking if the fluid is at normal operating temperature, 80°C (175°F). Is the fluid level correct without any signs of air bubbles in fluid? <p>NOTE: After any major power steering system or component overhaul, the old fluid should be purged and replaced with new fluid.</p>		Yes	▶ GO to A6.
		No	▶ ADD MERCON-II® or equivalent. Do not overfill the reservoir. GO to A5 for bleed procedure if bubbles are present.
A5	BLEED AIR FROM SYSTEM		
<ul style="list-style-type: none"> Fill reservoir as described. Operate engine until it reaches normal operating temperature. Turn steering wheel to the left and right several times without hitting stops. Recheck fluid level in reservoir and fill if required. Are air bubbles still present in fluid? 		Yes	▶ PURGE air from system as described in this section.
		No	▶ GO to A6.
A6	EXTERNAL LEAK CHECK		
<ul style="list-style-type: none"> Key OFF. Wipe off power steering pump, hoses and steering gear. Key ON, engine running. Turn the steering wheel from stop to stop several times. <p>CAUTION: To prevent damage to the pump, do not hold the wheel against the stops.</p> <ul style="list-style-type: none"> Check for leaks. 		Leaking power steering gear	▶ REFER to Power Steering Gear Leak Inspection in this section.
		Leaking power steering pump	▶ For Saginaw and Ford C-11 pumps, REFER to the appropriate Leak Diagnosis Chart in this section.
A7	EXTERNAL LEAK CHECK, BENDIX STEERING GEAR AND ZF PUMP		
<ul style="list-style-type: none"> Key OFF. Wipe off power steering hoses, steering gear and reservoir. Mix one teaspoon of oil-soluble aniline dye into power steering reservoir and fill reservoir to specifications as required. Key ON, engine running at 1000-1500 rpm. Turn steering wheel all the way to the left and right several times. <p>NOTE: To prevent damage to the pump, do not hold wheels against far left or right positions for more than 5 seconds.</p> <ul style="list-style-type: none"> Key OFF. Check for leaks. 		Reservoir ports leak	▶ CHECK hose clamps for proper installation and reservoir ports for cracks. SERVICE or REPLACE as required.
		Reservoir cover / cap or dipstick leaks	▶ GO to A8.
		Fittings or connections leak	▶ GO to A9.

DIAGNOSIS AND TESTING (Continued)

PRELIMINARY INSPECTION AND LEAK TESTS — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A8	RESERVOIR COVER AND DIPSTICK CHECK		
	<ul style="list-style-type: none"> Check reservoir cover and dipstick for good seal and tight fit. Check reservoir for damage. 	Bad seal or loose fitting cover Damaged reservoir	REPLACE as required. REFER to Section 11-02E. REPAIR or REPLACE as required. REFER to Section 11-02E.
A9	FITTINGS AND O-RING LEAK INSPECTION		
	<ul style="list-style-type: none"> Clean the outside of the steering gear, the bottom surface of the pump, and all lines and fittings. Tighten all fittings using a flare-nut wrench. <p>CAUTION: Do not tighten the fittings with a standard open-end wrench.</p> <ul style="list-style-type: none"> Are any leaks detected? 	Yes No	REPLACE tube seat. System OK.

TG807 1A

AUTOMATIC TRANSMISSION SELECTOR SHIFTER LEVER HARD TO ROTATE (EXCEEDING 37.8N OR 8.5 LBS. AT SHIFT LEVER KNOB) — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	LUBRICATE SHIFT LINKAGE		
	<ul style="list-style-type: none"> Lubricate the shift linkage with Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent. Does condition improve? 	Yes No	REPLACE any bushing or C-clip that was disconnected and adjust linkage. REFER to the appropriate section in Group 07. RETEST for correct shift effort. GO to B3.
B2	VISUAL INSPECTION		
	<ul style="list-style-type: none"> Inspect for bent rods or levers, damaged bushings. Is visual inspection OK? 	Yes No	GO to B3. REPLACE bent or damaged rods, levers, and / or bushings as required. REPLACE any bushing or C-clip that was disconnected and adjust linkage. REFER to the appropriate section in Group 07. RETEST for correct shift effort.
B3	CHECK SHIFT EFFORT		
	<ul style="list-style-type: none"> Disconnect linkage at the adjusting stud and check shift effort at shift lever knob. Shift effort must be below 8.9 N (2 lbs). 	Shift effort below 8.9 N (2 lbs) Shift effort at or above 8.9 N (2 lbs)	GO to B7. GO to B4.
B4	BEARING RETAINER FIT		
	<ul style="list-style-type: none"> Remove the lower bearing retainer and check the rotational fit to shift tube. 	Bearing retainer rotates freely in shift tube. Bearing retainer binds during rotation	GO to B5. REPLACE shift tube assembly or retainer. REPLACE any bushing or C-clip that was disconnected and adjust linkage. REFER to the appropriate section in Group 07. RETEST for correct shift effort.

DIAGNOSIS AND TESTING (Continued)**AUTOMATIC TRANSMISSION SELECTOR SHIFTER LEVER HARD TO ROTATE (EXCEEDING 37.8N OR 8.5 LBS. AT SHIFT LEVER KNOB) — TEST B (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
B5	SHIFT SOCKET FIT		
<ul style="list-style-type: none"> Check the rotational fit between the shift socket and flange. 		Shift socket rotates freely Shift socket binds during rotation	GO to B6 . REPLACE shift socket and / or flange as required. REPLACE any bushing or C-clip that was disconnected and adjust linkage. REFER to the appropriate section in Group 07. RETEST for correct shift effort.
B6	AXIAL CLEARANCE		
<ul style="list-style-type: none"> Check for 0.127mm (0.005 inch) minimum axial clearance between socket and flange. 		Clearance at or below 0.127mm (0.005 inch) Clearance above 0.127mm (0.005 inch)	DISASSEMBLE the steering column and REPLACE the shift linkage as required. REFER to Section 11-04A. REPLACE the outer tube assembly. REPLACE any bushing or C-clip that was disconnected and adjust linkage. REFER to the appropriate section in Group 07. RETEST for correct shift effort.
B7	TRANSMISSION SHIFT EFFORT		
<ul style="list-style-type: none"> Attach the fish scale to the adjusting stud. Measure the force required to shift the transmission. 		Shifting force less than 86.7 N (19.5 lbs) Shifting force greater than 86.7 N (19.5 lbs)	INSTALL nut on the adjusting stud and ROTATE stud by hand. If stud does not rotate freely, REMOVE C-clip and LUBE under stud. REPLACE any bushing or C-clip that was disconnected and adjust linkage. REFER to the appropriate section in Group 07. RETEST for correct shift effort. GO to B8 .
B8	RECHECK SHIFT EFFORT		
<ul style="list-style-type: none"> Disconnect the shift rod at the transmission lever. Attach a fish scale to the transmission lever and test shift effort. 		Shifting force less than 77.8 N (17.5 lbs) Shifting force greater than 77.8 N (17.5 lbs)	REMOVE the bellcrank support bracket from the transmission and LUBE the bushing thoroughly. CHECK all other bushings for hard rotational effort. REPLACE any bushing or C-clip that was disconnected and adjust linkage. REFER to the appropriate section in Group 07. RETEST for correct shift effort. Condition is associated with transmission. REFER to Section 07-00B.

TG3129H

DIAGNOSIS AND TESTING (Continued)

POWER STEERING SYSTEM TESTS — TEST C
E-150-250-350, F-150-250-350, F-SUPER DUTY CHASSIS CAB AND BRONCO

TEST STEP		RESULT	ACTION TO TAKE
C1	FLOW RATE AND PRESSURE CHECK		
	<ul style="list-style-type: none"> Remove the pressure fitting from the pump and connect it into the appropriate adapter of the analyzer. Thread the other adapter of the analyzer into the pump. Connect the analyzer to the adapters and tighten both to 20 N-m (15 ft-lb). <p>NOTE: The analyzer may be connected at alternate points between the pump and the gear.</p> <ul style="list-style-type: none"> Add power steering fluid to the pump as required. Start engine and run at idle for approximately 2 minutes. Record the flow and pressure at 74-79°C (165-175°F). Is the pressure above 1034 kPa (150 psi)? 	<p>Yes</p> <p>No</p>	<p>► CHECK for worn or damaged steering gear or restricted hoses. REPAIR or REPLACE as required.</p> <p>► GO to C2.</p>
C2	FLOW RATE CHECK, GATE VALVE PARTIALLY CLOSED		
	<ul style="list-style-type: none"> Partially close the gate valve and allow the pressure to build to 5102 kPa (740 psi) for C-II pumps or to 4275 kPa (620 psi) for Saginaw pumps. Record the flow at 74-79°C (165-175°F). Is the flow rate below specifications? 	<p>Yes</p> <p>No</p>	<p>► REPLACE cam pack. CHECK for worn or damaged pressure plates. REPLACE as required. REFER to Section 11-02A or 11-02D.</p> <p>► GO to C3.</p>
C3	PRESSURE CHECK, GATE VALVE OPENED AND CLOSED		
	<ul style="list-style-type: none"> Completely close and partially open the gate valve three times. <p>CAUTION: Do not allow the valve to remain closed for more than 5 seconds.</p> <ul style="list-style-type: none"> Record the pressure. <p>CAUTION: Do not allow fluid temperature to exceed 200°F during the test. Allow fluid to cool to 130°F before resuming test if overheating occurs.</p>	<p>Pressure is below minimum listed in specifications</p> <p>Pressure is above maximum listed in specifications</p> <p>Pressure is within specifications</p>	<p>► REPLACE flow control valve.</p> <p>► SERVICE or REPLACE the flow control valve as required.</p> <p>► GO to C4.</p>
C4	FLOW RATE CHECK, ENGINE RUNNING AT 1500 RPM		
	<ul style="list-style-type: none"> Increase engine speed to 1500 rpm. Record flow rate and compare it with the flow rate measured in Step C1. Is the flow rate within 1 gallon / min with the flow rate measured in Step C1? 	<p>Yes</p> <p>No</p>	<p>► GO to C5.</p> <p>► SERVICE or REPLACE the flow control valve as required.</p>
C5	PRESSURE AND FLOW RATE CHECK, STEERING WHEEL TURNED FROM STOP TO STOP		
	<ul style="list-style-type: none"> Turn the steering wheel from the left stop to the right stop. Record the pressure and the flow rate. Is the recorded pressure approximately the same as the pressure recorded in Step C3 and does the flow rate drop below 0.5 gallons / min? 	<p>Yes</p> <p>No</p>	<p>► GO to C6.</p> <p>► Excessive internal leakage. SERVICE or REPLACE steering gear and flow control valve as required.</p>

DIAGNOSIS AND TESTING (Continued)

POWER STEERING SYSTEM TESTS — TEST C
E-150-250-350, F-150-250-350, F-SUPER DUTY CHASSIS CAB AND BRONCO (Continued)

TEST STEP		RESULT	ACTION TO TAKE
C6	BACK PRESSURE CHECK		
<ul style="list-style-type: none"> Turn steering wheel slightly in both directions and release quickly while observing the pressure gauge. Does the needle return to normal back-pressure reading and snap back as the wheel is released? 		Yes No	<ul style="list-style-type: none"> System is OK. SERVICE the steering gear for sticking rotary valve as required. GO to A7. <p>NOTE: If the system is severely contaminated, both gear hoses, control valve and pump must be completely disassembled and cleaned before reassembly.</p>
C7	BALL JOINT AND LINKAGE CHECK		
<ul style="list-style-type: none"> Turn steering wheel slightly in both directions and release quickly while observing the pressure gauge. Does the needle move from the normal back-pressure reading and snap back as the wheel is released? 		Yes No	<ul style="list-style-type: none"> System is OK. SERVICE the ball joints or linkage as required.

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POWER STEERING SYSTEM TESTS — TEST D
F-SUPER DUTY COMMERCIAL CHASSIS AND MOTORHOME CHASSIS VEHICLES

TEST STEP		RESULT	ACTION TO TAKE
D1	PRELIMINARY CHECK		
<ul style="list-style-type: none"> Remove the pressure fitting from the pump and connect it into the appropriate adapter of the analyzer. Connect the analyzer to the adapters and tighten both to 41-51 N·m (30-40 ft-lb). <p>NOTE: Be sure analyzer line at shutoff valve end is connected to steering gear end of vehicle power steering system.</p> <ul style="list-style-type: none"> Add power steering fluid to the pump as required. Fully open shutoff valve, start engine and turn steering wheel to full left and right stops to purge air from system. <p>NOTE: Check the gauge needle for excessive vibration. This indicates that air is still in the system. If so, repeat the purging procedure until the excessive needle vibration no longer exists.</p> <ul style="list-style-type: none"> Install thermometer in reservoir and connect tachometer to engine. Align front wheels in straight ahead position, place transmission in NEUTRAL, and engage the parking brake. Partially close pressure line shutoff valve until pressure rises to 5516-6900 kPa (800-1000 psi). Fully open shutoff valve when fluid in reservoir reaches 50°C (120°F). Increase engine speed to 2200 rpm. Record flow rate and pressure at 55°C (130°F). 		Flow rate is below 13.2 liters / min (3.5 gallon / min) Pressure exceeds 552 kPa (80 psi)	<ul style="list-style-type: none"> CHECK if the correct pump is installed. GO to D3. GO to D2.
D2	LINE CHECK		
<ul style="list-style-type: none"> Check lines for kinks or obstructions. Do lines check OK? 		Yes No	<ul style="list-style-type: none"> GO to D3. REPAIR or REPLACE as required.

DIAGNOSIS AND TESTING (Continued)

POWER STEERING SYSTEM TESTS — TEST D
F-SUPER DUTY COMMERCIAL CHASSIS AND MOTORHOME CHASSIS VEHICLES (Continued)

TEST STEP		RESULT	ACTION TO TAKE
D3	MINIMUM PUMP FLOW CHECK		
	<ul style="list-style-type: none"> Decrease engine speed to 600 rpm. Slowly close shutoff valve until pressure rises to 8274 kPa (1200 psi). Record flow rate at 55°C (130°F). Is flow rate below 8.3 liters / min (2.2 gallon / min)? 	Yes No	► VERIFY correct pump is installed. SERVICE or REPLACE pump as required. ► GO to D4.
D4	RELIEF PRESSURE CHECK, LOW RPM		
	<ul style="list-style-type: none"> Maintain engine speed at 600 rpm. Close shutoff valve. (The flow rate should be zero.) Record pressure. Open shutoff valve quickly. (Flow rate should return to normal.) Is the recorded pressure below 116 bar (1680 psi) or above 124 bar (1800 psi)? 	Yes No	► REPAIR or REPLACE relief valve as required. ► GO to D5.
D5	FLOW RATE CHECK, POWER STEERING PUMP		
	<ul style="list-style-type: none"> Allow power steering pump fluid to cool to 55°C (130°F). Increase engine speed to full governed rpm. Close shutoff valve. (The flow rate should be zero.) Open shutoff valve quickly. (Flow rate should return to normal.) Close and open the shutoff valve again, but do not allow the fluid temperature to exceed 95°C (200°F). Does the flow rate return to normal immediately after opening the shutoff valve? 	Yes No	► GO to D6. ► REPAIR or REPLACE the pump as required.
D6	RELIEF PRESSURE CHECK		
	<ul style="list-style-type: none"> Place a steel block between the axle stop and the adjusting screw. <p>WARNING: THE BLOCK SHOULD BE AT LEAST 25.4MM (1 INCH) THICK AND LONG ENOUGH TO BE INSERTED WITHOUT DANGER OF PINCHING FINGERS. KEEP FINGERS CLEAR OF PINCH POINTS AND BE SURE BLOCK IS SQUARE TO CONTACT POINTS.</p> <ul style="list-style-type: none"> Make sure that fluid temperature in reservoir is 55°C (130°F) and the shutoff valve is totally open. Turn the steering wheel until the axle stops contact the spacer block. Apply sufficient torque to the steering wheel so that the power steering gear control valve is completely open in the direction of the turn. <p>CAUTION: Do not hold the torque on the steering wheel for more than 5 seconds after the pressure relief setting of the gear has been reached. The gear could be damaged.</p> <ul style="list-style-type: none"> Is the relief pressure reading above 1400 kPa (2052 psi) or below 1345 kPa (1950 psi)? 	Yes No	► ADJUST or REPAIR the relief valve as required. ► GO to D7.

DIAGNOSIS AND TESTING (Continued)

POWER STEERING SYSTEM TESTS — TEST D
F-SUPER DUTY COMMERCIAL CHASSIS AND MOTORHOME CHASSIS VEHICLES (Continued)

TEST STEP		RESULT	ACTION TO TAKE
D7	INTERNAL LEAKAGE CHECK, POWER STEERING GEAR, STEERING WHEEL TURNED TO LEFT		
	<ul style="list-style-type: none"> ● Key OFF. Remove plug from valve body using 26mm socket. ● Insert approximately 3-6mm of additional shims into the socket portion of the plug to raise the relief bypass valve setting above that of the power steering pump relief valve. Ordinary 3/8-inch outside diameter flatwashers may be used as shims. ● Key ON, engine running at idle speed. ● Turn steering wheel to the left until axle stop contacts spacer block. ● Apply sufficient torque to the steering wheel so that the power steering gear control valve is completely open in the direction of the turn. <p>CAUTION: Do not hold the torque on the steering wheel for more than 5 seconds after the pressure relief setting of the gear has been reached. The gear could be damaged.</p> <ul style="list-style-type: none"> ● Record flow rate with system at pump relief level. ● Is the pressure reading below 140 bar (203 psi) or above 155 bar (255 psi), and is the flow rate greater than 3.3 liters / min (3.5 quarts / min)? 	<p>Yes</p> <p>No</p>	<p>▶ REPAIR internal leakage in steering gear.</p> <p>▶ GO to D8.</p>
D8	INTERNAL LEAKAGE CHECK, POWER STEERING GEAR, STEERING WHEEL TURNED TO RIGHT		
	<ul style="list-style-type: none"> ● Position the spacer block between the right side axle stop and adjusting screw. ● Repeat the test procedures in Step D7, but with the steering wheel turned to the right. Observe all cautions. ● Is the pressure reading below 140 bar (203 psi) or above 155 bar (255 psi), and is the flow rate greater than 3.3 liters / min (3.5 quarts / min)? 	<p>Yes</p> <p>No</p>	<p>▶ REPAIR internal leakage in steering gear.</p> <p>▶ Gear checks OK.</p>

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ADJUSTMENTS

Clear Vision Adjustment**F-Super Duty Commercial and Motorhome Chassis**

Steering wheel misalignment (improper clear vision) on F-Super Duty Commercial Chassis and Motorhome Chassis vehicles can be corrected only by removing and recentering the steering wheel. Because the steering linkage has only one tie rod adjustment, improper clear vision cannot be corrected by adjustment of the steering linkage or suspension components. If improper clear vision is attempted to be corrected by adjustment of the tie-rod sleeve, grossly misadjusted toe may result.

E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco

Steering wheel clear vision is preset at assembly prior to toe adjustment and cannot be adjusted by removing the steering wheel and arbitrarily mis-indexing the wheel and center shaft alignment. Improper clear vision is an indication that toe is incorrect.

Refer to Section 11-04A, and Section 04-00 for the clear vision adjustment.

CLEANING AND INSPECTION

Power Steering Gear**Cleaning**

Disassembly and assembly of the steering gear and the sub-assemblies must be made on a clean workbench.

1. The bench, tools, and parts must be kept clean at all times.
2. Thoroughly clean the exterior of the unit with a suitable solvent.
3. When necessary, drain as much of the hydraulic fluid (or gear grease) as possible.

CLEANING AND INSPECTION (Continued)

4. Handle all parts very carefully to avoid nicks, burrs, scratches and dirt, which could make the parts unfit for use.

Do not clean, wash or soak seals in the cleaning solvent.

Inspection

1. Check input shaft bearing for damage. Replace if necessary.
2. Inspect the valve housing for scoring or burrs.
3. Inspect the tube seats in the housing pressure port and return port for nicks, etc. If necessary, replace tube seats.
4. Check all fluid passages for obstruction or leakage.
5. Inspect the steering gear housing for cracks, stripped threads, and mating surfaces for burrs. Inspect the piston bore of the housing for scoring. Check roller bearings for damage. If necessary, replace the housing.
6. Check the input shaft bearing after installation to be sure that it rotates without binding or roughness.
7. Check the piston rack teeth and sector shaft teeth for nicks and burrs.

Flushing

Flushing the steering gear is required when installing a repaired pump.

1. Remove the power steering pump and remove the pulley as outlined in Section 11-02D or 11-02A.
2. Install the pulley on the repaired pump. Install the pump and connect only the pressure hose to the pump.
3. Place the fluid return line from the gear in a suitable container and plug the reservoir return tube.
4. Fill the reservoir with Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent on Ford C-II pumps and on Saginaw Pumps.
5. Disconnect the ICM connector to prevent the engine from starting and raise the front wheels off the ground.
6. While approximately 1.9 litres (2 quarts) of steering gear fluid are being poured into the reservoir, crank the engine using the ignition key. At the same time, cycle the steering wheel from stop to stop. Do not hold the steering wheel against the stop for more than three to five seconds.

NOTE: Be careful to avoid excessive cranking as the battery will be drained and the starter damaged.
7. As soon as all of the fluid has been poured in, turn off the ignition key, and attach the ICM connector.
8. To clear fault codes, disconnect battery for one minute and then reconnect battery.

9. Remove the plug from the reservoir return tube, and attach the return hose to the reservoir.
10. Check the reservoir fluid level. If low, add fluid to the proper level. Do not overfill.
11. Lower the vehicle.
12. Start the engine and cycle the steering from stop to stop to expel any trapped air from the system.

Power Steering Pump, Ford C-II, Saginaw and ZF**Flushing**

When contamination is noted while overhauling the gear, it will be necessary to flush the power steering pump.

1. Leave all hoses connected, except the pressure line at the gear.
2. Place the pressure line in a suitable container.
3. Fill the reservoir with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or -DDX E4AZ-19582-B (ESP-M2C166-H) or equivalent.
4. On Ford C-II and Saginaw Steering Pump, fill reservoir with E6AZ-195822-AA (ESW-MZC33-F) or equivalent.
5. On gasoline engines, disconnect the coil wire or ICM connector to prevent the engine from starting. On diesel engine, crank engine for 5-10 seconds without starting. If engine should start during cranking, immediately shut down engine.
6. While pouring approximately 1.9 litres (2 quarts) of Motorcraft MERCON® into the reservoir, engage the starter.
7. As soon as all the fluid has been poured in, turn off the ignition.
8. Attach the pressure hose at the gear.
9. Check the reservoir fluid level.
10. Crank the engine with the starter and continue adding fluid until the level remains constant. On gasoline engines, attach the coil wire or ICM connector.
11. Start the engine and cycle the steering wheel from stop to stop to expel any air from the system.

Cleaning

Wash all parts except seals in a chlorinated solvent and dry with compressed air.

Inspection (Ford C-II Pump)

To determine when to replace power steering pump components, follow these guidelines. Some components must be replaced regardless of condition.

1. Re-use the outlet fitting if the corners are not rounded and the threads intact.
2. Replace all seals.

CLEANING AND INSPECTION (Continued)

3. Re-use the reservoir assembly if the reservoir seal areas are not damaged. Check for a broken or missing baffle.
4. Re-use the housing or housing assembly if the O-ring and snap ring surfaces are not damaged.
5. Re-use the rotor and cam assembly if wear is limited to removal of the phosphate coating on the cam contour. Do not disassemble the unit. Push the rotor part way through the cam insert, being careful not to dislodge the slippers and springs. Check the cam inside diameter for scoring or burring. Check the rotor faces and outside diameter for scoring and chipping. Do not repair or refinish the upper and lower pressure plates, cam or rotor assembly. If wear or burring is evident, replace them with new components.
6. Install a new rotor and cam assembly if the slippers are worn.
7. Re-use the rotor shaft if the thrust faces, bushing diameter and shaft seal diameter are not excessively worn or scored.
8. Re-use the housing and bushing assembly if all the threaded holes are not damaged beyond repair, and the bushing diameter is not scored or worn, 0.0127mm (0.0005 inch) over the 17.50mm (0.6891 inch) maximum. Repair the threaded holes by drilling out the damaged threads and installing helicoil inserts. If the bushing is scored or excessively worn, install a new housing and bushing assembly.
9. Re-use the valve body if valve bore is free of nicks, scoring and the valve screen is clean. Valve must fall freely in valve bore. Replace valve housing and/or valve if valve sticks in bore.

Inspection (Saginaw Pump)

The following describes the components of the power steering pump which must be replaced regardless of condition and how to determine when other components should be replaced:

1. All seals must be replaced with new components except the rotor shaft seal which should be reused unless it was leaking.
2. The flow control valve assembly may be reused unless it is damaged (score marks, wear, burrs, etc.).
3. The housing assembly may be reused if there is no damage (scratches, burrs, etc.) at machined surfaces, especially mating surfaces on O-ring seats.
4. If the shaft bushing in the pump housing is scored or excessively worn, the pump housing assembly must be replaced.
5. The pressure plate may be reused unless the V-shaped notches at the edges of the discharge ports are damaged or other visual damage (cracks, etc.) is evident. These notches must be clean and undamaged if pump noise is to be avoided, as they cushion the hydraulic shock when each vane passes the port.

6. The cam ring may be re-used if it is not damaged (score marks, cracks, etc.).
The cam ring is treated with lubricant which leaves a dull gray-black finish on the wear surface. A wavy grain appearance inside the cam ring is normal.
7. The vanes should be removed from the rotor and examined for wear; the vanes and rotor may be reused if not damaged.
8. The rotor shaft may be reused if there is no damage (score marks, excessive wear, etc.) at splines, keyway, bearing and seal surfaces.

Inspection (ZF Pump)

1. Thoroughly clean all pump and reservoir parts (except seals) with solvent. Wipe dry with a lint-free cloth.
2. For disassembly and assembly procedures, refer to Section 11-02E.

SPECIFICATIONS**STEERING TORQUE LIMITS E-150-250-350, F-150-250-350, F-SUPER DUTY AND BRONCO**

Description	N-m	Lb-Ft
Steering Gear to Frame	73-89	54-66
Pitman Arm to Steering Gear	230-310	170-230
Drag Link / Tie Rod End Studs	70-100	52-74
Linkage Adjusting Sleeve Clamp F-150-250-350, E-150-250-350, Bronco	40-57	29-41
Linkage Adjusting Sleeve Clamp (F-Super Duty)	81-126	60-93
Power Steering Pump to Support Bracket (All)	40-55	30-40
Power Steering Cooler to Frame Bracket F-150-250-350 (All)	15-21	11-16
Power Steering Pressure Hose (Pump) (Gear) E-150-250-350 (All)	34-46	25-34
Power Steering Pressure and Return Hose	30-40	25-30
Flange and Insulator Assembly to Steering Gear F-150-250-350, Bronco	33-50	24-37
Coupling Shaft to Steering Shaft F-150-250-350, Bronco	33-50	24-37
Flange and Insulator to Steering Column E-150-250-350	18-28	14-21
Flange and Insulator Assembly to Steering Gear E-150-250-350	27-47	20-35
Steering Wheel to Steering Shaft	41-56	30-42
Support Bracket to Steering Column	18-27	13-20
Steering Column (Support Bracket to Pedal Bracket) F-150-250-350	26-37	19-27
Steering Column (Floor Opening Cover Plate to Floor)	12-18	9-13

(Continued)

SPECIFICATIONS (Continued)

STEERING TORQUE LIMITS E-150-250-350,
F-150-250-350, F-SUPER DUTY AND BRONCO (Cont'd)

Description	N-m	Lb-Ft
Steering Column (Floor Opening Cover Plate Clamp) F-150-250-350, Bronco	11-24	8-18
Shroud	14-20	6-9
Ignition Switch to Steering Column	55-81	40-60

STEERING TORQUE SPECIFICATIONS, F-SUPER DUTY
AND E-350 COMMERCIAL CHASSIS AND MOTORHOME
CHASSIS VEHICLES

Description	N-m	Lb-Ft
Ignition Switch Retaining Nuts	4.5-7.3	40-65
Steering Wheel Nut	40-56	30-42
Steering Column Lower Bearing Retainer	14-18	10-14
Floor Opening Cover Plate — E-350	16-23	12-17
Floor Opening Cover Plate — F-Super Duty	11-15	8-11
Intermediate Shaft Lock Bolt — F-Super Duty	27-47	20-35
Intermediate Shaft Lock Bolt — E-350	54-80	40-60
Lock Actuator Insert Screw	1.7-2.8	15-25 (In-Lb)
Steering Column Tube Flange Nuts	6.8-8.5	60-75 (In-Lb)
Turn Signal Switch Screws	2.5-3.0	22-26 (In-Lb)
Steering Wheel Horn Cover Pad	0.8-1.2	7-11 (In-Lb)

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FORD INTEGRAL POWER STEERING GEAR
OPERATIONAL SPECIFICATIONS

Description	Specification
Type	Recirc. Ball Torsion Bar
Ratio	17:1
Turns of Steering Wheel (Lock-to-Lock — Linkage Disconnected)	4

(Continued)

FORD INTEGRAL POWER STEERING GEAR
OPERATIONAL SPECIFICATIONS (Cont'd)

Description	Specification
Fluid Capacity (Included in Pump Reservoir Fill)	.75L (1.6 pint Approx.)
Fluid Specification	ESW-M2C33-F C1AZ-19582-A, C, or D; or equivalent.
Worm Bearing Preload	0.45-1.0 N-m (4-9 in-lb) Not adjustable in field. Specification given for inspection purposes only.
Worm to Piston Preload	0.11-0.34 N-m (1-3 in-lb) Not adjustable in field. Specification given for inspection purposes only.

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BENDIX C-300N OPERATIONAL SPECIFICATIONS

Description	Specification
Steering Ratio (Input to Output Shaft)	21.2:1
Steering Wheel Revolutions for 90 Degree Rotation of Output Shaft	5.3
Maximum Output Shaft Rotation	75° (Power Assisted) 95° (Maximum Travel)
Maximum Output Shaft Torque with 1992 psi (140 Kg / CM) Power Assist	1985 Ft-Lb (270 mdaN)
Power Steering Fluid	Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or -DDX E4AZ-19582-B (ESP-M2C166-H) or equivalent
Maximum Working Temperature	120°C (248°F)
Maximum Peak Temperature	150°C (302°F)
Maximum Working Pressure	1800 psi (124 Bar)
Maximum Pressure Drop in the Return Line	43 psi (3 Bar)
Normal Flow	4.2 GPM (16 L / min)

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CHART I — FORD C-II PUMP

Pump Model	Minimum Flow @ 740 PSI		Minimum Pressure Relief		Maximum Pressure Relief	
	Liters / Minute 76°C + -15°C	Gallons / Minute 170°F + 5°F	kPa	PSI	kPa	PSI
HBC-JX	5.3	1.4	9650	1400	10550	1530
HBC-JY	5.7	1.5	10000	1450	10550	1530
HBC-KK	5.3	1.4	9650	1400	10550	1530

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SPECIFICATIONS (Continued)

CHART II — SAGINAW PUMP

Pump Model	Minimum Flow @ 620 PSI		Minimum Pressure Relief		Maximum Pressure Relief	
	Liters/Minute 76°C + -15°C	Gallons/Minute 170°F + 5°F	kPa	PSI	kPa	PSI
HBA-HA	6.8	1.8	9310	1350	9997	1450

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CHART III — ZF PUMP

Pump Model	Displacement		Minimum Flow @ 725 PSI		Control Flow (+20%-10%)		Weight		Maximum Speed
	CC	CI	Liters/Min	Gals/Min	Liters/Min	Gals/Min	Kg	Lbs	
7673	16.5	1.01	6.1	1.6	16	4.2	5.6	12.3	4500 Rpm

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SPECIAL SERVICE TOOLS/EQUIPMENT

ROTUNDA EQUIPMENT

Tool Number	Description
014-00207	Power Steering Analyzer
014-00230	Power Steering Analyzer

Tool Number	Description
D79L-33610-A	Power Steering Analyzer

SECTION 11-02A Steering Pump, Power, C-II

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Pump Belt Tension Adjustment	11-02A-16	Power Steering Pump	11-02A-5
DESCRIPTION AND OPERATION	11-02A-1	Power Steering Pump Pulley	11-02A-5
DIAGNOSIS AND TESTING	11-02A-3	Power Steering Pump Reservoir	11-02A-9
DISASSEMBLY AND ASSEMBLY		Rotor Shaft Seal	11-02A-8
Power Steering Pump	11-02A-10	SPECIAL SERVICE TOOLS	11-02A-17
REMOVAL AND INSTALLATION		SPECIFICATIONS	11-02A-16
Drive Belt, Automatically Tensioned (4.9L, 5.0L, 5.8L, 7.3L and 7.5L)	11-02A-8	VEHICLE APPLICATION	11-02A-1

VEHICLE APPLICATION

F-150-250-350, F-Super Duty, Econoline and Bronco Vehicles

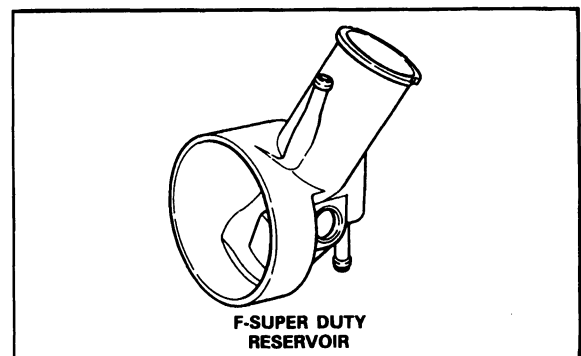
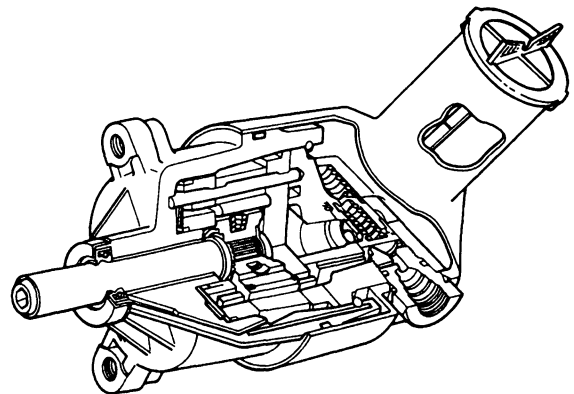
DESCRIPTION AND OPERATION

The C-II power steering pump is a belt-driven slipper-type pump with a fiberglass reinforced nylon reservoir. The reservoir is attached to the rear side of the pump housing front plate and the pump body is encased within the housing and reservoir. The pressure hose is attached with a quick connect fitting, located below the filler neck at the outboard side of the reservoir. The fitting allows the line to swivel. This is normal and does not indicate an untorqued fitting.

A pressure sensitive identification tag will be attached to the reservoir. The top line of this tag indicates the basic model number (HBC) and the suffix.

NOTE: Always use these tags when requesting service parts as there may be slight differences in internal components.

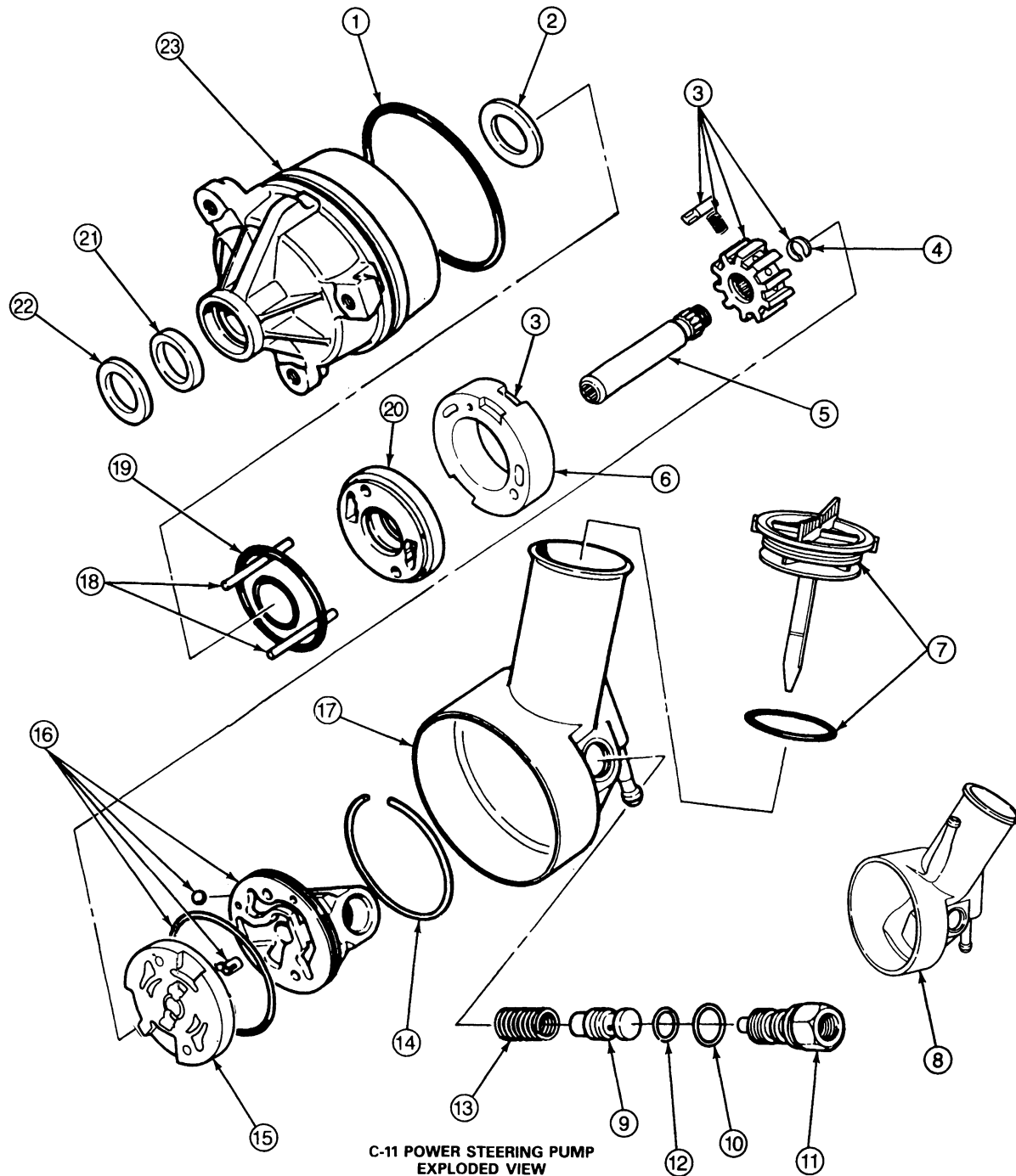
Ford Model C-II Power Steering Pump, Sectional View



G6330-B

DESCRIPTION AND OPERATION (Continued)

C-II Power Steering Pump, Exploded View



G6331-B

Item	Part Number	Description
1	387572-S100	Seal
2	3D596	Disc Spring
3	3D607	Cam and Rotor Assembly
4	3D607	C-Clip

(Continued)

Item	Part Number	Description
5	3B559	Shaft
6	—	High Displacement Cam
7	3A006	Cap
8	Ref.	F-Super Duty Reservoir

(Continued)

DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
9	—	Valve Assembly
10	389349-S	Seal
11	3D654	Outlet Fitting
12	387571-S94	Seal
13	3D586	Spring
14	387573-S	Retaining Ring
15	3A645	Upper Plate
16	36544	Valve Cover

(Continued)

Item	Part Number	Description
17	3E730	Reservoir
18	387579-S	Dowel Pins
19	387569-S100	Seal
20	3D590	Lower Plate
21	3B592	Shaft Seal
22	—	Retainer
23	3D643	Pump Housing Plate
24	387570-S100	Seal

DIAGNOSIS AND TESTING

For problem diagnosis, refer to Section 11-00.

DIAGNOSIS AND TESTING (Continued)

EXTERNAL LEAK CHECKS

LEAK CATEGORY	PARTS REQUIRED FOR SERVICE
1. Rotor shaft seal	<ul style="list-style-type: none"> Replace rotor shaft seal.
2. Reservoir O-ring seal	<ul style="list-style-type: none"> Replace O-ring seal.
3. Return hoses	<ul style="list-style-type: none"> Reposition or replace return hose clamp.
4. Outlet fitting	<ul style="list-style-type: none"> Tighten outlet fitting to 34-54 N·m (25-40 ft-lb). If leak continues: <ul style="list-style-type: none"> replace O-ring seal check for damaged threads (cross-threaded) replace outlet fitting housing cover threads are stripped; replace pump housing cover.
5. Hose tube nut	<ul style="list-style-type: none"> Tighten pressure hose tube nut to 41-54 N·m (30-40 ft-lb). If leak continues, remove tube nut and: <ul style="list-style-type: none"> inspect Teflon® washer. <div> <p>C-II POWER STEERING PUMP QUICK CONNECT FITTING</p> <p>G7236-B</p> <p>— replace Teflon® washer.</p> </div> <p>NOTE: IF LEAK OCCURS HERE, REPLACE HOSE ASSEMBLY</p> <div> <p>NOTE: IF LEAK OCCURS HERE, TIGHTEN NUT TO SPECIFICATION. REPLACE TEFLON SEAL IF NECESSARY</p> <p>NOTE: ALWAYS REPLACE THIS SEAL WHEN A LINE IS REMOVED</p> <p>G7237-B</p> </div> <p>Note: A tapered shaft may be required to stretch washer prior to installation on the tube nut, so it may be slipped over the nut threads.</p> <div> <p>G7238-B</p> </div> <ul style="list-style-type: none"> Replace pressure hose assembly if leak is caused by O-ring.
6. Filler cap	<ul style="list-style-type: none"> Check for damaged or missing reservoir cap or dipstick. Check oil level; correct as required. If leak continues, replace filler cap O-ring seal.

CG8331-A

REMOVAL AND INSTALLATION

The quick connect fitting may disengage if not fully assembled, if the snap ring is missing, or if the tube nut or the hose end is not machined properly.

If the fitting disengages, replace the hose and tube nut assembly. The fitting is fully engaged only when the hose will not pull out. To test for positive engagement, the system should be properly filled, the engine started, and the steering wheel cycled from lock-to-lock. Service hose assemblies have tube nuts, snap rings and O-rings already attached. Refer to External Leak Chart in this section.

Power Steering Pump Pulley

Removal

1. Remove the drive belt per the drive belt removal procedure shown in this section.
2. On some models, it may be necessary to remove the fan shroud to allow for proper installation and operation of the power steering pump pulley remover tool.
3. Install C-II Steering Pump Pulley Remover T69L-10300-B tool on the hub of the power steering pump pulley.
4. While holding the nut of the remover tool stationary with a wrench, rotate the inner spindle of the remover tool clockwise until the pulley is pulled off the shaft of the power steering pump.

NOTE: Do not apply pressure on the pump shaft. Pressure will damage internal thrust areas of the pump.

Installation

1. Place the pulley on the pump shaft.
2. Screw stud of the C-II Steering Pump Pulley Replacer T65P-3A733-C into end of power steering pump shaft.
3. While holding the inner spindle of the replacer stationary with a wrench, rotate the nut of the replacer tool clockwise until the pulley hub is flush within $\pm 0.25\text{mm}$ (± 0.010 inch) of the end of the pump shaft.

4. Remove the replacer tool and verify that the hub is flush with the end of the pump shaft.
5. If hub has been installed too far onto the shaft then pull back slightly using Pulley Remover Tool T69L-10300-B.
6. Install the fan shroud, if removed.
7. Install belt per the drive belt installation procedure shown in this section.

Power Steering Pump

Removal

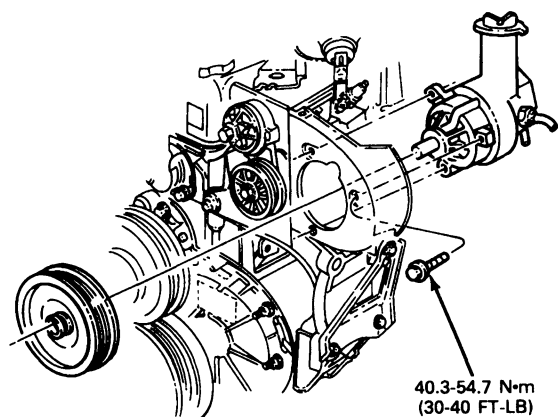
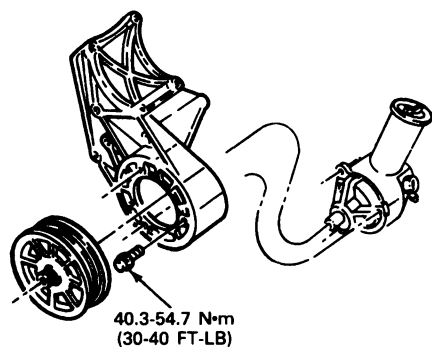
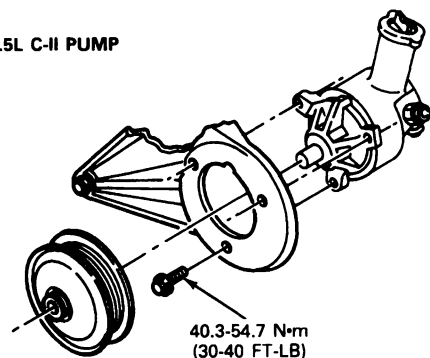
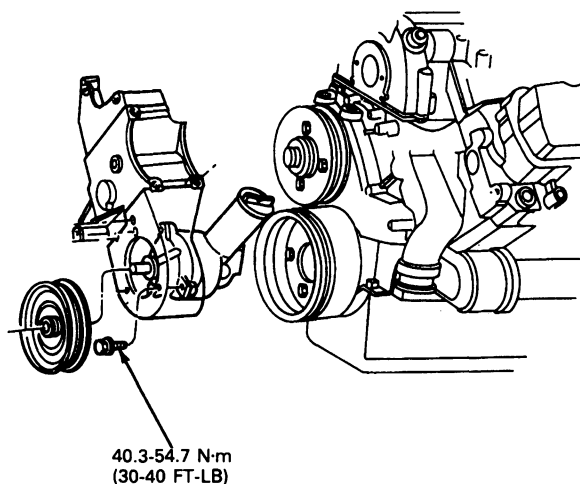
1. Disconnect power steering return hose at the pump connector and drain fluid.
2. Remove the pressure hose from the pump.
3. Remove drive belt. Refer to the procedure described in this section.
4. Remove the power steering pulley as outlined in this section.
5. Remove power steering attaching bolts and remove the power steering pump.

Installation

1. Position the power steering pump and install and tighten all attaching bolts. Refer to illustrations for bolt torques.
2. Install the power steering pulley as outlined in this section.
3. Install drive belt. Refer to the procedure described in this section.
4. Install the pressure hose tube nut into the pump outlet fitting and tighten to 45-54 N·m (30-40 ft-lb).
5. Connect return hose to pump and reposition the clamp.
6. Fill the reservoir with Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent. Start the engine and turn the steering wheel from left to right without hitting the stops to remove air from the system.

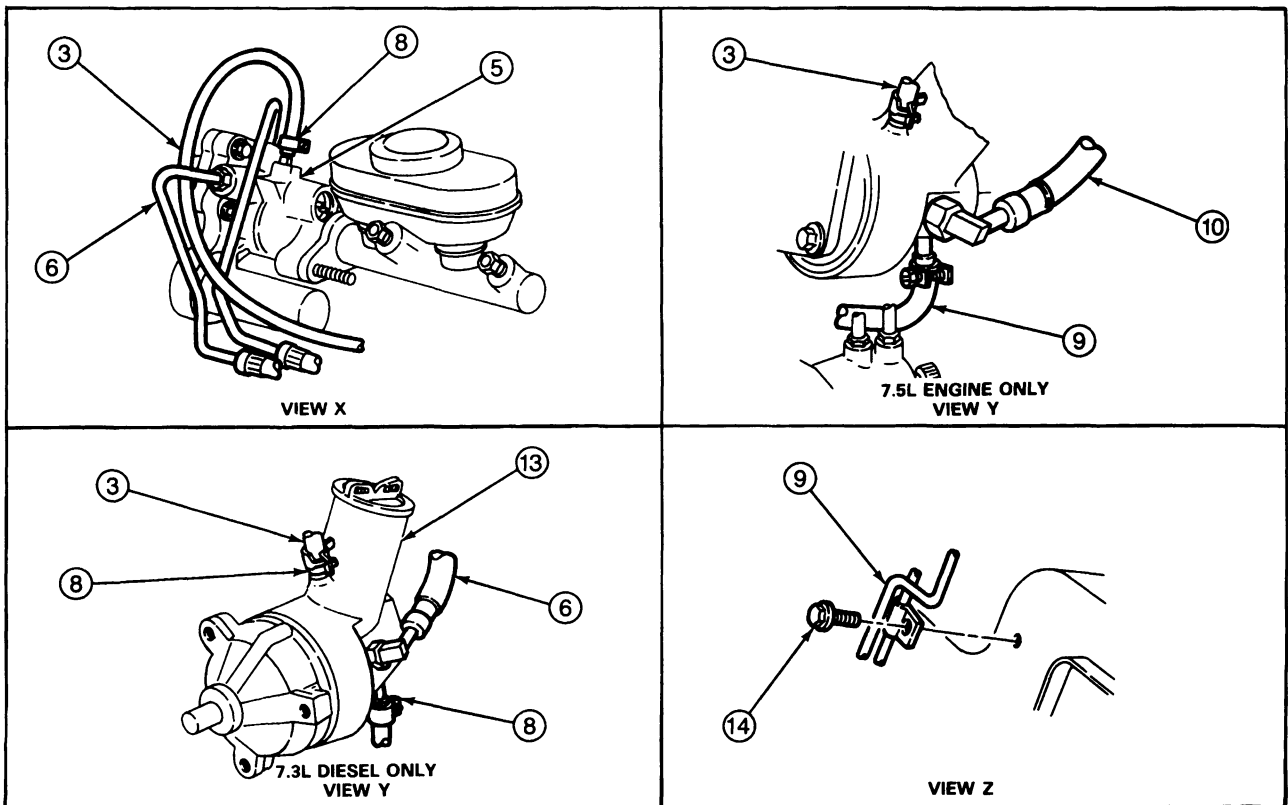
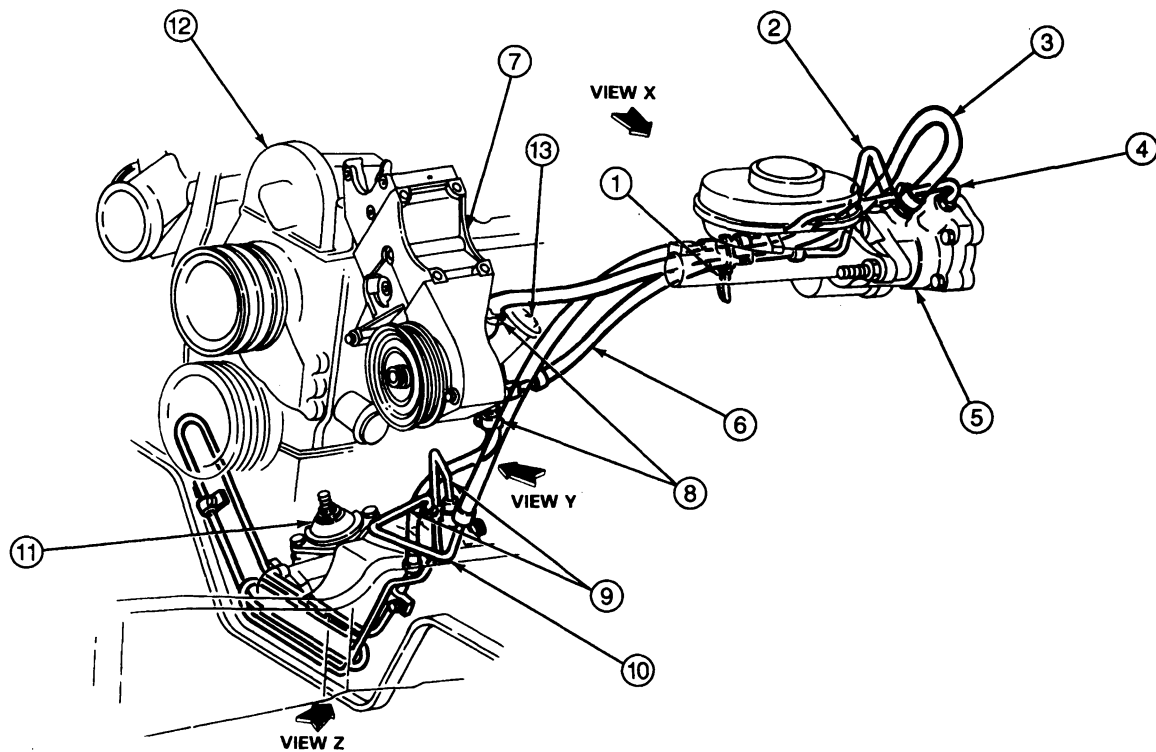
REMOVAL AND INSTALLATION (Continued)

7. Check for leaks and recheck the fluid level. Add fluid if necessary to proper level as specified in Section 11-00.

**4.9L C-II PUMP****5.0/5.8L C-II PUMP****G7667-B****7.5L C-II PUMP****G8332-A****7.3L C-II PUMP****G8333-A**

REMOVAL AND INSTALLATION (Continued)

Power Steering Pump Installation, F-Super Duty Chassis Cab



G6545-C

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	95873	Strap
2	3F523	Pressure Hose, Pump to Gear
3	3A005	Return Hose, Booster to Pump
4	3F524	Pressure Hose, Booster to Gear
5	2B559	Hydro-boost Assembly
6	3F523	Pressure Hose, Pump to Booster

(Continued)

Item	Part Number	Description
7	—	Fead Bracket
8	3C750	Clamp
9	3A713	Return Hose, Gear to Pump
10	3F524	Pressure Hose, Pump to Gear
11	3A500	Power Steering Gear
12	6007	Engine Assembly
13	3A674	Pump Assembly
14	40949	Screw 15-22 N-m (11-16 Ft-Lb)

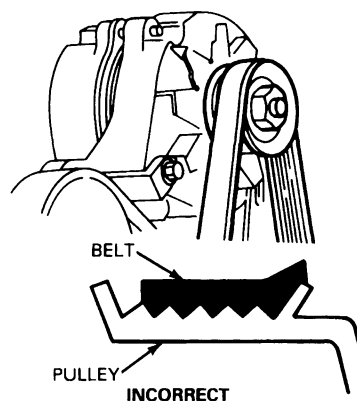
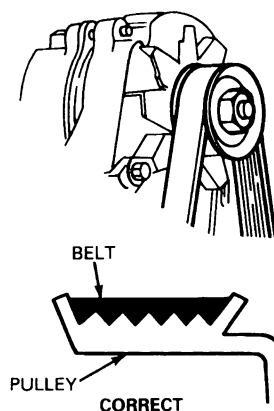
Drive Belt, Automatically Tensioned (4.9L, 5.0L, 5.8L, 7.3L and 7.5L)**Removal**

1. Install a 5/8-inch or 16mm closed end wrench on the tensioner pulley bolt and lift the tensioner arm away from the belt.
2. Remove belt. Release tensioner arm slowly. Do not allow arm to snap back after the belt is removed because this may damage the tensioner.

Installation

1. Install closed end wrench on the tensioner pulley bolt and rotate the tensioner arm clockwise for the 4.9L and counterclockwise for the 5.0L, 5.8L, 7.3L and 7.5L engines.
2. Install belt over pulleys making sure all six belt ribs are correctly seated in the pulley grooves. Release tensioner.

NOTE: Make sure correct seating on all pulleys. One revolution of the engine with an incorrectly seated belt may snap tensile members in the belt.



Q1696-F

Rotor Shaft Seal

Replacement of the rotor shaft seal requires pump disassembly. Refer to the Disassembly and Assembly procedures in this section for seal replacement.

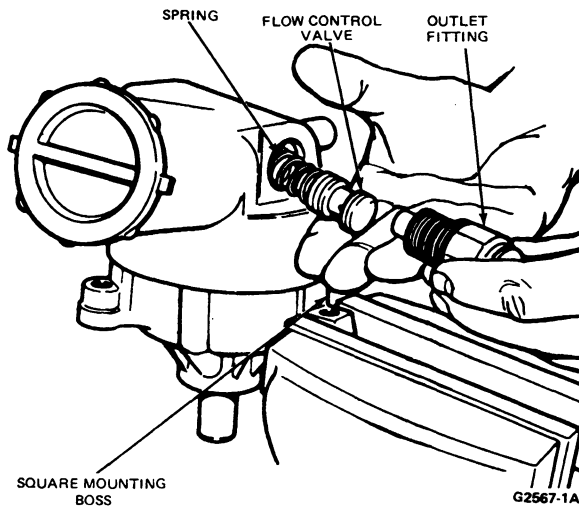
REMOVAL AND INSTALLATION (Continued)**Power Steering Pump Reservoir**

Take the following precautions when servicing the power steering pump reservoir:

1. Use a clean workbench and tools.
2. Plug the inlet and outlet openings of the pump with plugs or masking tape.
3. Thoroughly clean the exterior of the pump with solvent.

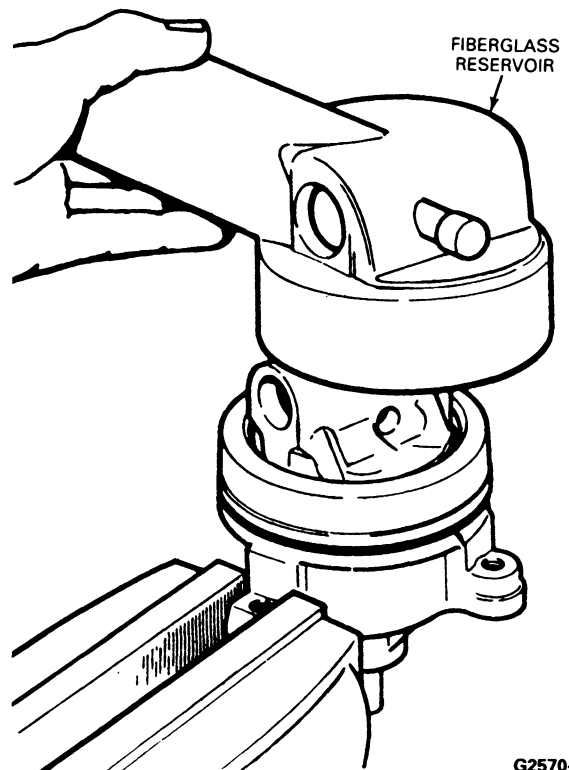
Removal

1. Place the pump assembly in a bench vise with soft jaws, and remove the outlet fitting, flow control valve and spring. Discard all seals.



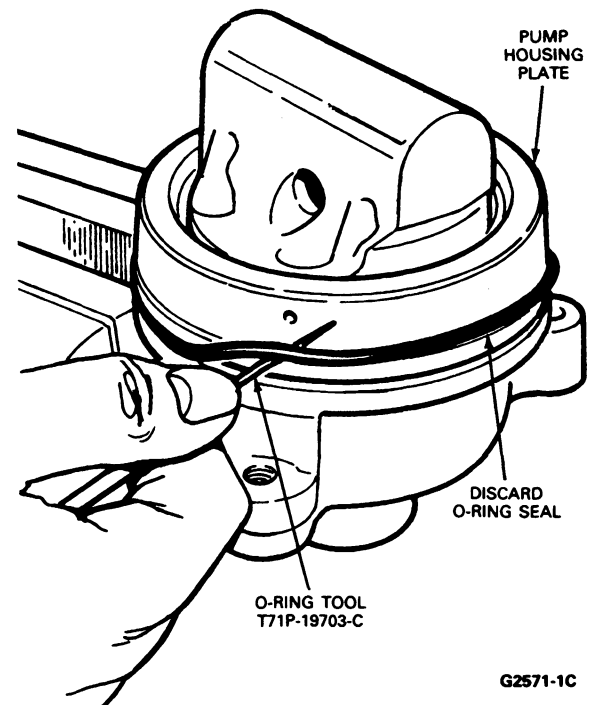
2. Lift fiberglass reservoir off pump housing.

NOTE: Do not hammer on reservoir.



G2570-1C

3. Discard O-ring seal on pump housing plate.



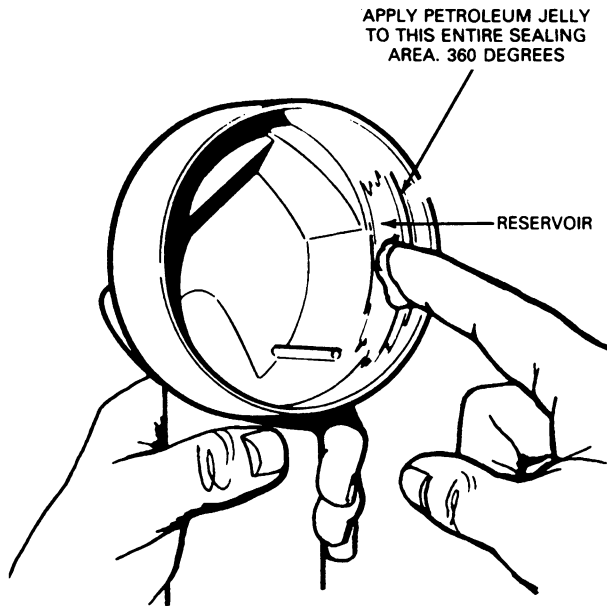
G2571-1C

Installation

1. Install a new O-ring seal on the pump housing plate.

REMOVAL AND INSTALLATION (Continued)

2. Apply petroleum jelly to the reservoir O-ring seal and the inside edge of the reservoir. Do not twist the O-ring seal.

Lubricating O-ring Seal

G2572-1B

3. Place the reservoir over the pump. Align the outlet fitting hole in the reservoir with the hole in the valve cover.
4. Be sure the reservoir is evenly seated on the pump housing plate.
5. Place a new O-ring seal on the outlet fitting. Install the spring, flow control valve and outlet fitting into the reservoir and valve cover. Tighten the fitting to 34-54 N·m (25-40 ft·lb).

NOTE: If the valve is cocked, it may become stuck in the valve cover. Do not force the valve forward; forcing the valve may shear off metal and carry the metal chips into the valve bore.

DISASSEMBLY AND ASSEMBLY**Power Steering Pump**

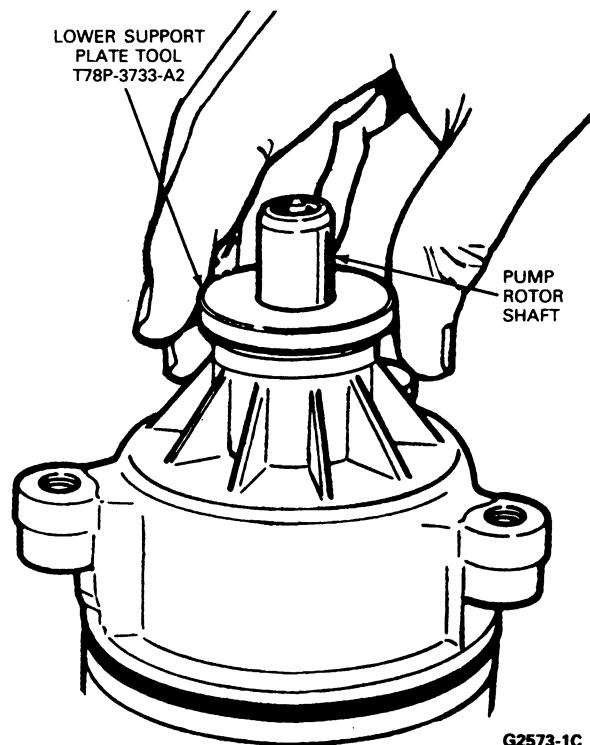
NOTE: Prior to disassembly of the power steering pump, the pump must be removed from the vehicle. Refer to removal and installation procedures in this section.

The following precautions must be observed when servicing the power steering pump:

1. Use a clean workbench and tools.
2. Thoroughly clean the exterior of the pump with solvent. Drain as much fluid as possible.
3. Do not use cleaning solvent on the seals.

Disassembly

1. Remove the outlet fitting, flow control valve, and spring from the pump. Remove the pump reservoir by lifting the pump housing.
2. Place C-clamp T74P-3044-A1 in a bench vise.
3. Place the lower support plate T78P-3733-A2 over the pump rotor shaft.



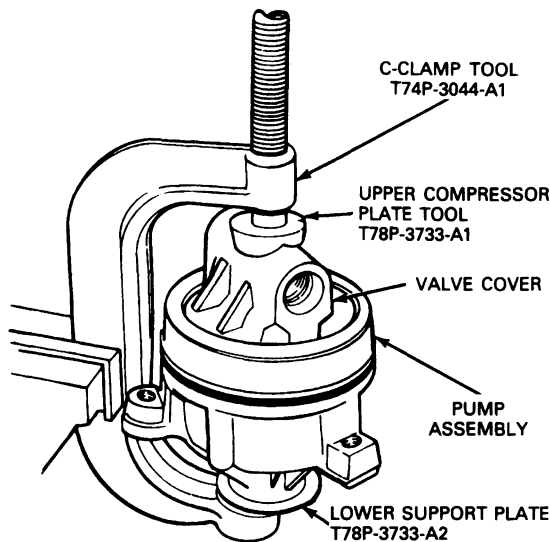
G2573-1C

4. Install the upper compressor plate tool T78P-3733-A1 into the upper portion of the C-clamp.

DISASSEMBLY AND ASSEMBLY (Continued)

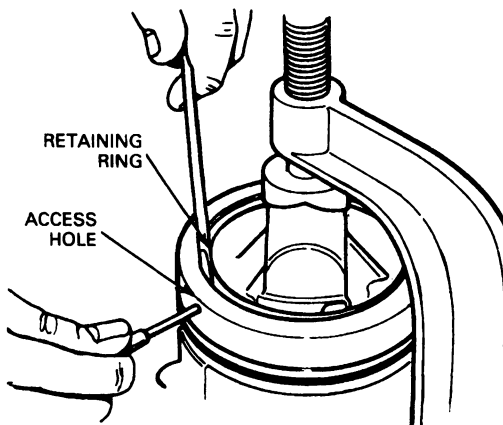
5. While holding the upper compressor tool, place the pump assembly into the C-clamp with the rotor shaft facing down.

NOTE: Position the contour of the upper compressor tool to fit the contour of the pump valve cover.



G2574-C

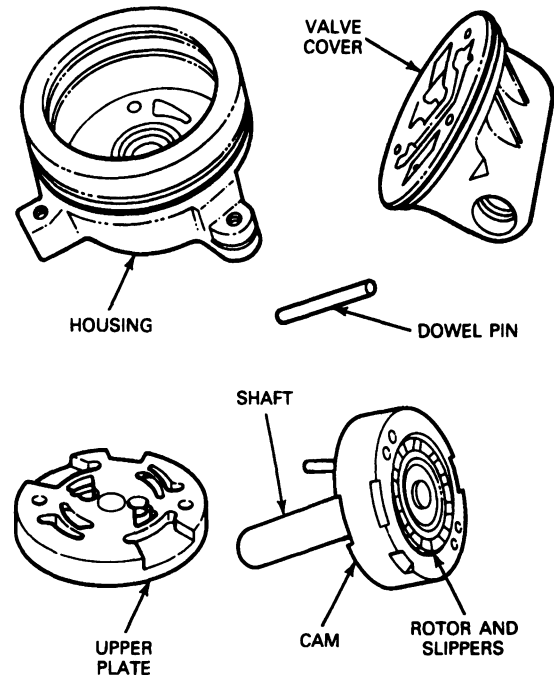
6. Tighten C-clamp until a slight bottoming of the valve cover is felt.
7. In the side of the pump housing plate is a small hole. Insert a small drift or suitable tool through this hole and push inward on the valve cover retaining ring. While applying pressure on the retaining ring, place a screwdriver under the edge of the retaining ring and remove the ring.



G2575-B

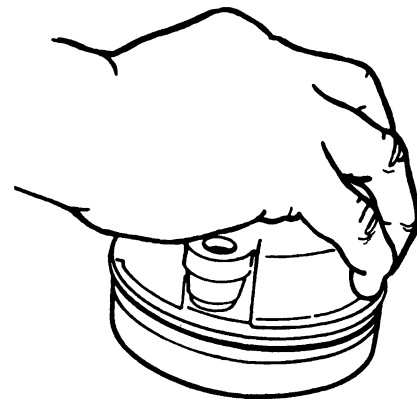
8. Loosen C-clamp. Remove the upper compressor plate, and remove the pump assembly.

9. Remove the pump valve cover. Discard the O-ring seal.
10. Push on the rotor shaft, and remove the rotor shaft, upper plate, rotor and slippers, cam insert and two dowel pins.



G2545-G

11. The lower plate and the disc spring will remain in the pump housing plate. To remove, place the pump housing plate on a flat surface. Raise slightly and slam the housing plate down until the lower plate and the disc spring fall out. Discard the O-ring seals.

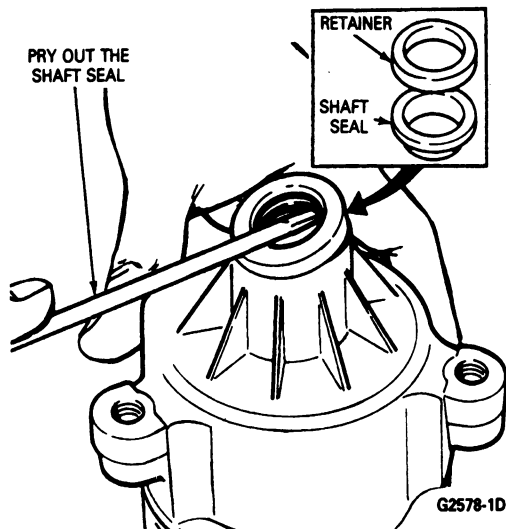


G2577-C

DISASSEMBLY AND ASSEMBLY (Continued)

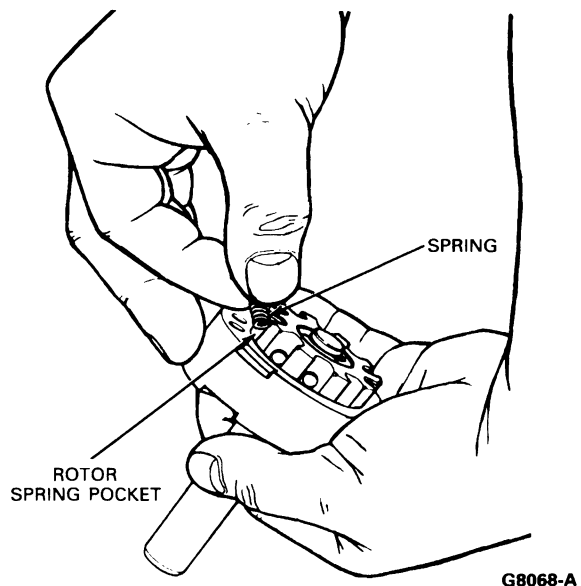
12. Remove the rotor shaft seal and seal retainer simultaneously by prying out with a screwdriver.

NOTE: This method is used only when the pump is disassembled.

**Assembly**

If the rotors, slippers, spring and cam insert were disassembled for cleaning and / or inspection, assemble as follows:

1. Place the rotor on the rotor shaft splines.
2. Install the retaining ring in the groove at the end of the rotor shaft using Retaining Ring Pliers D79L-7000-A or equivalent.
3. Place the insert cam over the rotor. Be sure the recessed flat on the insert cam is toward the reservoir.
4. With the rotor extended upward approximately half-way out of the cam, insert a spring into a rotor spring pocket.



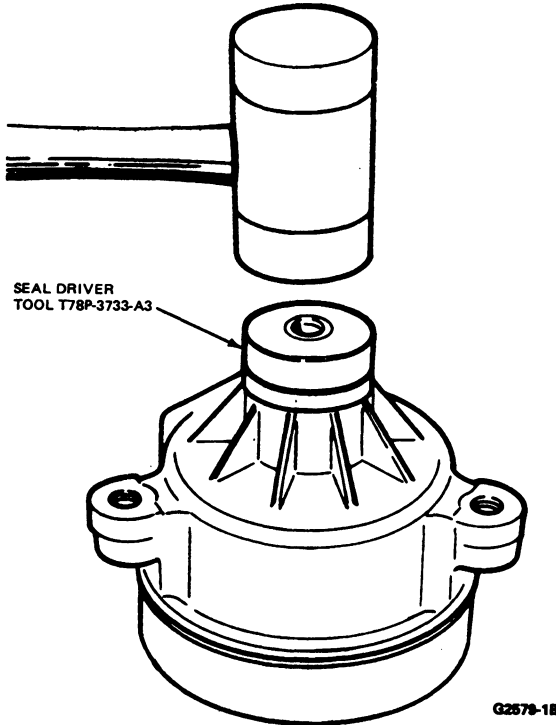
5. Use one of the slippers to compress the spring and install the slipper with the narrow groove facing upward.

NOTE: The slippers must be oriented with the narrow rail spacing toward the cam, otherwise the pump will not function.

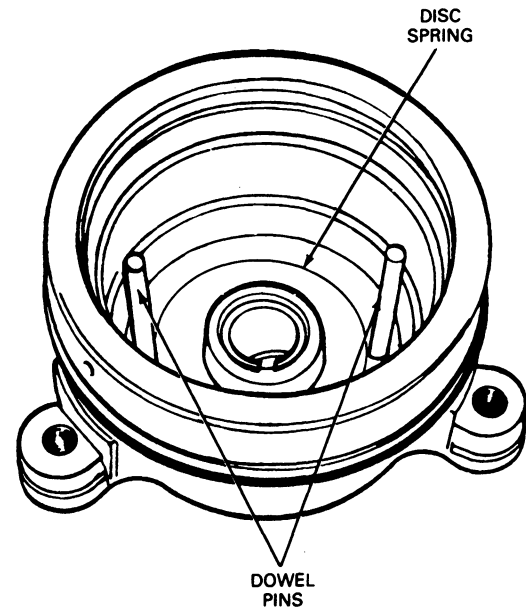
6. Hold the cam stationary, and turn the rotor either right or left one space at a time. Install another spring and slipper until all ten rotor cavities have been filled. Be careful when turning the rotor, that the springs and slippers already installed do not fall out.

DISASSEMBLY AND ASSEMBLY (Continued)

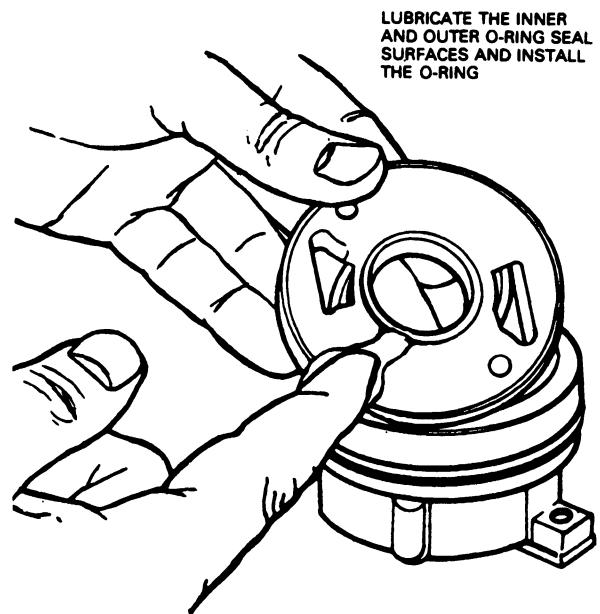
7. Install a new rotor shaft seal using Seal Driver T78P-3733-A3. Using a plastic mallet, drive the seal into the bore until a bottoming is felt. Install the seal retainer in the same manner.



8. Place the pump housing plate on a flat surface, with the pulley side facing down.
9. Insert the two dowel pins and the disc spring into the housing plate.
- NOTE: The disc spring must be inserted with the dished surface upward.

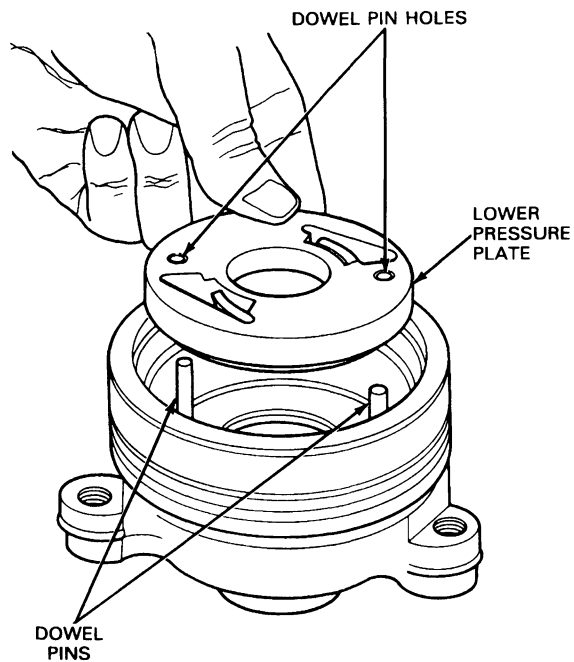


10. Lubricate the inner and outer O-ring seals with the specified power steering fluid and install these seals on the lower pressure plate.



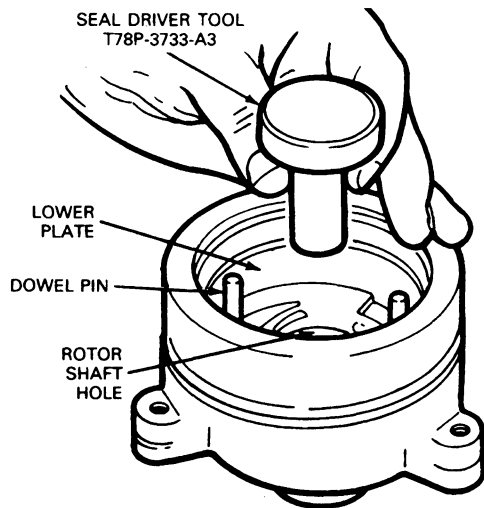
DISASSEMBLY AND ASSEMBLY (Continued)

11. Insert the lower pressure plate with the O-ring seals toward the front of the pump into the pump housing plate and over the dowel pins.

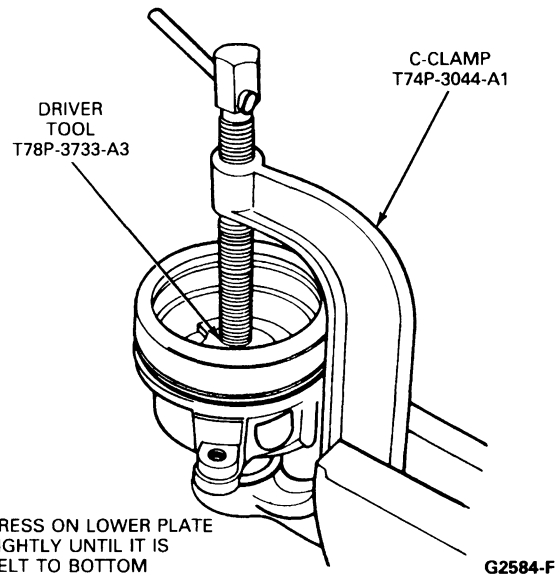


G2582-D

12. Place the entire assembly on the C-clamp.
13. Place driver T78P-3733-A3 into the rotor shaft hole and press on the lower plate lightly until it is felt to bottom into the pump plate housing. This operation will seat the outer O-ring seal.



G2602-1B

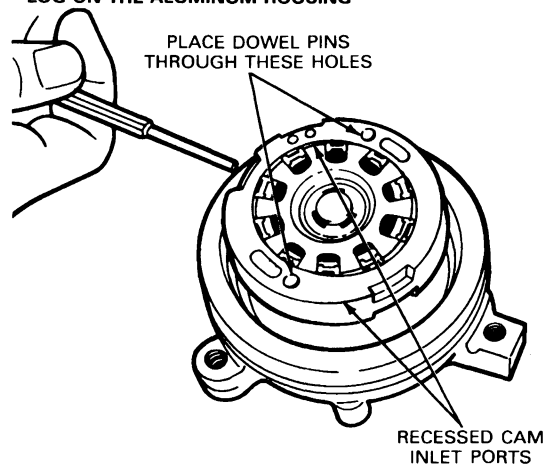


G2584-F

14. Install the cam, rotor and slippers, and rotor shaft assembly into the pump housing plate over the dowel pins.

NOTE: When installing this assembly into the pump housing plate, the stepped holes must be used for the dowel pins, and the recessed notch in the cam insert must face toward the reservoir and be approximately 180 degrees opposite the square pump mounting boss.

RECESSED NOTCH IN CAM INSERT APPROXIMATELY 180 DEGREES OPPOSITE THE SQUARE MOUNTING LUG ON THE ALUMINUM HOUSING

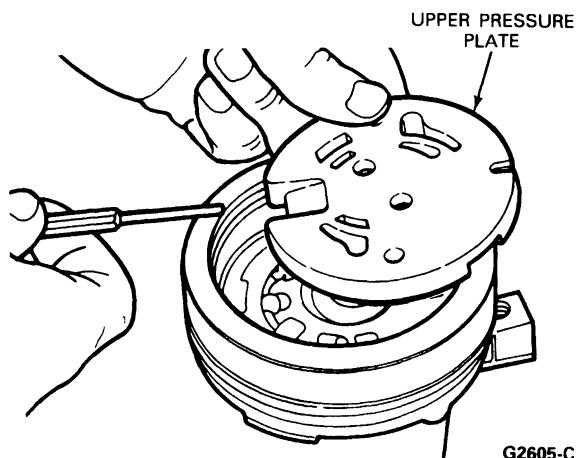


G2604-J

DISASSEMBLY AND ASSEMBLY (Continued)

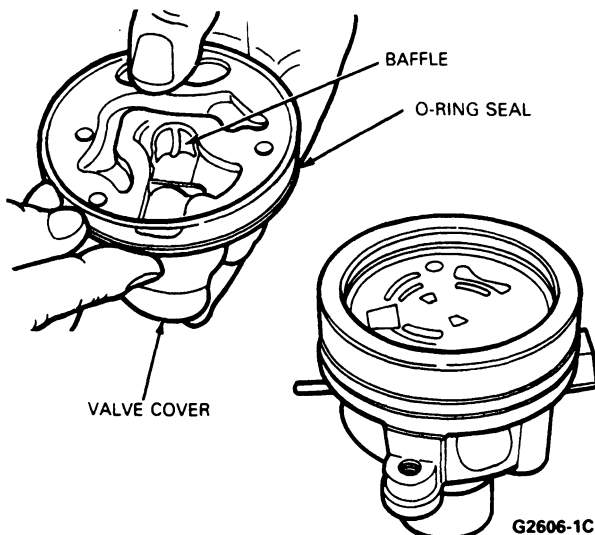
15. Place the upper pressure plate over the dowel pins.

NOTE: When installing the upper plate into the pump housing, observe the notch on the outside diameter of the plate. One side has a square recess cast into the plate. This square recess must be facing toward the reservoir and positioned approximately 180 degrees opposite the pump square mounting boss.



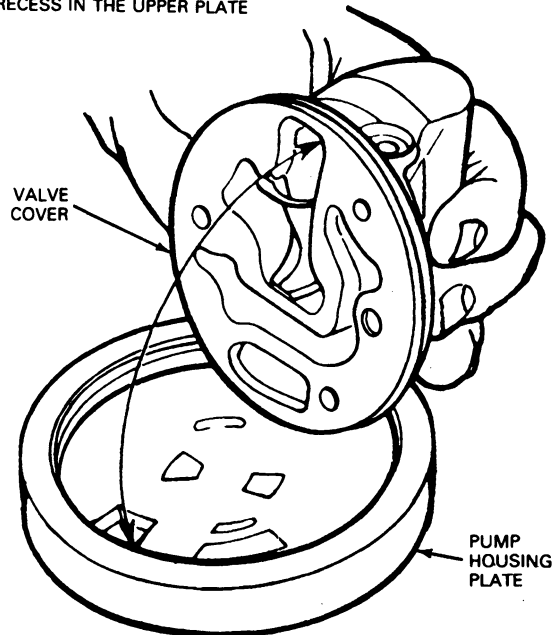
16. Place a new O-ring seal on the valve cover. Lubricate this seal with specified power steering fluid.

NOTE: Be sure the plastic baffle is securely in place in the valve cover. If the baffle is loose, apply a coating of petroleum jelly on the baffle and install it into location on the valve cover.

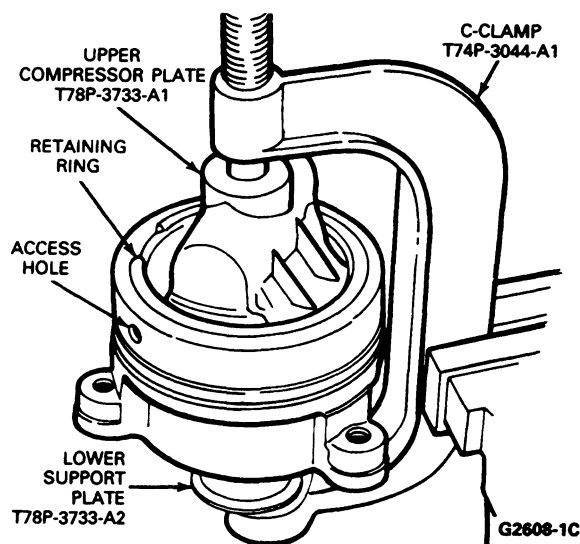


17. Insert valve cover over the dowel pins. Be sure the outlet fitting hole in the valve cover is directly in line with the square mounting boss of the pump housing plate.

PRESSURE CHANNEL IN THE VALVE COVER FITS DIRECTLY OVER THE RECESS IN THE UPPER PLATE



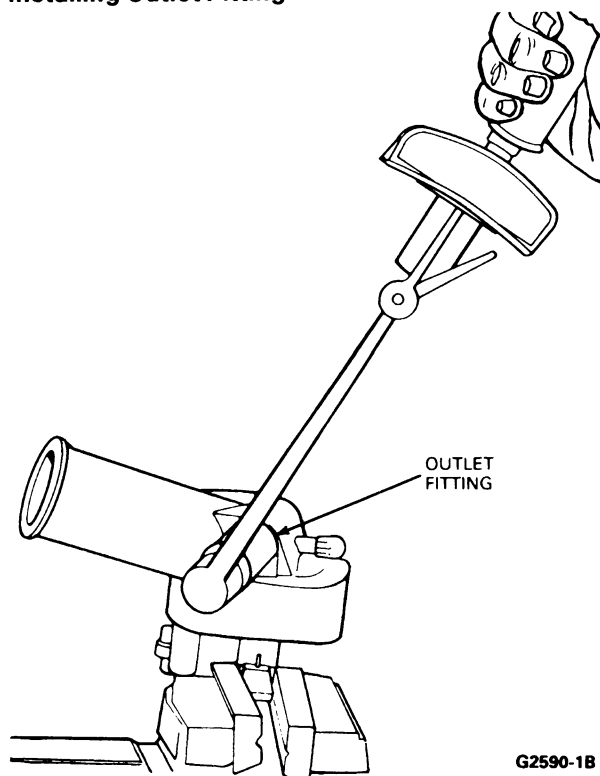
18. Place the entire assembly in the C-clamp T74P-3044-A 1 and compress the valve cover into the pump housing plate, until the retaining ring groove is exposed in the pump housing plate.
19. Install the valve cover retaining ring with the ends near the access hole in the pump housing plate.



20. Remove the pump assembly from the C-clamp tool.
21. Place a new O-ring seal on the pump housing plate. Lubricate O-ring seal with the specified power steering fluid.
22. Install the power steering reservoir.

DISASSEMBLY AND ASSEMBLY (Continued)

23. Install the flow control spring and flow control valve into the valve cover.
24. Place new O-ring seals on the outlet fitting. Lubricate these seals with the specified power steering fluid.
25. Install the outlet fitting into the valve cover and tighten to 34-54 N·m (25-40 ft-lb).

Installing Outlet Fitting

G2590-1B

ADJUSTMENTS**Pump Belt Tension Adjustment**

The drivebelt tension is maintained by an automatic belt tensioner and cannot be adjusted.

SPECIFICATIONS**C-II POWER STEERING PUMP TORQUE SPECIFICATIONS**

Description	4.9L (300 CID) I-6		5.0L (302 CID) V-8		5.8L (351 CID) V-8	
	N·m	(Ft-Lbs)	N·m	(Ft-Lbs)	N·m	(Ft-Lbs)
Pump to Support Bracket	40-55	30-41	40-55	30-41	40-55	30-41
Pump Outlet Fitting to Pump	34-54	25-40	34-54	25-40	34-54	25-40
Pressure Line Fitting at Steering Gear	30-40	20-30	30-40	20-30	30-40	20-30
Return Line Fitting at Steering Gear	30-40	20-30	30-40	20-30	30-40	20-30
Return Line to Frame Crossmember	15-20	11-16	15-20	11-16	15-20	11-16

TG8064A

C-II POWER STEERING PUMP TORQUE SPECIFICATIONS

Description	7.5L (460 CID) Gas Engine		7.3L Diesel Engine	
	N·m	(Ft-Lbs)	N·m	(Ft-Lbs)
Pump to Support Bracket	40-55	30-41	40-55	30-41
Pump Outlet Fitting to Pump	34-54	25-40	34-54	25-40

(Continued)

SPECIFICATIONS (Continued)

C-II POWER STEERING PUMP TORQUE SPECIFICATIONS (Cont'd)


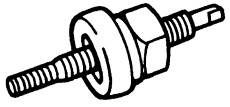
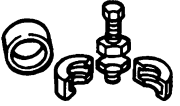


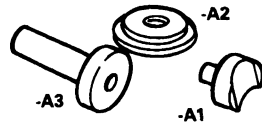
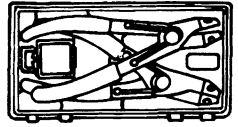
Description	7.5L (460 CID) Gas Engine		7.3L Diesel Engine	
	N-m	(Ft-Lbs)	N-m	(Ft-Lbs)
Pressure Line Fitting at Steering Gear	30-40	20-30	30-40	20-30
Pressure Line Fittings at Brake Booster	30-40	20-30	30-40	20-30
Return Line Fitting at Steering Gear	30-40	20-30	30-40	20-30
Return Line to Frame Crossmember	15-20	11-16	15-20	11-16

TG2646A

SPECIAL SERVICE TOOLS

Refer to the following chart for tools described in this section.

SPECIAL SERVICE TOOLS

ILLUSTRATION	TOOL NUMBER/DESCRIPTION
	T63L-8620-A BELT TENSION GAUGE
	T65P-3A733-C STEERING PUMP PULLEY REPLACER
	T69L-10300-B STEERING PUMP PULLEY REMOVER
	T71P-19703-C O-RING TOOL
	T74P-3044-A1 C-FRAME AND CLAMP ASSEMBLY
	T78P-3733-A POWER STEERING PUMP TOOLS
	D79L-7000-A RETAINING RING PLIERS (7053K)

G7604-A

SECTION 11-02B Steering Gear, Power, Bendix, Compact C-300N

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DISASSEMBLY AND ASSEMBLY (Cont'd.)	
Adjusting the Piston to Output Shaft Gear Backlash.....	11-02B-22	Cleaning.....	11-02B-14
DESCRIPTION AND OPERATION		Disassembly.....	11-02B-7
Description.....	11-02B-1	Inspection.....	11-02B-14
Operation.....	11-02B-2	REMOVAL AND INSTALLATION	
DIAGNOSIS AND TESTING	11-02B-2	Steering Gear.....	11-02B-2
DISASSEMBLY AND ASSEMBLY		SPECIAL SERVICE TOOLS/EQUIPMENT	11-02B-25
Assembly.....	11-02B-15	SPECIFICATIONS	11-02B-25
		VEHICLE APPLICATION	11-02B-1

VEHICLE APPLICATION

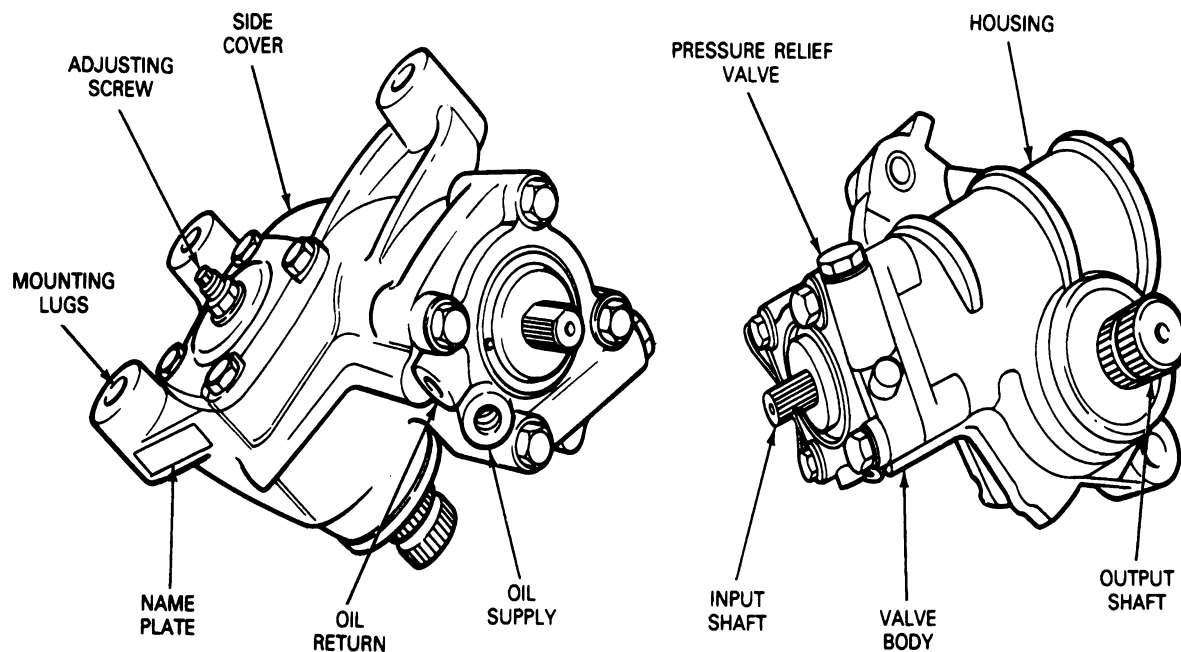
All F-Super Duty Commercial Chassis Vehicles and Motorhome Chassis Vehicles

DESCRIPTION AND OPERATION

Description

The Compact 300N, or C-300N, Power Steering Gear is designed for medium duty vehicles with front axle weight ratings of 6,000 to 9,000 pounds.

C-300N Power Steering Gear



G6223-2A

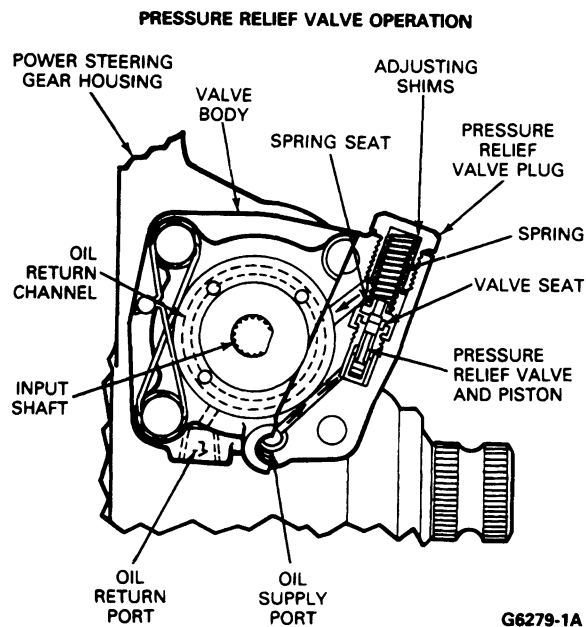
DESCRIPTION AND OPERATION (Continued)

Operation

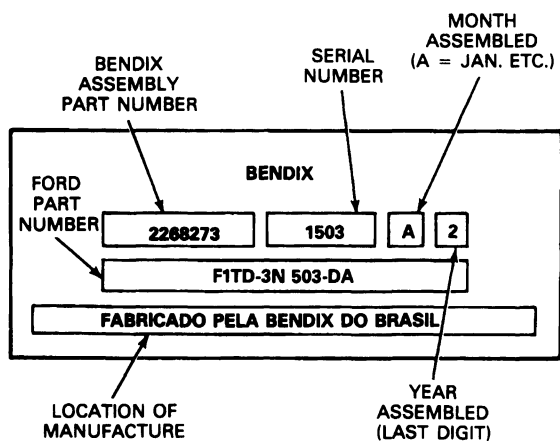
The C-300N Power Steering Gear is composed of both mechanical and hydraulic power assist components.

Pressure Relief Valve

Located in the valve body, the pressure relief valve limits hydraulic pressure within the power steering gear to a preset maximum.

**Power Steering Gear Identification**

A nameplate is attached to the exterior of the housings, generally on one of the mounting lugs.

POWER STEERING GEAR NAMEPLATE INFORMATION

DIAGNOSIS AND TESTING

Refer to Section 11-00.

REMOVAL AND INSTALLATION

Steering Gear

During the steering gear removal, observe the following precautions:

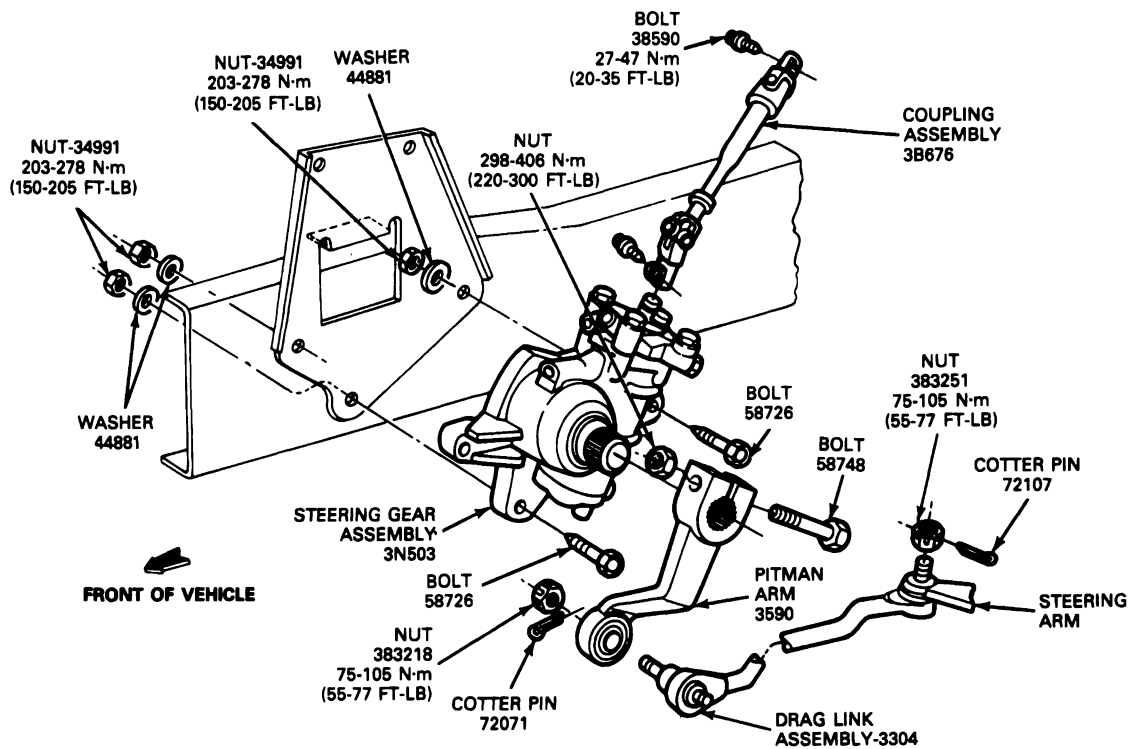
- Drain steering assembly.
- Thoroughly clean off all outside dirt, especially around fittings.
- Plug all port holes immediately after removing hoses and before removing the gear from the vehicle. Mark or identify the inlet and return lines at the valve body ports.
- Finish cleaning and dry the gear before placing on a work bench.

CAUTION: Never steam clean or high-pressure wash hydraulic steering assemblies. Do not force or abuse closely fitted parts, or damage will result.

CAUTION: Do not forcefully strike the steering gear input shaft or steering column coupling with a hammer or any other object during removal or installation of the steering column coupling. Severe internal damage to the steering gear can result.

REMOVAL AND INSTALLATION (Continued)

Steering Gear Installation, Commercial Chassis Vehicles



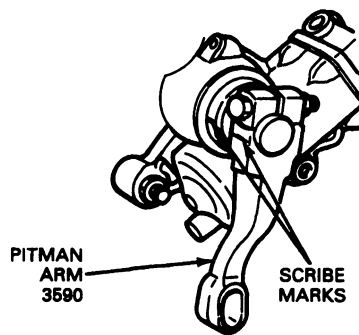
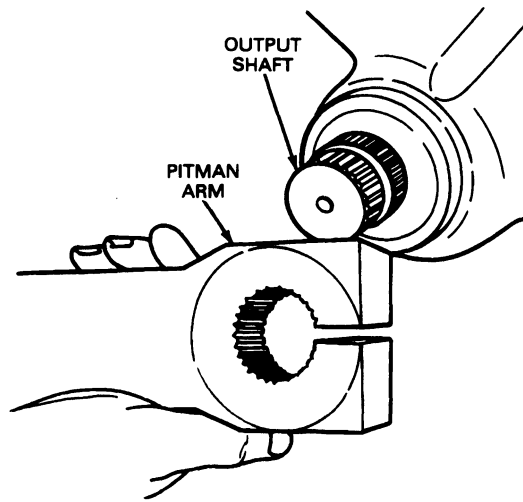
G6538-D

Removal

1. Disconnect the power steering pressure line at the gear.
2. Disconnect the power steering return line at the gear.

REMOVAL AND INSTALLATION (Continued)

3. Scribe a line or otherwise mark the relationship of the pitman arm to the output shaft.

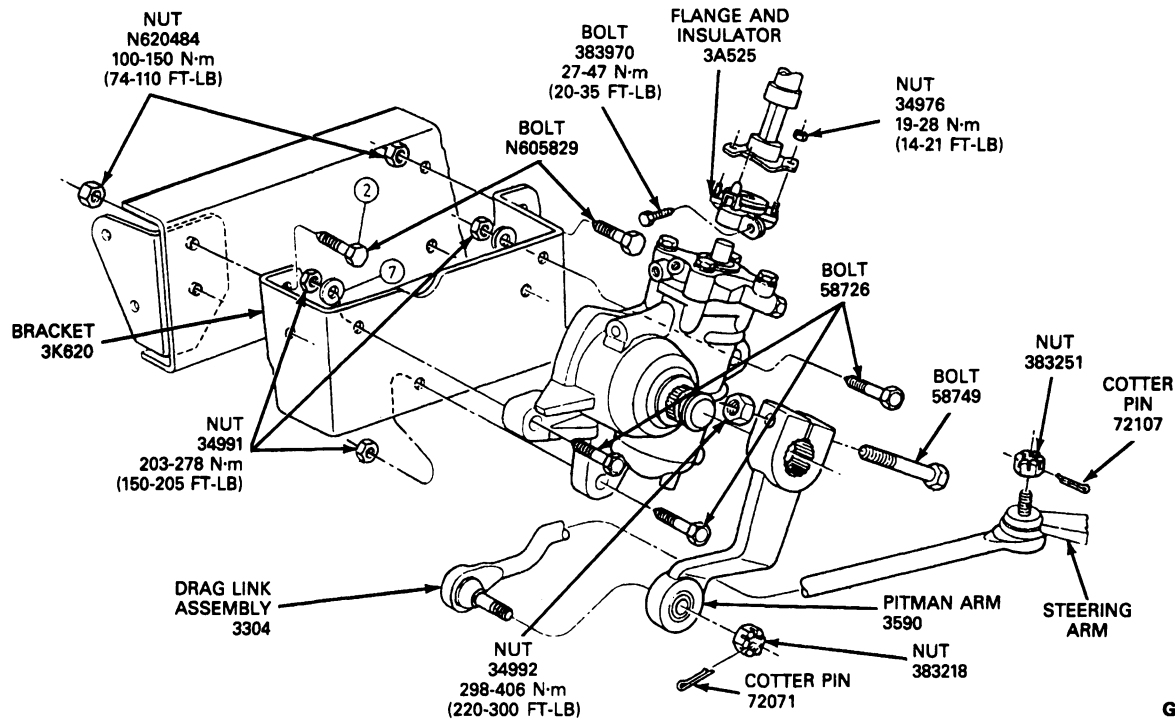


G6287-C

4. Remove the bolt and nut holding the pitman arm to the sector shaft. Remove the pitman arm from the sector shaft using steering Pitman Arm Puller Tool T64P-3590-F.
5. Remove the bolt and nut holding the flange and insulator or coupling shaft to the steering gear input shaft.
6. Remove the bolts and nuts holding the steering gear to the frame side rail. Remove the steering gear from the vehicle.

REMOVAL AND INSTALLATION (Continued)

Steering Gear Installation, Motorhome Chassis Vehicles



G6750-B

Installation

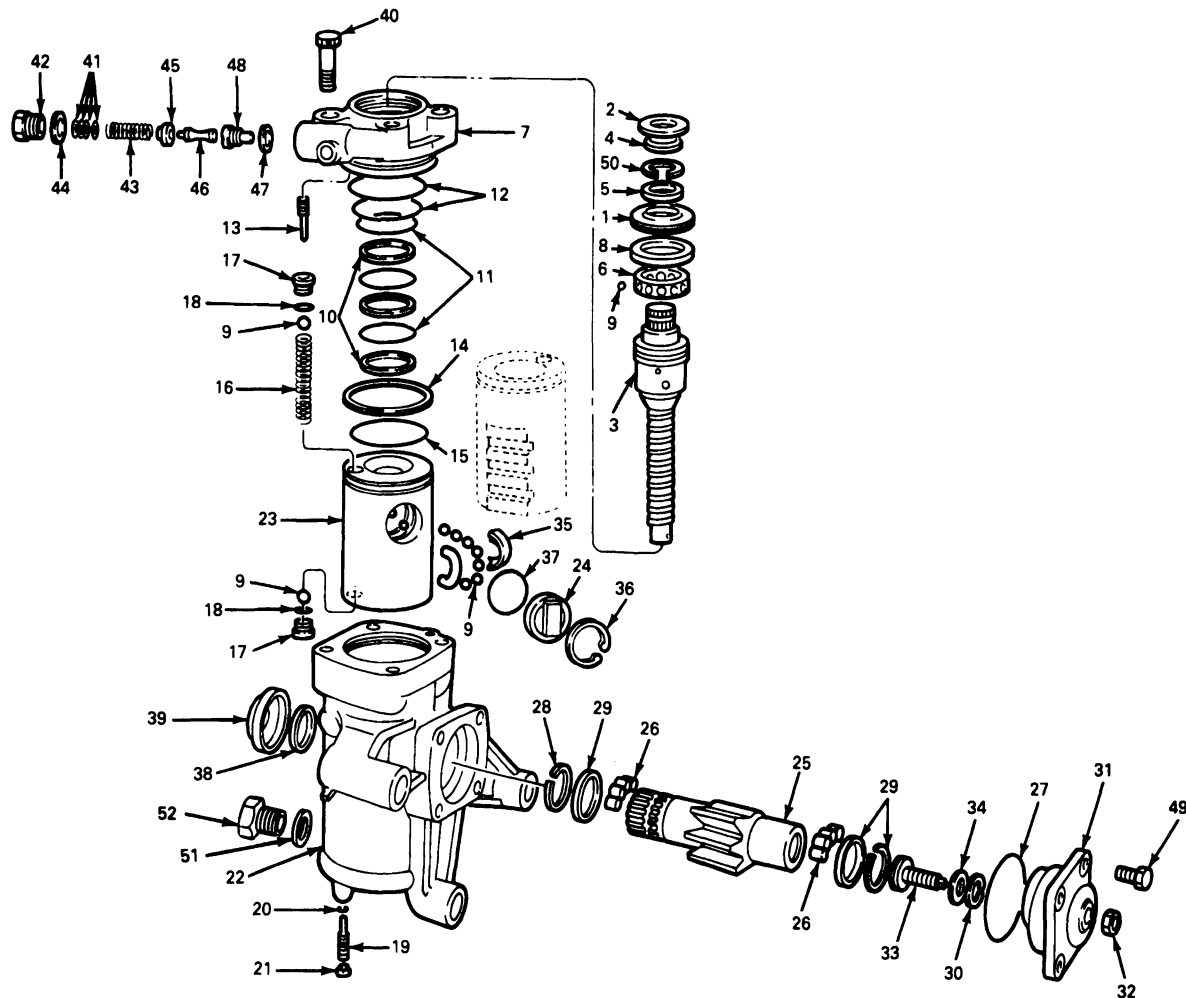
1. Place the gear on the side rail. Install the bolts and nuts and tighten to 203-278 N·m (150-205 ft-lb).
2. Place the intermediate shaft U-joint or flange and insulator on the steering gear input shaft. Tighten to 27-47 N·m (20-35 ft-lb).
3. Place the pitman arm on the steering gear sector shaft, making sure the timing mark on the pitman arm aligns with the timing mark on the sector shaft. Use a chisel to help spread the pitman arm to slide onto the sector shaft.

WARNING: DO NOT USE A HAMMER TO FORCE THE PITMAN ARM ONTO THE SECTOR SHAFT. THIS MAY LEAD TO DAMAGE OF THE SECTOR SHAFT BEARINGS AND A LOSS OF GEAR PRELOAD.

4. Install the bolt and nut. Tighten the nut to 299-406 N·m (220-300 ft-lb).
5. Connect the power steering pressure and return lines to the gear.
6. Fill the reservoir with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or -DDX (E6AZ-19582-B) or equivalent.
7. Start the engine, turn the steering wheel from left to right, and check for fluid leaks.

REMOVAL AND INSTALLATION (Continued)

C-300N Power Steering Gear, Disassembled



G6282-C

Item	Description
1	Valve Nut and O-Ring
2	External Dust Seal
3	Spindle Assembly
4	Internal Dust Seal
5	Seal
6	Ball Cage
7	Valve Body
8	Ball Race
9	Ball
10	Teflon Ring
11	O-Ring
12	O-Ring
13	Steering Limiting Stem
14	Seal Ring
15	O-Ring
16	Spring
17	Valve Seat
18	Sealing Washer
19	Steering Limiting Stem

(Continued)

Item	Description
20	O-Ring
21	Plug
22	Housing
23	Piston
24	Tube Cover
25	Output Shaft
26	Rollers
27	O-Ring
28	Backup Ring
29	Seal
30	Retaining Ring
31	Side Cover
32	Nut
33	Adjusting Screw
34	Adjusting Screw Spacer
35	Ball Tube
36	Retaining Ring
37	O-Ring
38	Dust Seal

(Continued)

REMOVAL AND INSTALLATION (Continued)

Item	Description
39	Dust Boot
40	Bolt
41	Adjusting Shims
42	Pressure Relief Valve Plug
43	Spring
44	Sealing Washer
45	Spring Seat

(Continued)

Item	Description
46	Valve Piston
47	Seal Washer
48	Valve Seat
49	Bolt
50	Retaining Ring
51	Seal Washer
52	Drain Plug

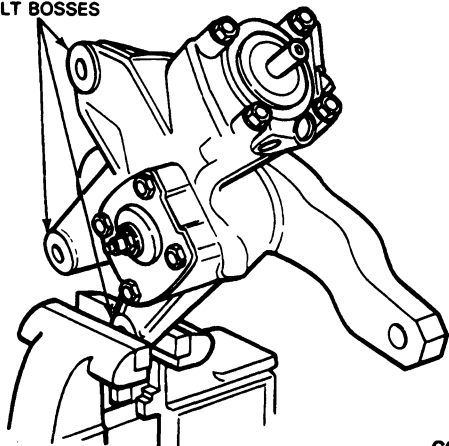
DISASSEMBLY AND ASSEMBLY**Disassembly****Steering Gear**

A high level of cleanliness should be observed at all times when working on the power steering gear.

1. Clean the exterior of all parts prior to disassembly.
2. Removing the power steering unit from the vehicle and cleaning the outside.
3. Secure the power steering unit to the work bench for disassembly. A large vise with jaw protectors may be used. Clamp across the mounting bolt bosses. Do not overtighten.

NOTE: If the steering gear was removed from the vehicle without the pitman arm, then the pitman arm must be removed from the drag link assembly and installed on the steering gear for disassembly, Step 3. Remove the pitman arm from the drag link end stud using Tie Rod End Remover TOOL-3290-D and place the pitman arm onto the steering gear output shaft, making sure the timing mark on the pitman arm aligns with the timing mark on the output shaft. Install the bolt and nut and hand tighten. If possible, remove the steering gear and pitman arm from the vehicle as an assembly.

HOUSING
MOUNTING
BOLT BOSSES

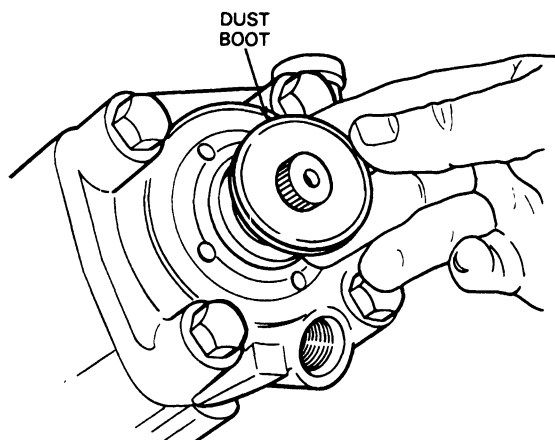


G6283-1A

NOTE: The following disassembly and assembly procedures are presented for reference purposes and presupposes that a major rebuild of the power steering gear is being undertaken. Several replacement parts and maintenance kits are available which do not require full disassembly. The instructions provided with these parts and kits should be followed in lieu of the instructions presented here.

Input Shaft

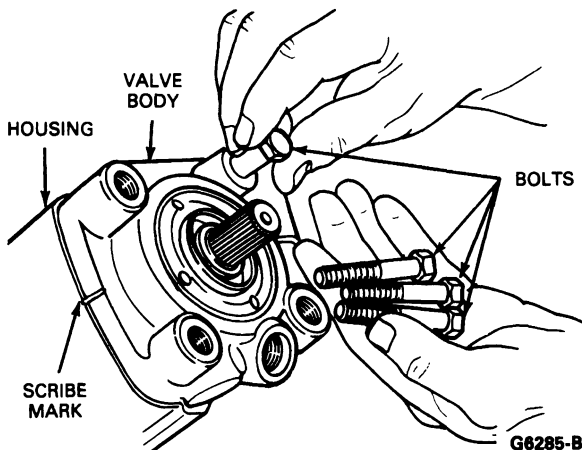
1. Remove the external dust boot from the spindle assembly's input shaft spline.



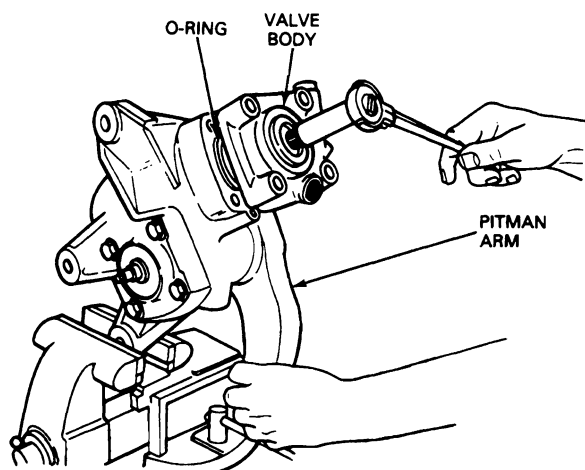
G6284-1A

DISASSEMBLY AND ASSEMBLY (Continued)

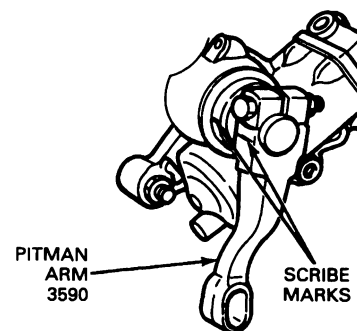
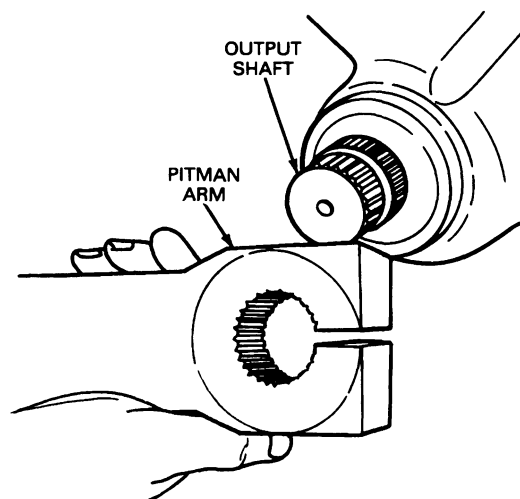
2. Scribe a line or otherwise mark the relationship of the valve body to the housing. Using a 19mm wrench remove the four bolts that secure the valve body to the housing.



3. Separate the valve body from the housing by rotating the output shaft using the pitman arm. It may be necessary to hold or rotate the input shaft during this operation. Continue to separate the valve body from the housing until both O-rings on the valve body can be seen.

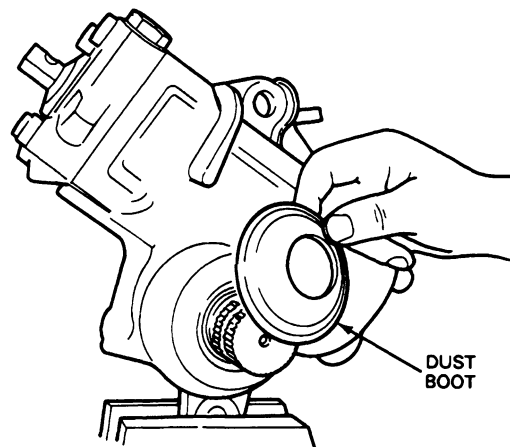


4. Scribe a line, or otherwise mark the relationship of the pitman arm to the output shaft, then remove the pitman arm.



5. Remove the dust boot.

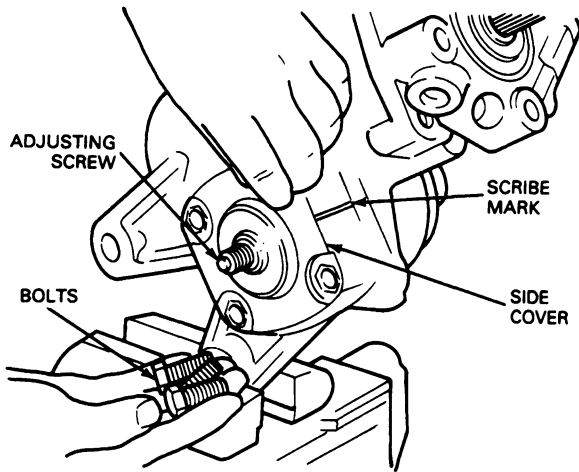
Remove any accumulated dirt, grease, grime, and corrosion from the exposed portion of the output shaft to facilitate removal through its seals.



6. Loosen and remove the locknut from adjusting screw on the side cover using a 19mm wrench.

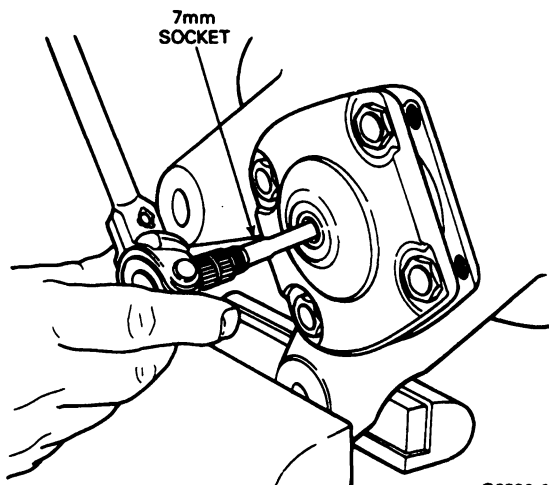
DISASSEMBLY AND ASSEMBLY (Continued)

7. Scribe a line or otherwise mark the relationship of the side cover to housing. Using a 19mm wrench, remove the four bolts that secure the side cover to the housing.



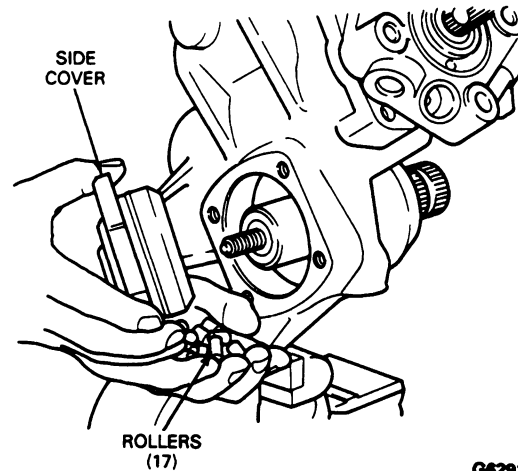
G6289-1A

8. Separate the side cover from the housing by turning the adjusting screw clockwise with a 7mm socket. Continue turning the adjusting screw until the side cover can be removed from the housing.



G6290-1A

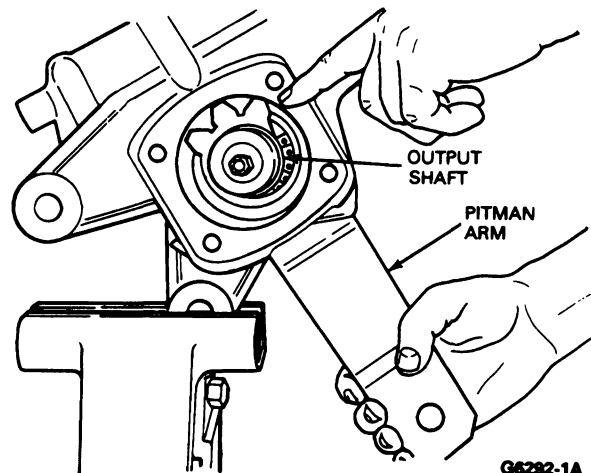
9. When the side cover is removed from the housing, the 17 rollers in the side cover bearing will fall out. These rollers **MUST NOT BE INTERCHANGED** with the rollers in the housing bearing which are identical.



G6291-1A

CAUTION: Do not attempt to remove the outer race of the roller bearing from the side cover.

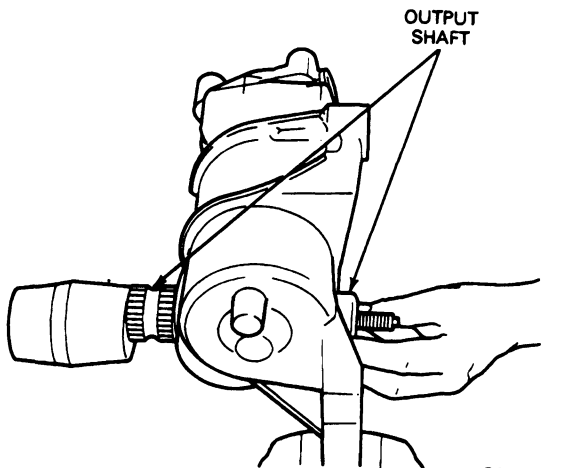
10. Loosely install the pitman arm and use it to center the piston and output shaft gear teeth inside the side cover opening of the housing.



G6292-1A

DISASSEMBLY AND ASSEMBLY (Continued)

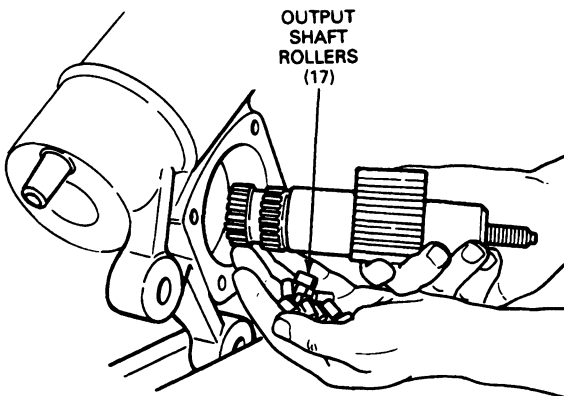
Remove the pitman arm and then remove the output shaft by tapping gently on the splined end with a soft mallet.



G6293-1A

When the output shaft is removed from the housing, the 17 rollers in the housing bearing will fall out. These rollers **MUST NOT BE INTERCHANGED** with the rollers in the side cover bearing which are identical.

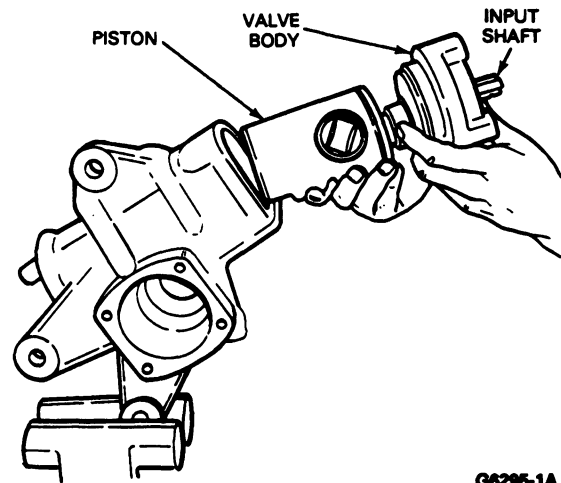
CAUTION: Do not attempt to remove the outer race of the roller bearing from the housing.



G6294-1A

Piston

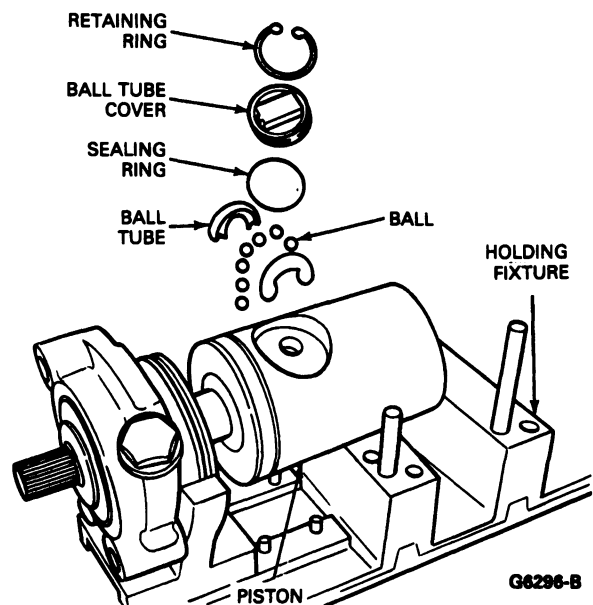
10. While preventing rotation of the input shaft end of the spindle assembly, pull the valve body and piston out of the housing.



G6295-1A

11. Remove the retaining ring, ball tube cover, the ball tube and seven of the 26 balls from the piston. Remove the sealing ring from the piston. The ball tube cover is removed by using Tube Cover Remover D89T-3504-B or equivalent.

NOTE: Valve Body Holding Fixture D89T-3504-E or equivalent is a convenience but not a necessity for disassembly.

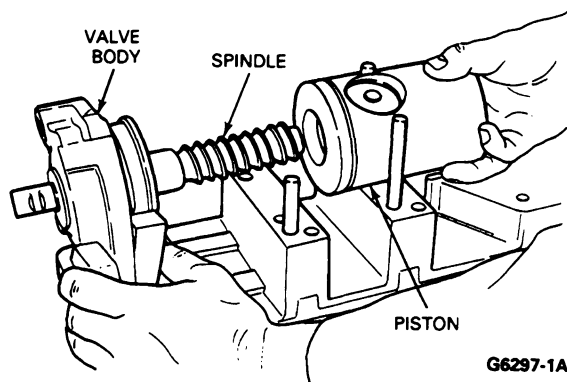


G6296-B

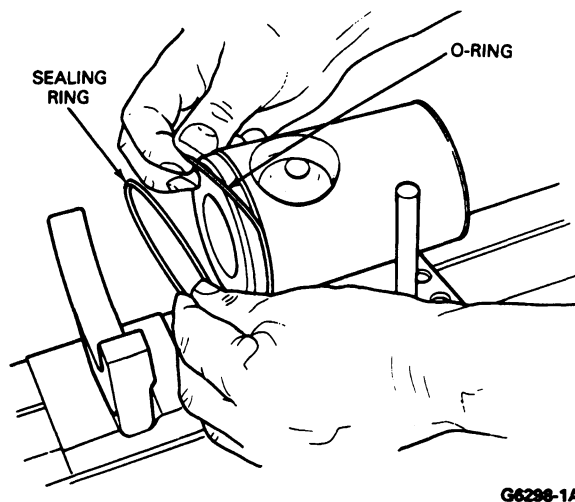
DISASSEMBLY AND ASSEMBLY (Continued)

12. In order to remove the remaining 19 balls from piston, rotate the input shaft in the direction (clockwise or counterclockwise) that threads the spindle assembly OUT OF THE PISTON.

Separate the valve body and spindle from the piston. Check the inside of the piston for any stray balls that may not have been removed in the operation above. A total of 26 balls, seven from the ball tube and 19 from the piston, should be accounted for.



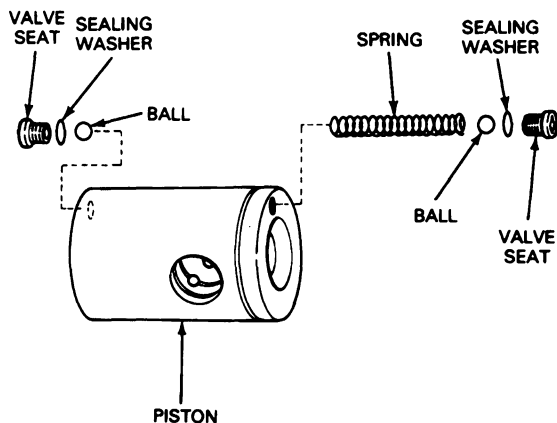
13. Remove the sealing ring and O-ring below it from the groove in the piston.



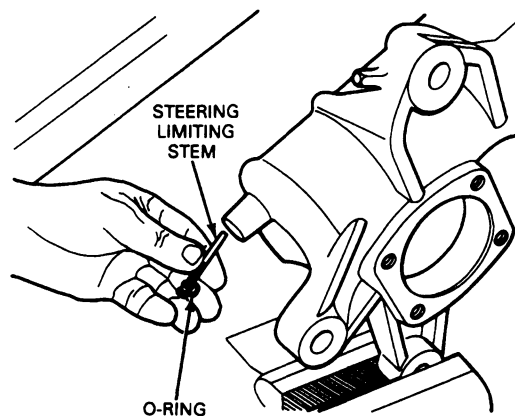
14. Remove either of the steering limiting valve seats and sealing washer from the piston. Either a Phillips or straight blade screwdriver will be required, depending upon which of the two styles of valve seats are in use.

NOTE: Care must be taken during this operation since damage to the screwdriver slot will make removal difficult.

15. Remove one of the two balls, the spring and then the remaining ball. Referring to the previous step, remove the remaining steering limiting valve seat and its sealing washer from the other end of the piston.

**Housing and Side Cover**

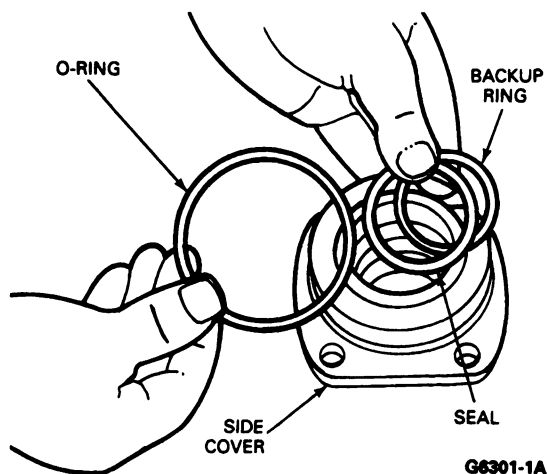
16. Remove the steering limiting stem protective plug from the housing. Using a screwdriver, remove the stroke limiting valve stem from the housing and separate the O-ring from the stem.



DISASSEMBLY AND ASSEMBLY (Continued)

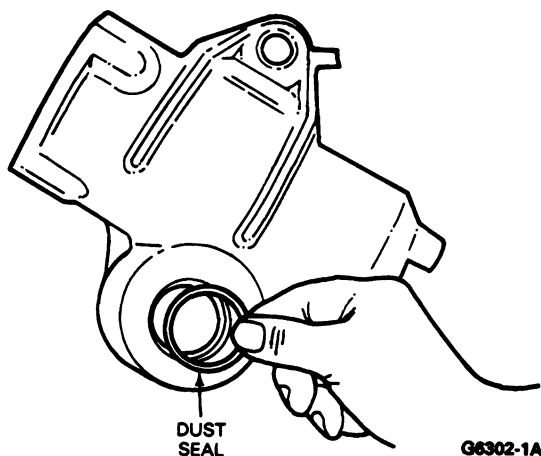
17. Remove the O-ring from the side cover. Remove the seal and its split nylon backup ring from the side cover bore. The nylon split ring comes out separately but is part of the seal.

CAUTION: Do not remove the outer race of the roller bearing from the side cover.



G6301-1A

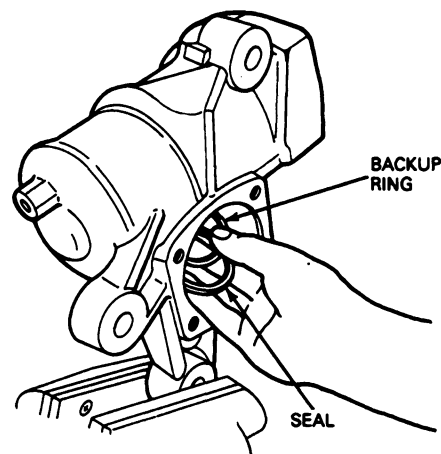
18. Carefully pry out and remove the dust seal from the housing.



G6302-1A

19. Reaching through the side cover opening of the housing, remove the output shaft seal and nylon backup ring which comes out separately but is part of the seal.

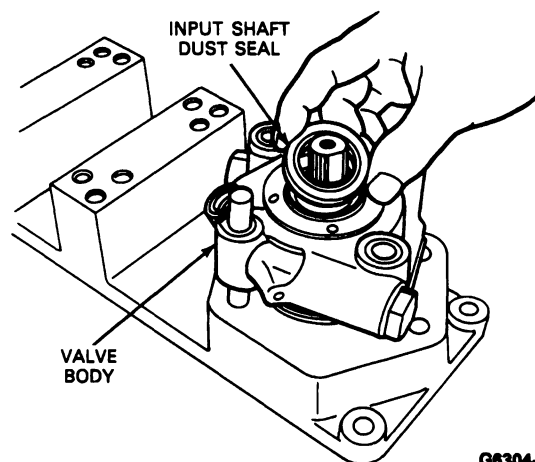
CAUTION: Do not remove the outer race of the roller bearing from the housing.



G6303-1A

Valve Body and Spindle

20. Remove the input shaft dust seal from the valve nut.

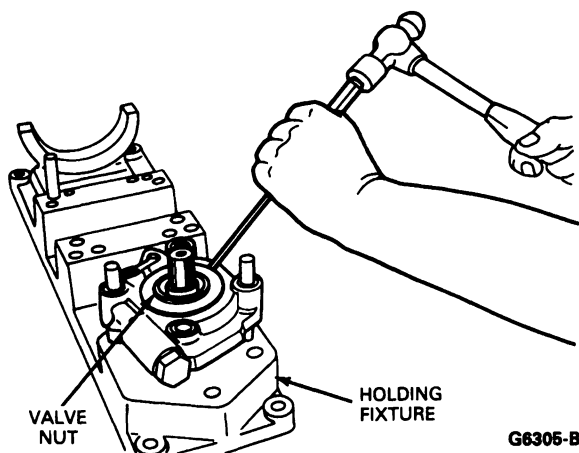


G6304-B

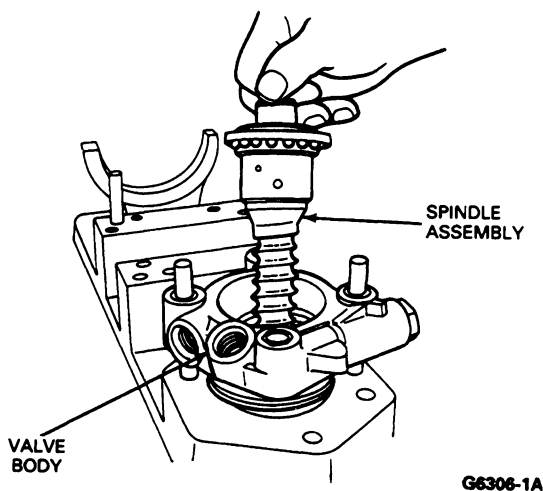
DISASSEMBLY AND ASSEMBLY (Continued)

21. With a drift punch, unblock the safety point between the valve nut and valve body. Using Spanner Nut Wrench D89T-12458-R or equivalent loosen and remove the valve nut and O-ring from the valve body.

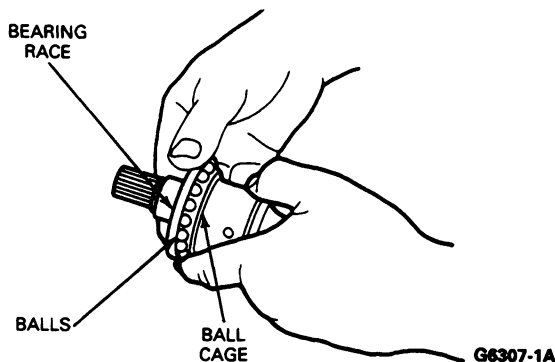
NOTE: Valve Body Holding Fixture D89T-3504-E or equivalent is a convenience but not a necessity for disassembly.



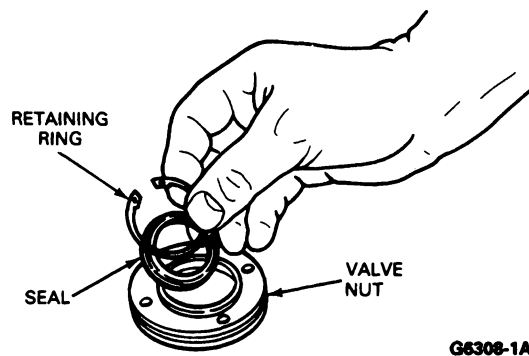
22. Grasp the input shaft end of the spindle assembly and lift the spindle assembly, ball cage, 17 balls and one half of the outer race out of the valve body.



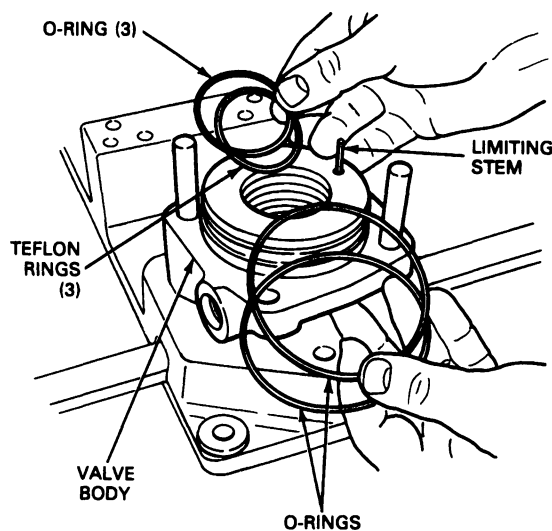
23. Separate the outer race, ball cage and 17 balls from the spindle assembly.
24. Do not remove the other half of the ball bearing outer race in the valve body.



25. Remove the retaining ring and then the seal from the valve nut. Remove and check O-ring valve nut seal. Check for damage and replace as necessary.



26. Remove the two outside O-rings from the valve body and then remove the three Teflon® rings and the corresponding three O-rings from the spindle bore.

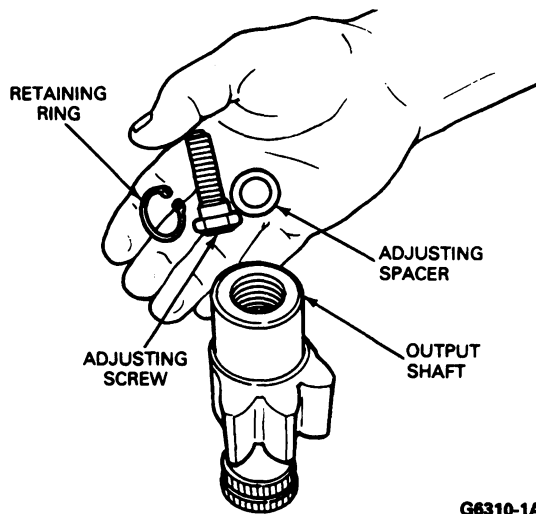


DISASSEMBLY AND ASSEMBLY (Continued)

27. If the steering gear is equipped with a steering limiting feature, check the condition and length of the limiting stem in the valve body. The length of the stem measured from the surface of the valve body to the tip of the stem should be 18.7mm (0.736 inch). If the limiting stem is of the correct length and in good condition, **DO NOT REMOVE** it. The limiting stem can be removed, if necessary, by heating the poppet stem to loosen the Loctite, and then turning counterclockwise.

Output Shaft

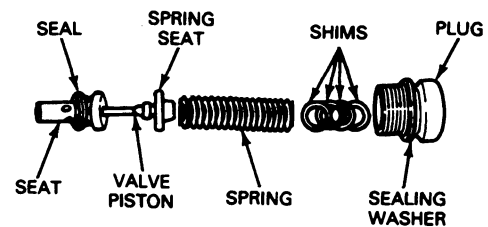
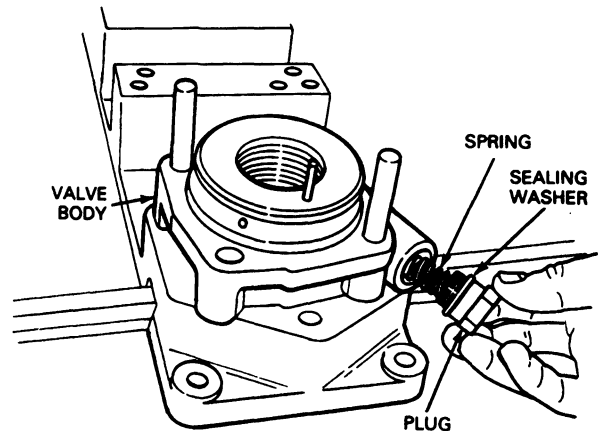
28. Remove the retaining ring, the adjusting screw spacer and the adjusting screw from the output shaft.



G6310-1A

Pressure Relief Valve

29. Begin disassembly of the pressure relief valve by removing the plug and sealing washer from the valve body.
30. Remove the spring, spring seat adjusting shims and the valve piston.



G6311-1A

31. Using a wide-bladed screwdriver or Piloted Screwdriver D89T-3504-C or equivalent, remove the seat and seal.

Spindle

CAUTION: Do not attempt disassembly of the spindle assembly which contains the rotary valve. Individual replacement parts are NOT available. It must be treated as a single component.

NOTE: Additionally, the piston must be purchased (piston and spindle kit) due to the match of the grinding of the two components.

Cleaning

Wash all parts individually in clean solvent and dry thoroughly. All non-metallic parts should be discarded and replaced with new.

Inspection

Parts found broken, cracked, distorted, excessively pitted, or scored must be replaced. Cause for the replacement of any part should be investigated and corrected to prevent reoccurrence.

Visually inspect all parts, carefully paying particular attention to the following conditions.

DISASSEMBLY AND ASSEMBLY (Continued)

1. Bearings and bearing surfaces should not exhibit brinelling, pitting, spalling or cracks. If, upon inspection, it is determined that the outer races of the roller bearings contained in the housing or the side cover are not serviceable, the entire housing or side cover must be replaced. If the outer ball bearing race remaining in the valve body is not serviceable, the entire valve body must be replaced. Inspect the bearing surfaces of both the inputs.
2. Gear teeth in the output shaft and piston may show signs of polishing and slight wear; however, pitting, spalling, and cracks should not be present.
3. Check output and input shaft splines.
4. Check the ball rolling surfaces on the exterior of spindle and interior of piston for cracks, pitting, spalling and brinelling.
5. Check exterior of piston and interior of housing bore.
NOTE: Minor scuffing of the piston exterior and housing bore can be considered normal. If deep scoring is detected, the affected parts should be replaced as leakage will occur and steering control and reaction will be affected. Do not attempt honing or boring of these parts as leakage rates will increase.
6. Check pitman arm.
7. Check exterior of housing and its mounting lugs.
8. Check valve body and porting.

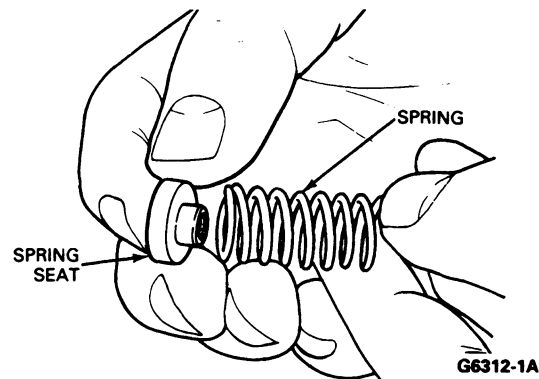
Assembly

To ensure proper operation of the power steering gear, the following procedure and its sequence should be carefully followed. Failure to do so may result in damage to the gear or faulty operation or both.

The appropriate maintenance kits should be obtained prior to reassembly.

1. Install the sealing washer around the pressure relief valve seat and, using a large bladed screwdriver or Piloted Screwdriver D89T-3504-C or equivalent, install both in the valve body. Tighten the valve seat to 20-24 N-m (15-18 ft-lb).
2. Install the pressure relief valve piston spring seat and spring in the valve body.

CAUTION: The spring seat must be installed as shown in illustration. Incorrect installation of the spring seat will result in malfunction of the relief valve and damage to the valve and seat.

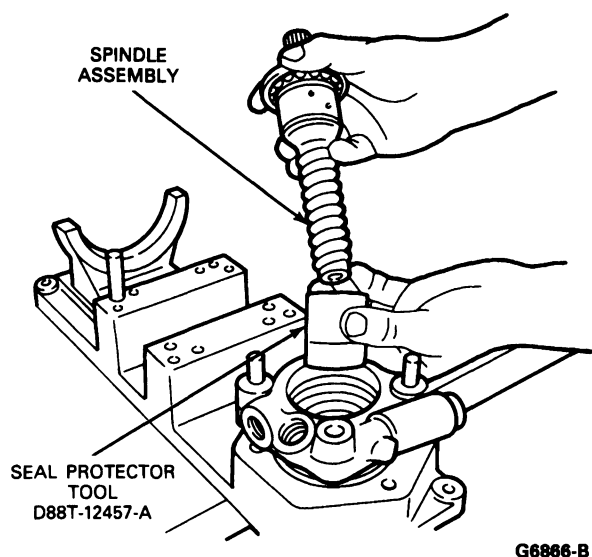


3. Install the pressure adjusting shims and the seal washer on the plug. Install the plug in the valve body and torque to 89-99 N-m (66-73 ft-lb) using a 26mm socket.

NOTE: When installing the pressure adjusting shims, use the shims that were removed during disassembly. However, if a complete rebuild of the power steering gear is underway, it may be necessary to add or subtract shims in order to properly set the pressure relief valve.

4. Install the three O-rings and three Teflon® rings in the appropriate grooves in the valve body. Form (expand) O-rings and Teflon® rings into their grooves by pushing Seal Protector D88T-12457-A or equivalent through the bore of the valve body.

NOTE: Prelubricate the tool with a light film of lithium base grease such as Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent. The spindle assembly can be used to assist in pushing the tool through the bore.

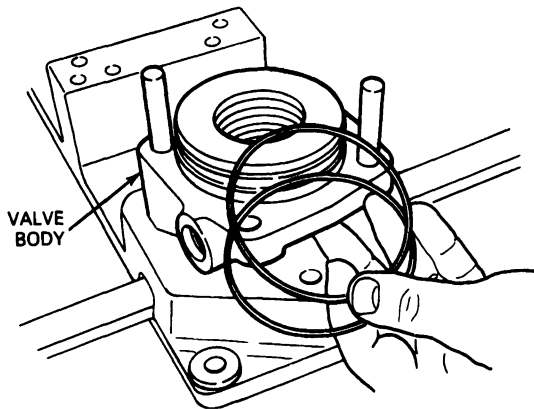


DISASSEMBLY AND ASSEMBLY (Continued)

5. If the steering limiting valve was removed from the valve body, install the stem now. Apply Loctite™ 222 to the threads and screw the limiting stem into the valve body until a stem height of 18.7 mm (0.736 inch) above the valve body surface is obtained.

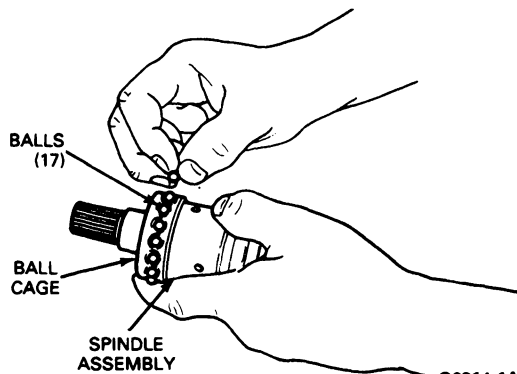
CAUTION: Use care in applying the Loctite™ compound to prevent this material from coming in contact with other surfaces of the valve body. Allow sufficient time to cure.

6. Install the O-rings on the valve body.



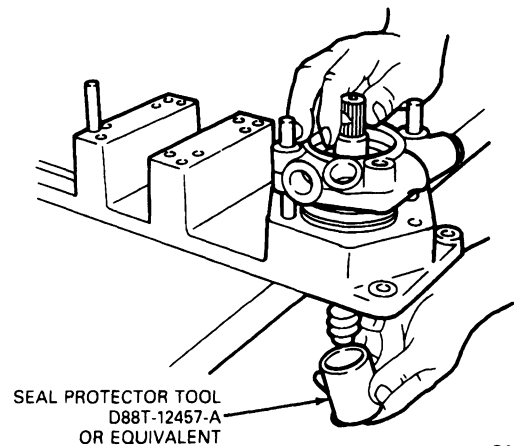
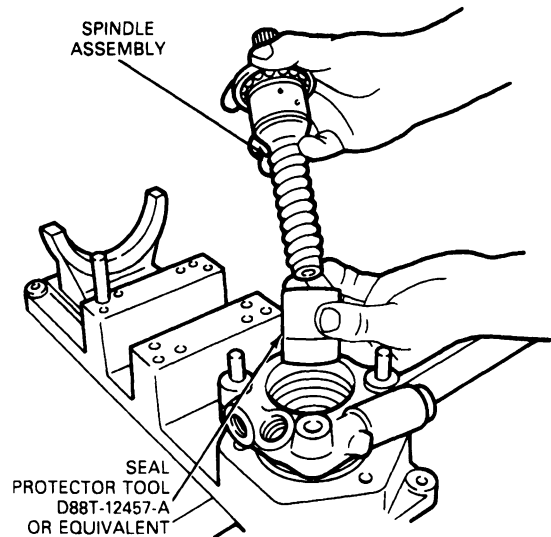
G6329-B

7. Install the ball cage on the input end of the spindle assembly. Using Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent grease to hold them in place, install the seventeen balls in the ball cage.



G6314-1A

8. Install the outer ball bearing race half over the input end of the spindle assembly and insert the spindle assembly through Seal Protector tool D88T-12457-A or equivalent. Insert the spindle and tool into the valve body until tool completely exits the other side and the 17 balls of the bearing assembly are resting against the outer race in the valve body.

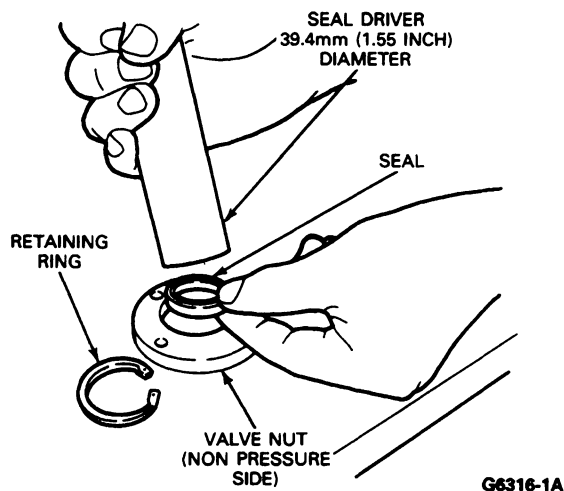


G6315-C

DISASSEMBLY AND ASSEMBLY (Continued)

9. Position the pressure side of the seal in the bore of the non-pressure side of the valve nut. Carefully drive the seal into the bore until the retaining ring groove within the bore is visible. Install the retaining ring, making certain it is completely seated in the groove.

NOTE: The seal can be driven into the valve body bore using a piece of round brass stock with a diameter of 39.4mm (1.55 inch).



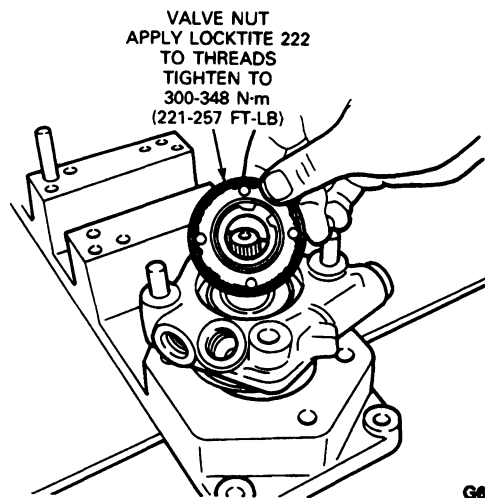
G6316-1A

After installing the retaining ring, gently tap the seal from the opposite side until it rests squarely against the retaining ring.

10. Using minor sealing service kit (Bendix 2264084), install a new O-ring on the valve nut and apply primer N and Loctite™ 242 Sealant to valve nut thread.

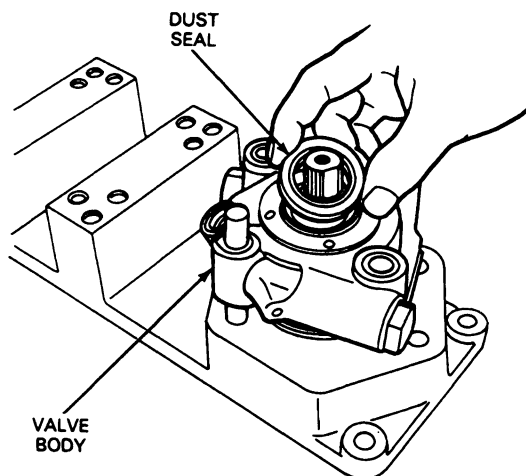
NOTE: Due to the proximity of the spindle ball bearing, use extreme care during application of primer and sealant to the valve nut threads. Making certain not to damage the seal, install the valve nut over the input shaft end of the spindle assembly and into the valve body. Using Spanner Wrench D89T-12458-R or equivalent tighten the valve nut to 300-348 N·m (221-257 ft-lb).

Reset the safety point between the valve nut and valve body using a drift punch or similarly appropriate tool.



G6317-1A

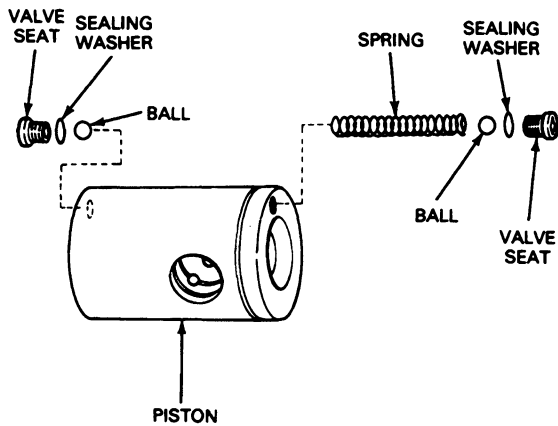
11. Install the dust seal in the valve nut, taking care not to damage the seal.



G6304-1A

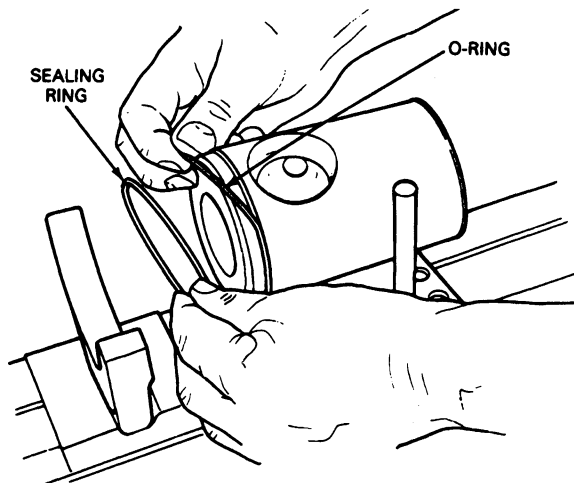
DISASSEMBLY AND ASSEMBLY (Continued)**Piston**

12. Install one of the two steering limiting valve seats and its sealing washer into the piston. Insert one of the two balls, then the valve spring into the piston from the opposite end and install the remaining ball, sealing washer, and seat in the piston. Taking care not to damage the valve seats, tighten each to 10-15 N·m (88-132 in-lb).



G6299-1A

13. Install the O-ring into its groove in the piston.



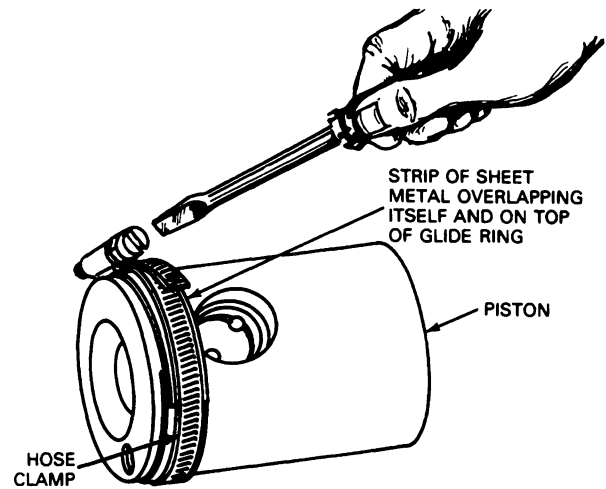
G6298-1A

14. Thoroughly heat the sealing ring to 140°-160°C (285°-320°F) in preparation for installation on the piston.

NOTE: DO NOT USE AN OPEN FLAME to heat the sealing ring. A heat lamp or a similar device should be used.

15. Install the heated sealing ring over the O-ring in the piston's groove.

CAUTION: The sealing ring should be distorted as little as possible during installation. Using an automotive piston ring compression tool or a smooth piece of sheet metal and an appropriately large screw-type hose clamp, reshape the sealing ring into the piston groove. Allow approximately ten minutes cooling time before removing the compression tool from the piston.



G6318-1A

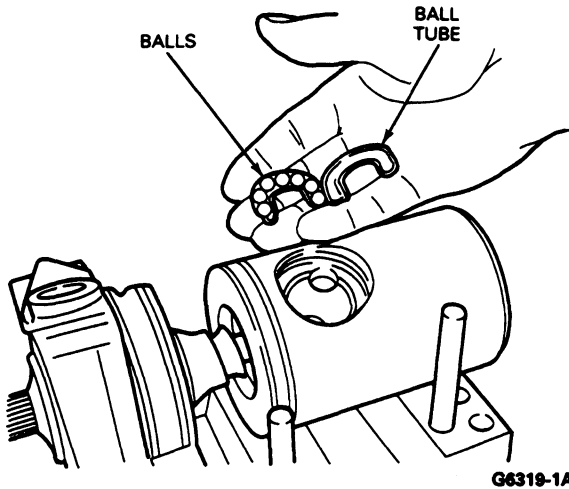
16. Install the O-ring in its groove in the ball return opening of the piston.
17. Insert the valve body and spindle assembly all the way into the piston making certain that the stroke limiting stem is not damaged and that it mates with the valve seat in the piston. Insert 19 of the balls, one at a time, into one of the recirculating tube holes in the ball return opening in the piston. Rotate the input shaft end of the spindle slightly, either clockwise or counterclockwise, after each ball is inserted. Rotate the spindle in one direction only and do not alternate from clockwise to counterclockwise.

NOTE: When this operation is performed correctly, the spindle and valve body should screw out of the piston, and the balls inserted in one recirculating tube hole should appear at the opposite hole. Before proceeding, make certain the balls are at an equal depth in both holes of the piston. This will assure correct installation of the return tube.

CAUTION: The utmost care must be taken with these steps. Incorrect assembly of this group may result in one or more balls falling inside the piston or coming out at the top and lodging in the housing.

DISASSEMBLY AND ASSEMBLY (Continued)

18. Install the remaining seven balls in the recirculating tube halves, and use a lithium-base grease such as Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent, to retain them in the tube. Seat the assembled tube halves containing the seven balls in the recirculating tube holes in the piston.



Lightly grease the sealing surfaces of the tube cover and install it in the piston using Tube Cover Remover / Installer D89T-3504-B or equivalent, making certain the slot in the underside of the cover mates with the recirculating tube in the piston. Install the retaining ring in the piston to secure the tube cover, making certain it is completely seated in its groove. After assembly, check for smooth rotation of the spindle assembly in both directions.

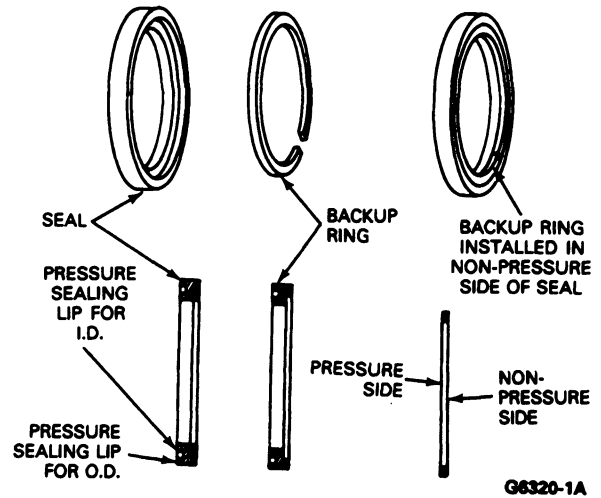
Housing

19. Reaching through the side cover opening of the housing, install the seal with its pressure side toward the INTERIOR of the housing.

NOTE: Do not distort this flexible seal any more than is necessary for installation.

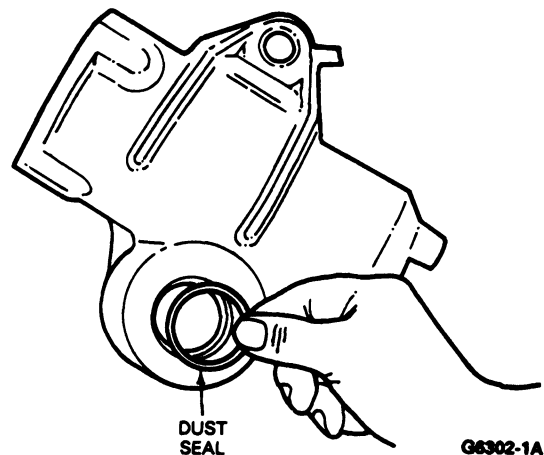
Install the split nylon backup ring, which is a separate part of the seal, in the groove formed by the backside (non-pressure side) of the seal and the housing. Make certain the split surfaces of the ring mate properly.

NOTE: This seal prevents pressurized fluid from leaking out of the housing around the output shaft.



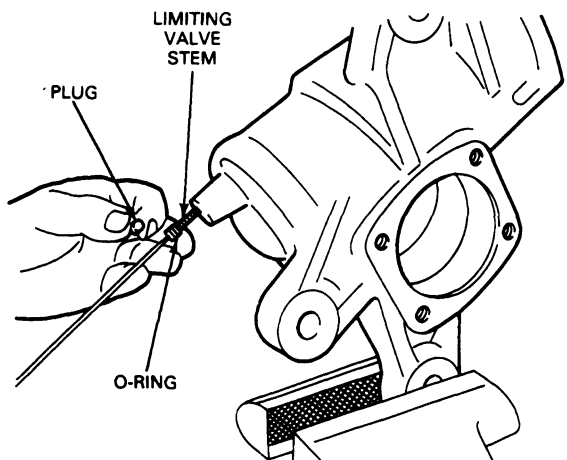
20. Install the dust seal in the housing with its sealing lip toward the OUTSIDE of the housing.

NOTE: This seal is intended to prevent water and dirt from entering the housing.



DISASSEMBLY AND ASSEMBLY (Continued)

21. Install the O-ring in the groove around the steering limiting stem and screw the stem into the housing about five or six full turns.



G6321-1A

22. Install the 17 rollers of the bearing in the outer race contained in the housing. Use a heavy coating of Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent to hold the rollers in place.

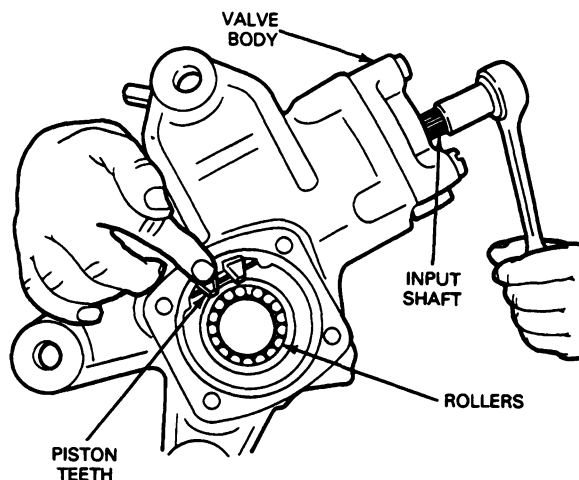
NOTE: The 17 rollers that are installed must be the same rollers that were removed from this bearing during disassembly.

23. Align the steering limiting stem in the valve body with the steering limiting valve seat in the piston. Insert the piston into the housing so that the rack teeth of the piston are visible in the side cover opening in the housing.

Make certain that the valve body is oriented in the housing so that the marks made during disassembly align. Slide the piston and valve body assembly completely into the housing taking special care not to damage the piston glide ring and the valve body O-rings.

Secure the valve body to the housing using four bolts. Torque the bolts to 110-119 N·m (81-88 ft·lb) using a 19mm socket and torque wrench.

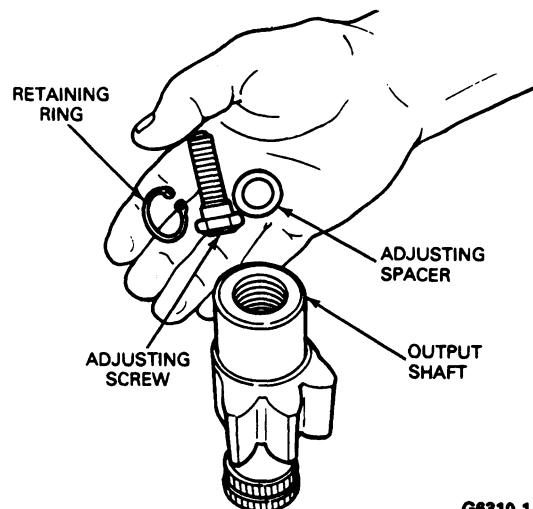
Rotate the input shaft of the spindle until the rack teeth of the piston are centered in the side cover opening in the housing.



G6322-1A

Output Shaft and Side Cover

24. Install the adjusting spacer over the adjusting screw and secure both in the output shaft using the retaining ring.



G6310-1A

The maximum end play permitted for these parts is 0.050mm (0.002 inch). If end play is excessive, it may be necessary to install a different adjusting spacer. The adjusting spacer is available in eight different thicknesses to provide the proper end play.

25. Install the seal in the side cover with its pressure side toward the outer race of the side cover roller bearing.

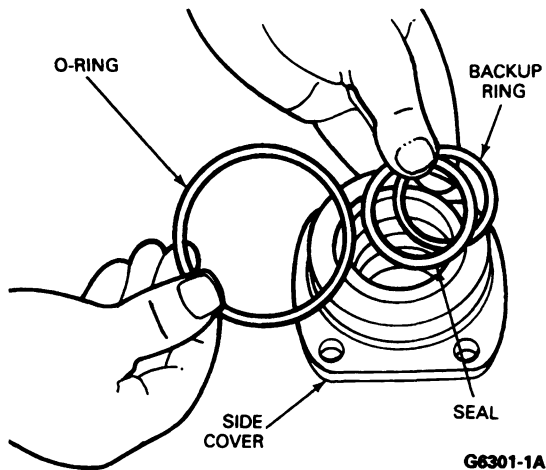
NOTE: This seal prevents fluid leakage around the output shaft. Do not distort this flexible seal more than is necessary for installation.

DISASSEMBLY AND ASSEMBLY (Continued)

26. Install the split nylon backup ring, which is a separate part of the seal, by winding it into the groove formed by the side cover and the backside of the seal.

Make certain the split ring is completely seated and that the diagonal split surfaces of the ring mate properly.

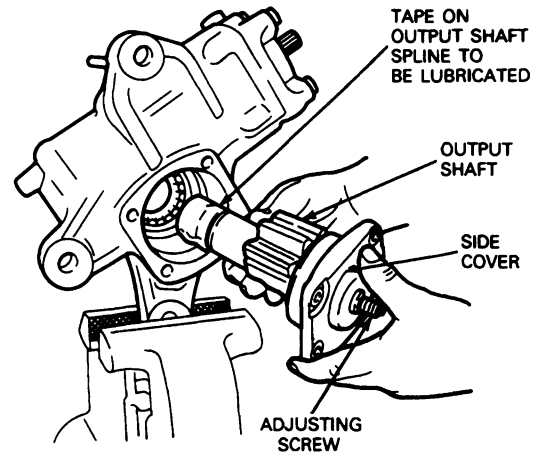
Install the O-ring in its groove in the side cover.



27. Install the 17 rollers of the bearing in the outer race contained in the side cover. Use a heavy coating of lithium-base grease such as Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent, to hold the rollers in place.

CAUTION: The 17 rollers that are installed must be the same rollers that were removed from this bearing during disassembly.

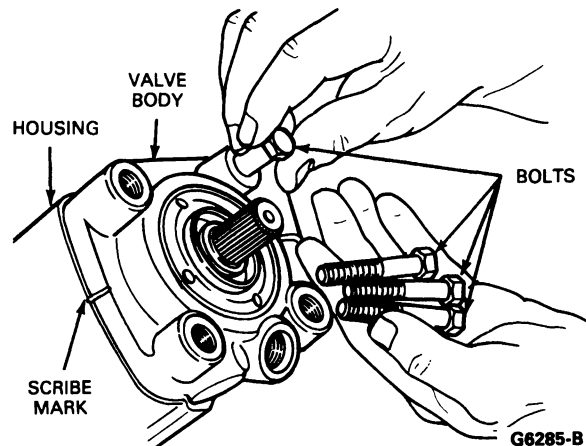
28. Lightly lubricate the seals contained in both the housing and side cover with a lithium-base grease such as Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent. Lubricate the sealing surface of the output shaft on the adjusting screw end only. Using a 7mm socket wrench, install the assembled side cover on the output shaft adjuster screw and screw it on as far as it will go, then back it off 1/8 of a turn.
29. Prior to inserting the output shaft into the housing, wrap a single layer of masking tape around the splines to protect the housing seal. Lubricate the exterior of the tape with a lithium-base grease such as Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent, and insert the shaft and side cover assembly into the housing with a twisting motion. Remove the masking tape from the output shaft splines.



30. Secure the side cover to the housing using four bolts. Make certain that the side cover is positioned so marks made during disassembly are aligned. Tighten the bolts to 110-119 N·m (81-88 ft-lb) using a 19mm socket and torque wrench.

Pack the input and output cavities with a lithium-base grease such as Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent.

Install the exterior dust boot on the output shaft and the exterior dust seal on the input shaft.



ADJUSTMENTS

Adjusting the Piston to Output Shaft Gear Backlash

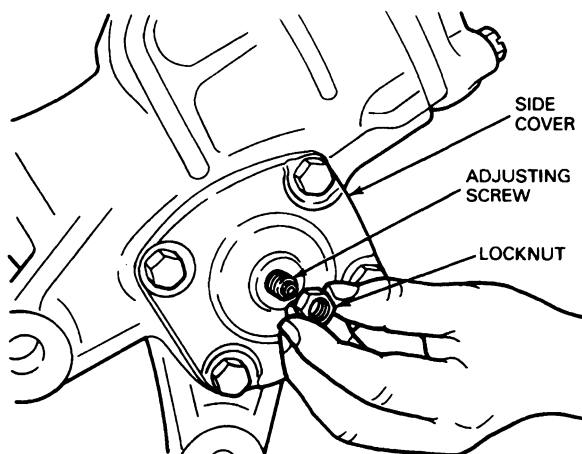
1. The piston and output shaft gear backlash is correct when a 0.50-2.0 N-m (4-18 in-lb) increase in torque is noted. The torque increase at the input shaft will occur only as the piston travels through the midpoint of its travel and should disappear as the piston moves past the midpoint.

To obtain the adjustment stated above, make certain the adjusting screw is turned counterclockwise as far as it will go. Rotate the input shaft as far as possible in both directions. Count the total revolutions in either direction and at the same time measure the average torque to rotate the shaft.

To obtain the proper backlash adjustment, rotate the input shaft 180 degrees in both directions past the midpoint of piston travel. The midpoint of piston travel is approximately one half the number of input shaft revolutions possible in a single direction.

Each time the direction of input shaft rotation is changed, turn the output shaft adjustment screw clockwise 1/8 to 1/4 turn. Continue this procedure until a 0.50-2.0 N-m (4-18 in-lb) increase is noted in the torque required to rotate the input shaft.

2. When the adjustment is correct, install locknut and tighten to 100-119 N-m (74-88 ft-lb) with a 19mm crow foot and torque wrench while holding the adjustment screw in position with the 7mm socket.



G6324-1A

3. After all the described steps have been performed, check that the power steering unit runs smoothly throughout its entire motion and that the backlash at the center position is as described in Step 1.
4. Install the C-300N power steering gear on the vehicle. Fill gear with fluid, Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or -DDX (E6AZ-19582-B) or equivalent.

5. Purge air, test for flow, leakage and the pressure relief valve setting.
6. Set stroke limiting as detailed in the following procedures.

Adjusting the Stroke Limiting Stem

The function of the optional steering limiting feature is to relieve most of the hydraulic power assist prior to the piston reaching the end of its full travel in either direction. This ensures that the axle stops are not impacted with full hydraulic assist when a full wheel cut is made in either direction.

The C-300N has two adjustable steering limiting stems of which only one is externally adjustable. The internal adjustable stem must be present during assembly to meet vehicle requirements.

1. Adjust the axle stops using the vehicle specifications.
2. Install a pressure gauge or gauge and flow meter combination such as Rotunda Power Steering System Analyzer 014-00230 or equivalent in the pressure (supply) line between the power steering pump and steering gear.

CAUTION: During the procedure that follows use extreme care not to operate the power steering pump at its relief valve pressure for more than a few seconds at a time. Extended operation at pump relief pressure will result in excessive heat and subsequent damage to the system. A thermometer installed in the pump reservoir will allow temperature checks to assure the maximum pump and gear temperatures are not exceeded.

3. Start the engine and gently turn the steering wheel to the axle stop in both directions while observing the pressure gauge and the direction of the wheel cut (right or left). This procedure should reveal which turning direction (either right or left) the externally adjustable steering limiting stem is intended to adjust. The desired reaction is described in Step a, below.
 - a. In one turning direction, gauge pressure should drop substantially just prior to the steering mechanism contacting the axle stop. In the other turning direction, the gauge should register pump relief valve pressure as the steering mechanism contacts the axle stop. The turning direction that registers pump relief is the one controlled by the externally adjustable steering limiting stem.
 - b. If gauge pressure does not drop prior to axle stop contact in either direction, the internally adjustable steering limiting stem or valve is not functioning properly.
 - c. If gauge pressure drops prior to axle stop contact in both directions, turn the externally adjustable stroke limiting stem counterclockwise and repeat the test until the reaction described in Step a, above, is obtained.

ADJUSTMENTS (Continued)

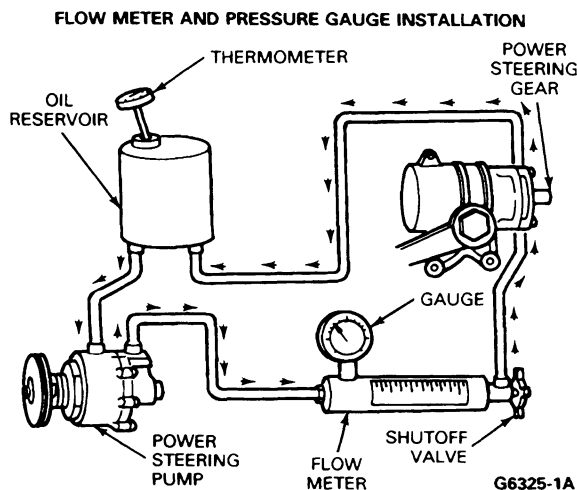
4. Return the steering to a neutral straight-ahead position and turn the externally adjustable stroke limiting stem clockwise to its full travel.
5. Gently turn the steering wheel in the direction effected by the externally adjustable stroke limiting stem until the axle stop is contacted. Pressure registered on the gauge should be relatively low. With the steering wheel held to maintain axle stop contact, turn the stroke limiting stem counterclockwise until the gauge pressure JUST begins to rise or until the gauge pressure specified by the vehicle manufacturer is obtained.

NOTE: A rise in pressure on the gauge while turning the stroke limiting stem counterclockwise indicates that the stroke limiting valve is beginning to close. Continued turning of the stem will cause the valve to close and the pressure to rise until the valve is completely closed and the pressure rises to the gear relief setting.

6. After adjustment of the stroke limiting stem is complete, install the plug in the stem bore in the housing.

On-Vehicle Power Steering Tests

Perform the power steering pump performance tests specified in Section 11-00. Make certain that system back pressure, maximum and minimum pump flow and pump relief pressure all meet specified requirements.



Testing the Power Steering Gear Pressure Relief Valve

1. To prevent the operation of the steering limiting valves, if the gear is so equipped, place a steel spacer block between the axle stop and the adjusting screw. The block should be a minimum of 25.4mm (1 inch) thick and long enough to be inserted without danger of pinching fingers. Keep fingers clear of pinch points and be sure block is square to points of contact.

WARNING: FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SERIOUS INJURY OR DAMAGE TO THE EQUIPMENT.

2. Check fluid temperature in the reservoir. Thermometer reading should be approximately 54.5°C (130°F) at start of the test and the shut-off valve on the flow meter must be totally open.
3. Turn the steering wheel until the axle stop contacts the spacer block. Apply sufficient torque to the steering wheel to make sure the power steering gear control valve is completely open in the direction of the turn. At this time the pressure gauge will read the gear pressure relief setting. If the pressure reading is 13100-14480 kPa (1900-2100 psi) the pressure relief valve is operating properly. If the pressure is outside of this range, the pressure relief valve should be adjusted or repaired as necessary.

A Pressure Adjustment Service Kit, Part Number E8HZ-3K604-A, is available and consists of three adjusting shims, sealing washer and an instruction sheet. This kit allows adjusting of the relief pressure of a Bendix gear without removing the gear from the vehicle.

CAUTION: When running this test, do not hold the torque on the steering wheel for more than five seconds beyond the time the pressure relief setting has been reached. It may damage the unit or cause the temperature of the oil to rise beyond 93°C (200°F).

Testing the Power Steering Gear for Internal Leakage

NOTE: Excessive internal leakage past seals and O-rings will generally be manifested by an increase in steering effort especially when steering quickly to the right or left. The tests that follow can be used to confirm this symptom.

Use of Valve (Test) Plug Assembly

The valve (test) plug assembly is required when the pump pressure relief setting or the steering gear internal leakage must be checked. When installed in the power steering gear, the valve plug temporarily raises the setting of the gear pressure above that of the pump.

CAUTION: The vehicle should not be used in service with the valve plug installed.

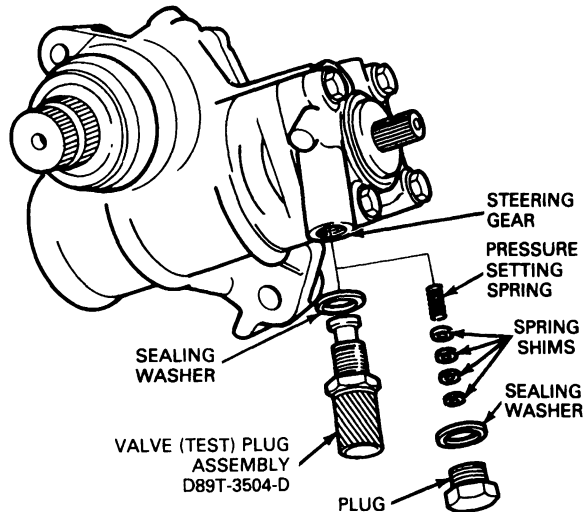
CAUTION: During the procedure that follows, use extreme care not to operate the power steering pump at its relief valve pressure for more than a few seconds at a time. Extended operation at pump relief pressure will result in excessive heat and subsequent damage to the system.

Installation of Valve (Test) Plug

1. Park the vehicle on a level surface, block the wheels and stop the engine.

ADJUSTMENTS (Continued)

2. Locate the power steering gear pressure relief valve. Remove the valve plug and sealing washer from the power steering gear.

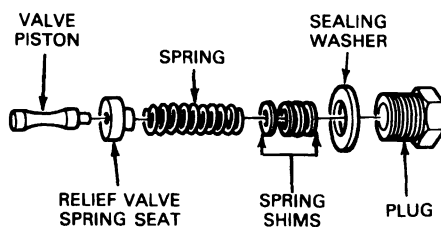


G6867-B

3. Remove the spring shims and the pressure setting spring.

CAUTION: Do not remove the pressure relief valve spring seat or valve piston. If these parts are accidentally removed, reinstall them in the order shown, making certain the small diameter of the spring seat will fit inside the inside diameter of the valve plug or valve spring.

Pressure Relief Valve Detail



G6868-B

4. Separate the sealing washer from the plug. Reinstall the sealing washer on the valve (test) plug assembly.

NOTE: Reusing the sealing ring on the test plug may result in some minor leakage during testing. If this is objectionable, use a **new** sealing ring on the test plug.

NOTE: Install the valve (test) plug assembly into the power steering gear making certain the inside diameter of the test plug fits over the spring seat. Tighten the valve (test) plug to 89-99 N-m (66-73 ft-lb).

5. After tightening the valve (test) plug, the power steering pump pressure relief valve and/or steering gear internal leakage tests may be performed.

Internal Leakage Test

1. To prevent the operation of the steering limiting valves, if the gear is so equipped, place a steel spacer block between the axle stop and the adjusting screw. The block should be a minimum of 25.4mm (1 inch) thick and long enough to be inserted without danger of pinching fingers. Keep fingers clear of pinch points and be sure block is square to points of contact.

WARNING: FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SERIOUS DAMAGE TO THE EQUIPMENT.

2. Run the engine at idle. Turn the steering wheel until the axle stop contacts the spacer block. Apply a sufficient torque to the steering wheel to make sure the power steering gear control valve is completely open in the direction of the turn. Observe the following.
 - a. Gauge pressure should read the same as the power steering pump relief pressure.
 - b. With system pressure at pump relief, read the flow meter. If a flow greater than 3.8 liters (1 gallon) per minute is noted, internal leakage is excessive and the steering gear requires repair.

CAUTION: When running this test, do not hold the torque on the steering wheel for more than five seconds beyond the time the pressure relief setting has been reached. It may damage the unit or cause the temperature of the oil to rise beyond 93°C (200°F).

3. Repeat Step 2, turning the steering wheel in the opposite direction.

NOTE: Before returning this vehicle to service, remove the pressure gauge and flow meter combination and the valve (test) plug according to the following procedure.

Removal of Valve (Test) Plug

1. Remove the valve (test) plug assembly and sealing washer from the steering gear. Discard the sealing ring.

2. Install a new sealing ring on the plug.

NOTE: It is important that a new (unused) sealing ring be installed to prevent leakage.

3. Install all the adjusting shims removed during Step 3 of the installation of the plug.

NOTE: Install the spring making certain its inside diameter fits over the small diameter of the spring seat as illustrated.

ADJUSTMENTS (Continued)

4. Install the assembled plug (with sealing ring and shims) in the power steering gear and tighten the plug to 89-99 N-m (66-73 ft-lb). Refer to the caution in Step 3 of the Installation.
5. Start the engine, operate the steering and check for leakage around the plug.

SPECIFICATIONS**C-300N STEERING GEAR TORQUE SPECIFICATIONS**



Description	N-m	Lb-Ft
Steering Gear to Frame Rail Bolts	203-278	150-205
Intermediate Shaft to Gear Input Shaft	27-47	20-35
Pitman Arm to Gear Output Shaft Nut	299-406	220-300
Pressure Relief Valve Seat	20-24	15-18
Pressure Relief Valve Plug	89-99	66-73
Input Shaft Valve Nut	300-348	221-257
Valve Body to Housing Bolts	110-119	81-88
Side Cover Bolts	110-119	81-88
Output Shaft Adjustment Screw Lock Nut	100-119	74-88
Steering Limiting Valve Seats	10-15	88-132 (in-lb)

BENDIX C-300N OPERATIONAL SPECIFICATIONS

Steering Ratio (Input to Output Shaft)	21.2:1
Steering Wheel Revolutions for 90 Degree Rotation of Output Shaft	5.3
Maximum Output Shaft Rotation	75° (Power Assisted) 95° (Maximum Travel)
Maximum Output Shaft Torque with 1992 psi (13734.0 kPa) Power Assist	1985 Ft-Lb (8830.0 N)
Power Steering Fluid	Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or DDX E6AZ-19582-B or equivalent
Maximum Working Temperature	120°C (248°F)
Maximum Peak Temperature	150°C (302°F)
Maximum Working Pressure	2050 psi (14134.0 kPa)
Maximum Pressure Drop in the Return Line	43 psi (296 kPa)
Normal Flow	4.2 GPM (16 L/min)

CG6327-D

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number / Description	Illustration
T64P-3590-F Pitman Arm Puller	 T64P-3590-F
TOOL-3290-D Tie Rod End Remover	 TOOL-3290-D

Tool Number	Description
D88T-12457-A (Bendix #297676)	Seal Protector
D89T-3504-B (Bendix #107732)	Tube Cover Remover
D89T-3504-C (Bendix #298077)	Piloted Screwdriver
D89T-3504-E (Bendix #SA-9004-14)	Valve Body Holding Fixture
D89T-12458-R (Bendix #106234)	Spanner Nut Wrench

ROTUNDA EQUIPMENT

Tool Number	Description
014-00230	Power Steering Analyzer

SECTION 11-02C Steering Gear, Power, Ford

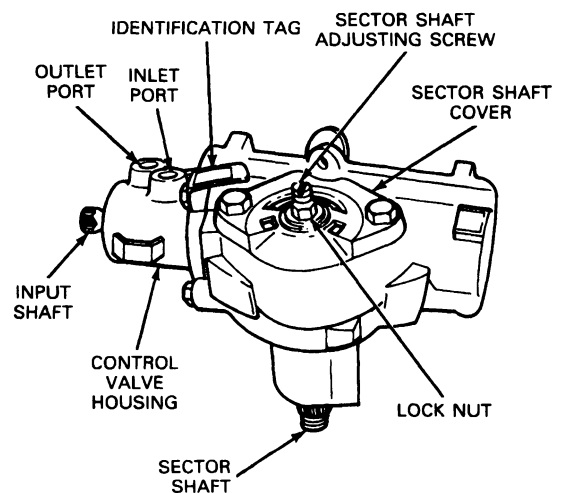
SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DISASSEMBLY AND ASSEMBLY (Cont'd.)	
Adjustment In-Vehicle.....	11-02C-13	Steering Gear Housing	11-02C-8
Meshload	11-02C-13	Valve Housing.....	11-02C-9
Rotary Valve Centering Check	11-02C-14	Worm and Valve Sleeve.....	11-02C-11
DESCRIPTION AND OPERATION	11-02C-1	REMOVAL AND INSTALLATION	
DIAGNOSIS AND TESTING	11-02C-1	Steering Gear.....	11-02C-4
DISASSEMBLY AND ASSEMBLY		SPECIAL SERVICE TOOLS	11-02C-16
Piston	11-02C-13	SPECIFICATIONS	11-02C-15
Steering Gear.....	11-02C-6	VEHICLE APPLICATION	11-02C-1

VEHICLE APPLICATION

F-150-250-350, E-150-250-350, Bronco and F-Super Duty (Chassis Cab) Vehicles

DESCRIPTION AND OPERATION

The steering unit is a torsion-bar type of hydraulic-assisted system. The system includes a worm and one-piece rack piston which is meshed to the gear teeth on the steering sector shaft. The unit also includes a rotary-style hydraulic valve consisting of an input shaft, control valve sleeve and torsion bar. The valve sleeve is pinned to the worm. The input shaft is connected to the worm through the torsion bar. The other end of the input shaft is attached to the steering column and wheel.



G4728-B

DIAGNOSIS AND TESTING

Refer to the following guides for aid in diagnosing steering gear conditions. For other related diagnosis and testing procedures, refer to Section 11-00.

DIAGNOSIS AND TESTING (Continued)

STEERING GEAR CONDITIONS		
CONDITION	POSSIBLE SOURCE	ACTION
Feedback (rattle, chuckle, knocking noise in steering gear) Vehicle is driven over rough pavement and this roughness is felt in the steering wheel by the driver. In addition, if the gear is not adjusted properly, excessive rattle, knocking and/or chuckle noises can be heard inside the vehicle.	<ul style="list-style-type: none"> ● Gear loose on frame. ● Insufficient meshload. ● Loose worm race nut. ● Insufficient worm thrust bearing preload. ● Damaged / omitted sector shaft bearing (gear might also exhibit external leakage from sector seals). 	<ul style="list-style-type: none"> ● Check bolts for damage and replace as required. If bolts are not damaged, tighten mounting bolts (3) to 73-90 N·m (54-66 ft-lb). ● Set meshload to specification. Refer to meshload, in the Adjustments portion of this section. ● Check nut for damage and replace as required. If nut is not damaged, tighten nut to 75-122 N·m (55-90 ft-lb). ● Replace valve assembly. Refer to Disassembly and Assembly procedures in this section. ● Replace gear housing. Refer to Disassembly and Assembly procedures in this section.
Hissing Sound There is some noise in all power steering systems.	<ul style="list-style-type: none"> ● "Hiss" may be expected when the steering wheel is at the end of travel or when turning it at standstill. 	<ul style="list-style-type: none"> ● Hiss is a normal characteristic of rotary valve steering. Do not replace the input shaft and valve assembly unless the hiss is extremely objectionable. A replacement valve will also exhibit a slight noise and is not usually a cure for the condition. ● Investigate for a grounded column or a loose boot at the dash panel. ● Any metal to metal contacts will transmit valve hiss into the passenger compartment through the steering column. ● Verify clearance between flexible coupling components. Be sure steering column shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates.
Front End Wander Vehicle is driven in a straight ahead position with the wheel held in a firm position, but the vehicle wanders to either the right or left side. NOTE: Front end alignment and tire pressures should be checked before any gear service is performed.	<ul style="list-style-type: none"> ● Gear loose on frame. ● Incorrect meshload. ● Loose race locknut. ● Insufficient worm thrust bearing preload. ● Damaged sector shaft bearing (gear might also exhibit external leakage from sector seals). ● Center lash. 	<ul style="list-style-type: none"> ● Check mounting bolts for damage and replace if required. If no damage is found, tighten bolts to 73-90 N·m (54-66 ft-lb). ● Set meshload to specification. Refer to meshload in the Adjustments portion of this section. ● Check race locknut for damage and replace as required. If no damage is found, tighten nut to 75-122 N·m (55-90 ft-lb). ● Replace valve assembly. Refer to Steering Gear in the Disassembly and Assembly portion of this section. ● Replace gear housing assembly. Refer to Steering Gear Housing in the Disassembly and Assembly portion of this section. ● Improper fit of worm to piston. Replace valve assembly (be certain to check meshload prior to replacing valve for center lash).

DIAGNOSIS AND TESTING (Continued)**STEERING GEAR CONDITIONS (Continued)**

CONDITION	POSSIBLE SOURCE	ACTION
Heavy Steering Efforts, Poor Assist While vehicle is turning corners and especially while parking. A road test can verify the condition.	<ul style="list-style-type: none"> ● Low steering system fluid fill. ● Engine idle too low. 	<ul style="list-style-type: none"> ● Add steering fluid to proper level. ● Set engine idle to specification. Refer to the appropriate section in Group 03.
	<ul style="list-style-type: none"> ● Low power steering pump belt tension. 	<ul style="list-style-type: none"> ● Check belt tension and set to specification. Refer to Section 11-02A for power steering pump belt tightening procedure.
	<ul style="list-style-type: none"> ● Pump flow / relief pressure not to specification. 	<ul style="list-style-type: none"> ● Test pump and service as necessary. Refer to Section 11-00 for pump testing procedures.
	<ul style="list-style-type: none"> ● External leakage giving low fluid level. 	<ul style="list-style-type: none"> ● Refer to Section 11-00 for external leak diagnosis.
	<ul style="list-style-type: none"> ● Piston Teflon® seal cut or twisted. 	<ul style="list-style-type: none"> ● Replace piston Teflon® seal. Refer to Piston in the Disassembly and Assembly portion of this section.
	<ul style="list-style-type: none"> ● Loose / missing rubber backup piston O-ring. 	<ul style="list-style-type: none"> ● Replace / install rubber backup piston O-ring. Refer to Piston in the Disassembly and Assembly portion of this section.
	<ul style="list-style-type: none"> ● Valve / gear housing oil passages blocked. 	<ul style="list-style-type: none"> ● Replace gear housing or valve housing as required. Refer to Disassembly and Assembly procedures in this section.
	<ul style="list-style-type: none"> ● Leakage past piston end cap. 	<ul style="list-style-type: none"> ● Check piston end cap for damage. If no damage is found, tighten piston end cap to 95-149 N-m (70-110 ft-lb). If damage is found, replace valve assembly. Refer to the Disassembly and Assembly portion of this section.
	<ul style="list-style-type: none"> ● Porosity in the piston bore (housing casting). 	<ul style="list-style-type: none"> ● Replace gear housing. Refer to Steering Gear Housing in the Disassembly and Assembly portion of this section.
	<ul style="list-style-type: none"> ● Porosity in piston. 	<ul style="list-style-type: none"> ● Replace valve assembly. Refer to Valve Housing in the Disassembly and Assembly portion of this section.
	<ul style="list-style-type: none"> ● Valve sleeve Teflon® seal(s) damaged. 	<ul style="list-style-type: none"> ● Replace valve sleeve Teflon® seal(s). Refer to Worm and Valve Sleeve in the Disassembly and Assembly portion of this section.

DIAGNOSIS AND TESTING (Continued)

STEERING GEAR CONDITIONS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
External Leakage One of the most common conditions causing repeat repairs is fluid leaks. Make sure you clean the steering gear first before any steering gear external leakage checks are performed.	<ul style="list-style-type: none"> Loose hose fittings. Missing / damaged hose fitting tube seats. Leak from input shaft seal. Leak at valve mounting face. Leak at sector adjuster screw locknut. Leak at sector shaft seal. Leak from gear housing. Leak at sector cover face, or cracked sector cover. 	<ul style="list-style-type: none"> Check hose fittings for damage and replace as required. If no damage is found, tighten fittings to specification. Refer to Specifications portion of this section for torque specification. Install / replace tube seats. Refer to Valve Housing in the Disassembly and Assembly portion of this section. Replace input shaft seal. Check shaft for damage. Check housing bore for porosity or damage. Check bolts for proper torque. Replace valve housing O-ring(s). Refer to Valve Housing in the Disassembly and Assembly portion of this section. Check locknut for damage and replace as required. If no damage is found, tighten locknut to 48-61 N·m (35-45 ft-lb). Replace sector seals and examine sector shaft for pitting or corrosion. Replace sector shaft if necessary. Check housing seal bore for porosity or damage. Replace housing if necessary. Replace gear housing. Refer to Steering Gear Housing in the Disassembly and Assembly portion of this section. Check bolt torques. Check O-ring seal and system relief pressure.
Poor Returnability — Sticky Feeling Vehicle is in a turn and returns to center with effort from the driver. In addition, when the driver returns the steering wheel to center, it may have a sticky or catchy feel.	<ul style="list-style-type: none"> Meshload set too tight. Sector adjuster not properly staked to sector. Damaged input shaft bearing. Binding in valve assembly. 	<ul style="list-style-type: none"> Reset meshload to specification. Refer to meshload in the Adjustments portion of this section. Replace sector assembly. Refer to Steering Gear in the Disassembly and Assembly portion of this section. Replace valve assembly. Refer to Valve Housing in the Disassembly and Assembly portion of this section. Replace valve assembly. Refer to Valve Housing in the Disassembly and Assembly portion of this section.

TG3856E

REMOVAL AND INSTALLATION

Steering Gear

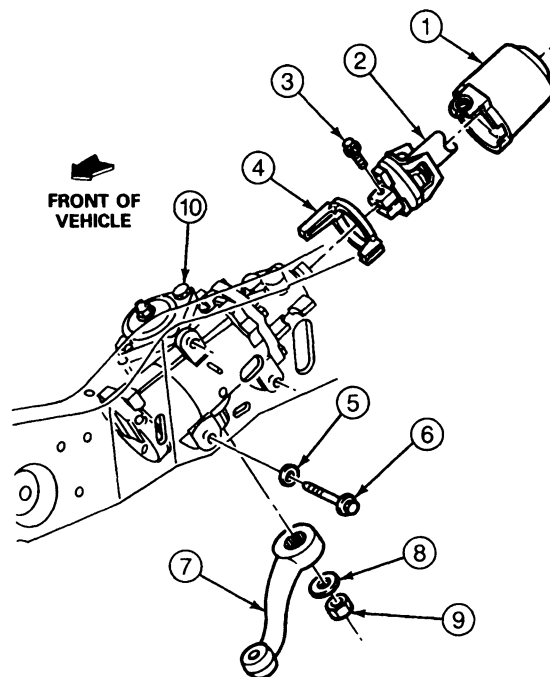
Removal

1. Disconnect the pressure and return lines from the steering gear. Plug the lines and the ports in the gear to prevent entry of dirt.
2. If equipped, remove the splash shield from the flex coupling. Disconnect the flex coupling at the steering gear by removing the bolt.

3. Raise the vehicle and remove the pitman arm attaching nut and washer.
4. Remove the pitman arm from the sector shaft using Pitman Arm Remover T64P-3590-F. Remove the tool from the pitman arm.
5. Support the steering gear, and remove the steering gear attaching bolts.
6. Work the steering gear free of the flex coupling. Remove the steering gear from the vehicle.

REMOVAL AND INSTALLATION (Continued)**Installation**

1. If equipped, install the splash shield onto the steering gear lugs.
2. Slide the flex coupling into place on the steering shaft assembly. Turn the steering wheel so the spokes are in the horizontal position.
3. Center the steering gear input shaft with the indexing flat facing down.
4. Slide the steering gear input shaft into the flex coupling and into place on the frame side rail. Install the flex coupling attaching bolt and tighten to 41-57 N·m (30-42 ft-lb). Install the gear to frame attaching bolts and tighten to 73-90 N·m (54-66 ft-lb).
5. Be sure the wheels are in the straight ahead position, then install the pitman arm on the sector shaft. Install the pitman arm attaching washer and nut. Tighten nut to 230-310 N·m (170-228 ft-lb).
6. Connect and tighten the pressure and the return lines to the steering gear to 27-41 N·m (20-30 ft-lb).
7. Snap the flex-coupling shield over the hose fitting and the splash shield.
8. Disconnect the coil wire. Fill the reservoir to specifications listed in Section 11-00. Turn on the ignition and turn the steering wheel from left to right to distribute the fluid.
9. Re-check fluid level and add Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent if necessary. Connect the coil wire, start the engine and turn the steering wheel from side to side. Inspect for fluid leaks. Recheck fluid level.

Steering Gear Installation, F-150-250-350, Bronco and F-Super Duty

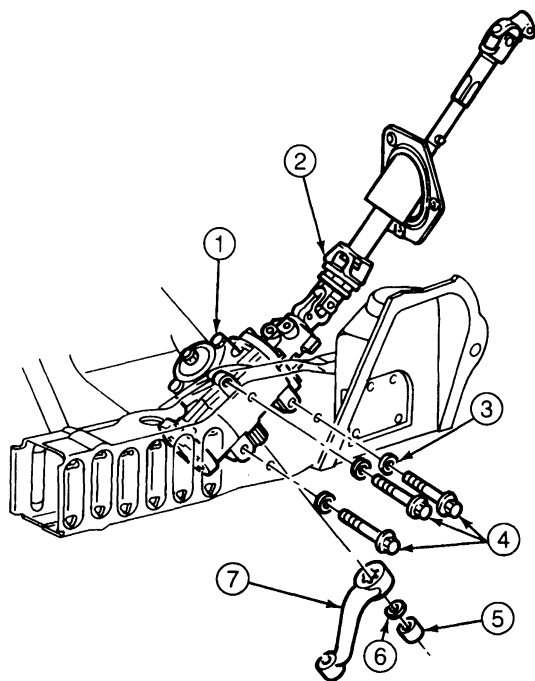
G7629-A

Item	Part Number	Description
1	3F540	Upper Shield
2	3C662	Steering Column Lower Shaft
3	N803942-S100	Bolt 41-57 N·m (30-42 Ft-Lb)
4	3F540	Lower Shield
5	388273	Washer
6	389442-S190	Bolt 73-90 N·m (54-66 Ft-Lb)
7	3590	Pitman Arm
8	34798	Washer
9	380771	Nut 230-310 N·m (170-228 Ft-Lb)
10	3504	Steering Gear

TG7629A

REMOVAL AND INSTALLATION (Continued)

Steering Gear Installation, E-150-250-350



G7631-A

Item	Part Number	Description
1	3504	Steering Gear
2	3A525	Steering Column Flex Coupling
3	388273-S100	Washer
4	388272-S190	Bolt 73-90 N·m (54-66 Ft-Lb)
5	380771	Nut 230-310 N·m (170-228 Ft-Lb)
6	34798-S2	Washer
7	3590	Pitman Arm

TG7631A

DISASSEMBLY AND ASSEMBLY

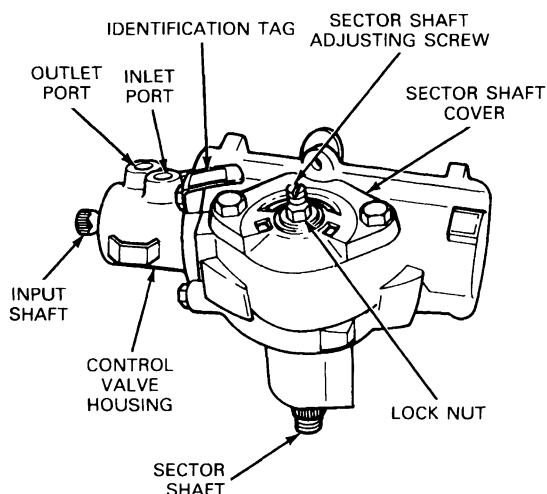
Take the following precautions when servicing the steering gear:

1. Use a clean workbench and tools.
2. Thoroughly clean the exterior of the gear with solvent and drain off excess hydraulic fluid, if necessary.
3. Handle all parts carefully to avoid nicks, burrs, scratches and dirt.
4. Do not use solvent on seals.

Steering Gear

Disassembly

1. Hold the steering gear upside down over a drain pan and cycle the input shaft several times to drain the fluid from the gear.
2. Secure the gear in a soft-jawed vise.

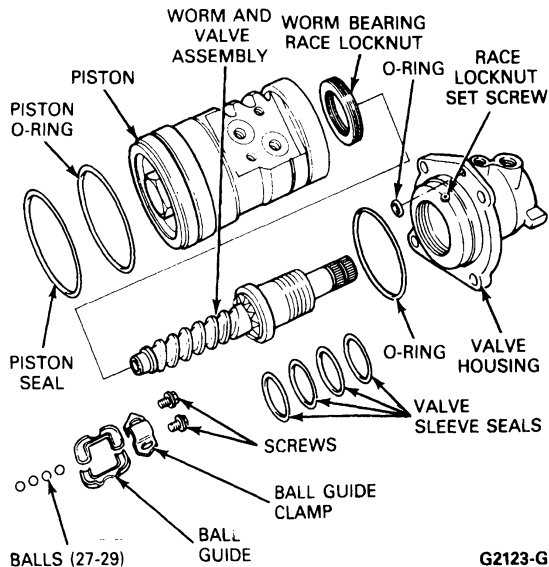


G4728-B

3. Turn the input shaft to either stop, then turn it back two turns to center the gear.
NOTE: The indexing flat on the input shaft should be facing downward.
4. Remove the sector shaft cover attaching bolts.
5. Tap the lower end of the sector shaft with a soft hammer to loosen it, and lift the cover and shaft from the housing **as an assembly**. Discard the O-ring.
NOTE: The following step is required only when it is necessary to remove sector shaft from the sector assembly.
6. Remove the nut from the sector shaft adjusting screw. Turn the sector shaft cover counterclockwise and remove it from the sector shaft adjuster screw.
7. Remove the valve housing attaching bolts and identification tag. Lift the valve housing off the steering gear housing. Remove the valve housing, piston assembly, and control valve gasket. Discard the gasket.
NOTE: If valve housing or the valve sleeve seals are to be replaced, proceed to Step 11. If sector shaft seals are to be replaced go to steering gear housing section. Balls need to be removed if valve sleeve rings are to be replaced.
8. With the piston held so the ball guide faces up, remove the ball guide clamp screws and ball guide clamp.

DISASSEMBLY AND ASSEMBLY (Continued)

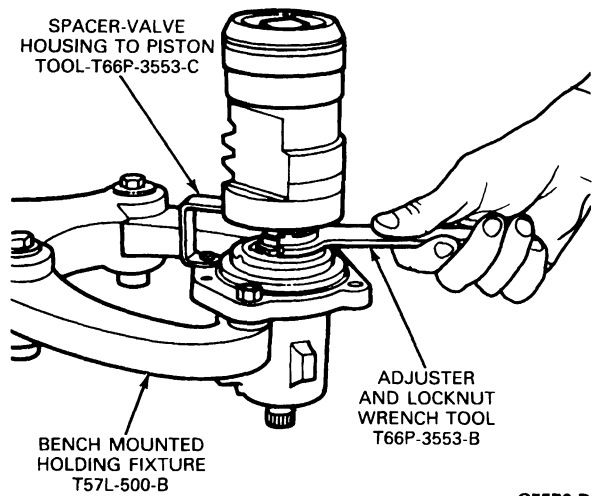
9. With a finger over the opening in the ball guide, turn the piston so the ball guide faces down over a clean container. Let the guide tubes drop into the container.



G2123-G

10. Rotate the input shaft from stop to stop until all balls fall from the piston into the container. The valve assembly can then be removed from the piston. **Inspect the piston bore to make sure all balls have been removed.**
11. Install the valve body assembly in the Bench Mounted Holding Fixture T57L-500-B and loosen the Allen head race locknut screw from the valve housing.
12. Remove the worm bearing race locknut using Adjuster and Locknut Wrench T66P-3553-B and Valve Housing to Piston Spacer T66P-3553-C.
13. Carefully slide the input shaft, worm and valve assembly out of the valve housing.

REMOVING WORM BEARING RACE LOCKNUT



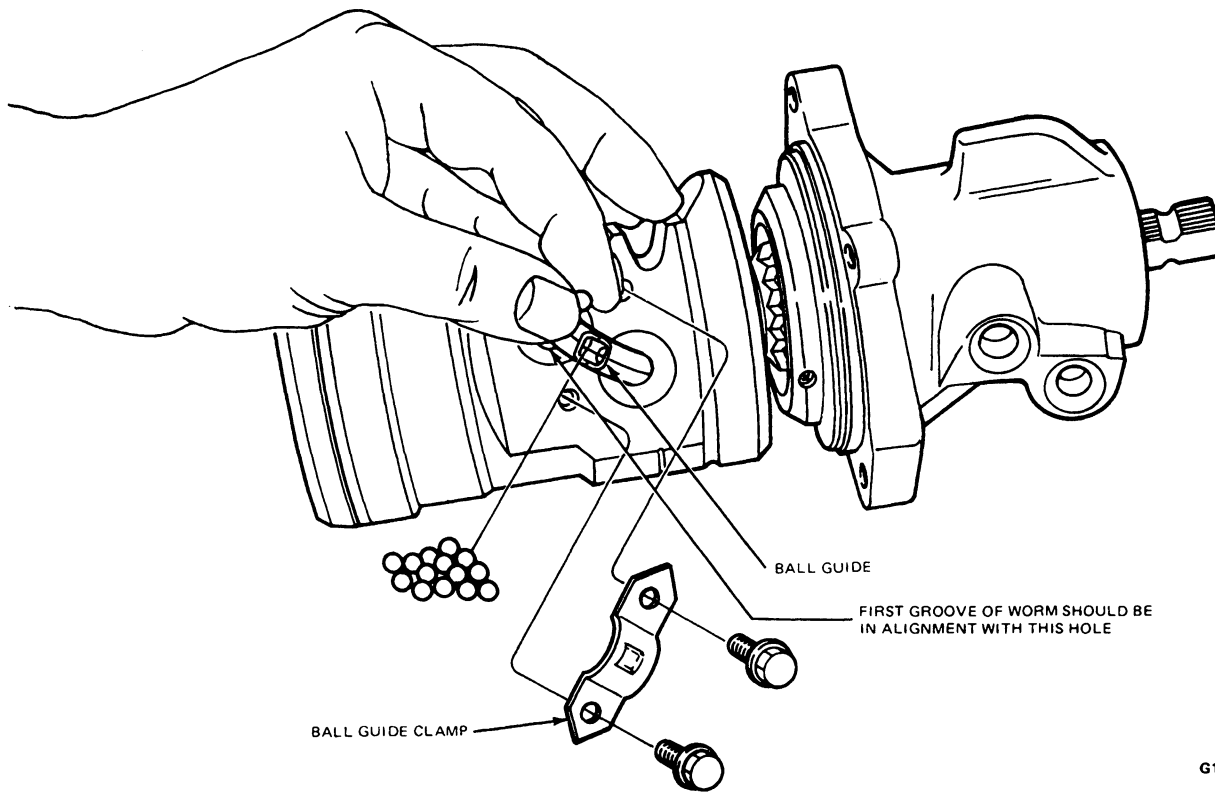
G5576-D

Assembly

1. Mount the valve housing in the Bench Mounted Holding Fixture T57L-500-B with the flanged end up.
2. Apply a light coat of Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent to the Teflon® rings on the valve sleeve.
3. Carefully install the worm shaft and valve in the housing.
4. Install the worm bearing race locknut in the housing and tighten to 75-122 N·m (55-90 ft-lb).
5. Install the Allen head race locknut set screw through the valve housing and tighten to 1.7-2.8 N·m (15-25 in-lb).
6. Place the piston on the bench with the ball guide holes facing up. Insert the worm into the piston so the first groove is in line with the hole nearest the center of the piston.
7. Place the ball guides in the piston. Turning the input shaft counterclockwise, place the same balls as removed in Step 9 of Steering Gear Disassembly in the ball guide. During assembly 27 to 29 balls are required. If all the balls have not been inserted upon reaching the left stop, rotate the input shaft in one direction then the other while inserting the remaining balls.

DISASSEMBLY AND ASSEMBLY (Continued)

Steering Gear Assembly



G1554-2C

8. Secure the guides in the ball nut with the clamp. Tighten screws to 4.8-7.9 N·m (42-70 in-lb).
9. Apply petroleum jelly or equivalent to the Teflon® seal on the piston.
10. Place a new control valve O-ring on the valve housing.
11. Slide the piston and valve into the gear housing being careful not to damage the piston ring.
12. Align the oil passage in the valve housing with the passage in the gear housing. Place a new O-ring onto the oil passage hole of the gear housing. Install identification tag onto the housing. Install, **but do not tighten**, the attaching bolts. Identification tag is to be installed under upper right valve housing bolt.
13. Rotate the piston so the teeth are in the same plane as the sector teeth. Tighten the valve housing attaching bolts to 40-60 N·m (30-45 ft-lb).

14. Position the sector shaft cover O-ring in the steering gear housing. Turn the input shaft to center the piston.
15. Apply petroleum jelly or equivalent to the sector shaft journal, and position the sector shaft and cover assembly in the gear housing. Install the sector shaft cover attaching bolts. Tighten the bolts to 75-94 N·m (55-70 ft-lb).
16. Attach an inch-pound torque wrench to the input shaft. Adjust meshload to specification. Refer to specifications at the end of this section.

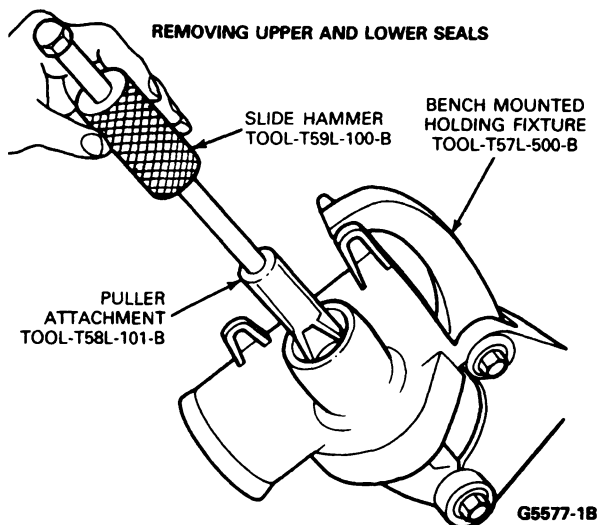
Steering Gear Housing

Disassembly

1. Remove the snap ring from the lower end of the housing.

DISASSEMBLY AND ASSEMBLY (Continued)

- Remove dust seal using Puller Attachment T58L-101-B and Slide Hammer T59L-100-B or equivalent. Discard the seal.



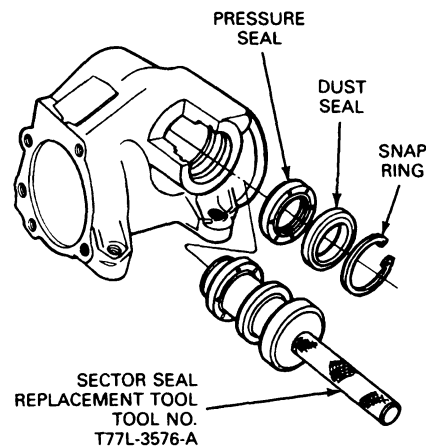
- Remove pressure seal in the same manner. Discard the seal.

Assembly

NOTE: Proper seal installation tools and procedures must be used to prevent damage to seals during assembly.

- Lubricate the new pressure seal and new dust seal with clean Multi-Purpose Grease DOAZ-19584-AA (ESR-M1C 159-A) or equivalent.
- Apply Multi-Purpose Grease DOAZ-19584-AA (ESR-M1C 159-A) or equivalent to the sector shaft seal bore.
- Place the dust seal on Sector Seal Replacement Tool T77L-3576-A so the raised lip of the seal is toward the tool.
- Place the pressure seal on the tool with lip away from the tool. The flat back side of the pressure seal should be against the flat side of the dust seal.

NOTE: Failure to use proper seal installation tools and procedures may damage the seals and cause a fluid leak.



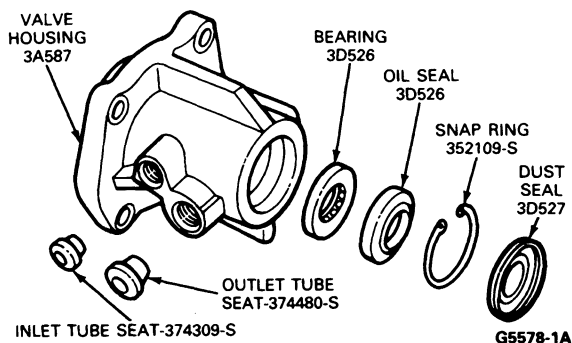
- Insert the seal driver tool into the sector shaft bore and drive the tool until the seals clear the snap ring groove. Do not bottom seals against bearing. **The seal will not function properly when bottomed against the bearing.**
- Install snap ring in the groove in the housing.
- Apply a generous amount of Ford Multi-Purpose Grease DOAZ-19584-AA (ESR-M1C 159-A) or equivalent grease to the areas between the seal lips.

Valve Housing

NOTE: The only service that can be performed on the control valve assembly is the replacement of the four Teflon® seals on the valve sleeve and replacement of the control valve housing.

Disassembly

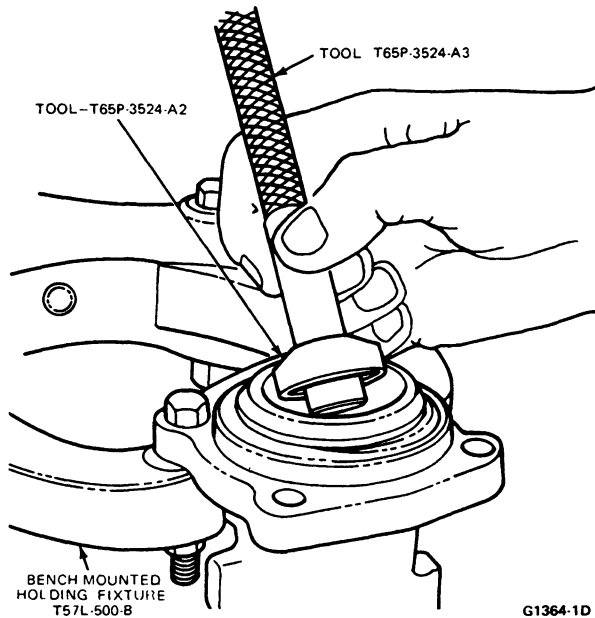
- Remove the dust seal from the rear of the valve housing using Puller Attachment T58L-101-B and Slide Hammer T59L-100-B. Discard the seal.
- Remove the snap ring from the valve housing.



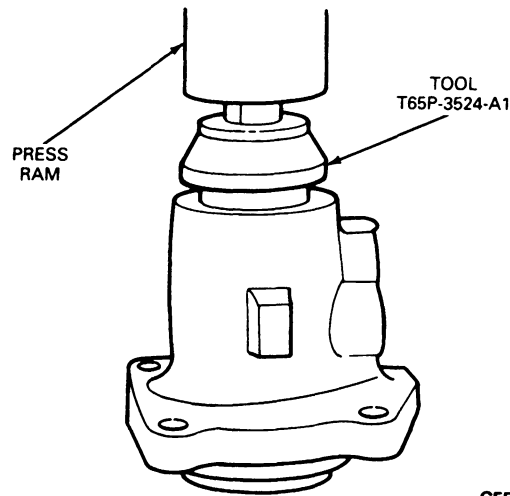
- Turn Bench-Mounted Holding Fixture T57L-500B to invert valve housing.

DISASSEMBLY AND ASSEMBLY (Continued)

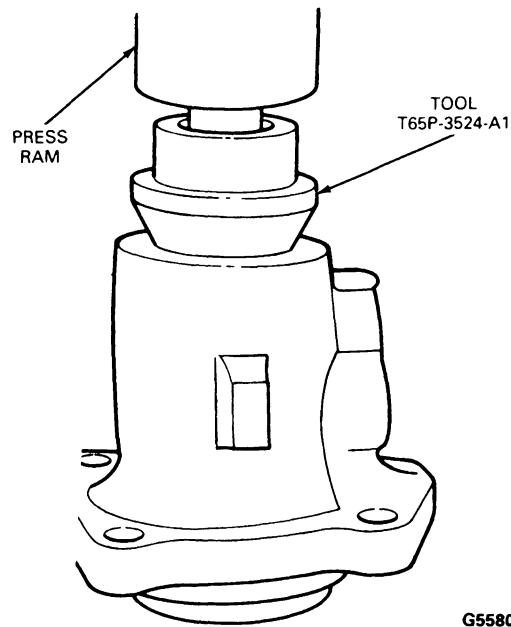
4. Insert Input Shaft Bearing / Seal Tools T65P-3524-A2 and T65P-3524-A3 in the valve body assembly opposite the oil seal end, and gently tap the bearing and seal out of the housing. Discard the seal. **Do not damage the housing when inserting and removing the tools.**
5. Remove the fluid inlet and outlet tube seats with Tube Seat Remover T74P-3504-L or equivalent if they are damaged.

**Assembly**

1. Coat the fluid inlet and outlet tube seats with petroleum jelly or equivalent. Install seats in the housing with a Tube Seat Installer T74P-3504-M.
2. Coat the bearing and seal surface of the housing with petroleum jelly or equivalent.
3. Install the bearing with the metal side covering the rollers facing outward. Seat the bearing in the valve housing using Tool T65P-3524-A1. Be sure the bearing rotates freely.



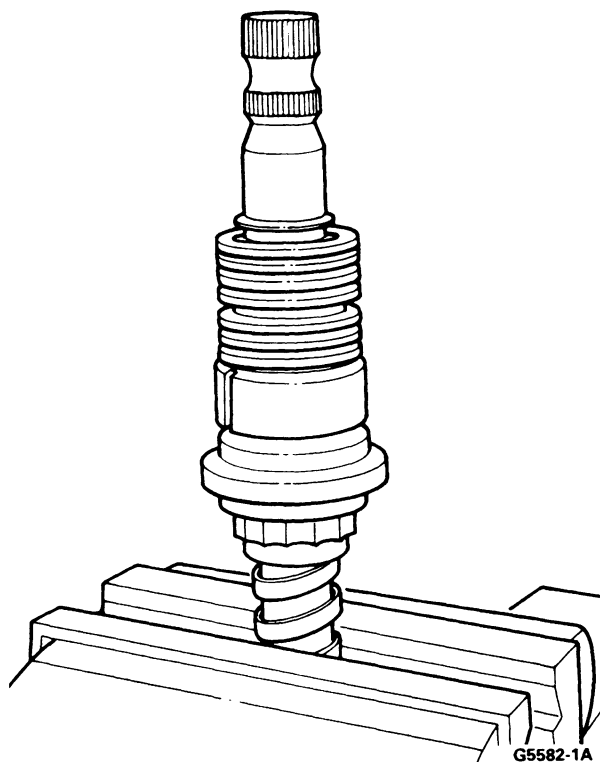
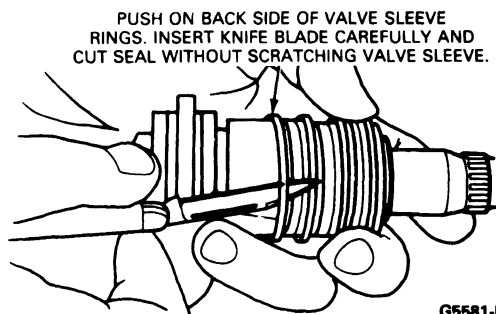
4. Dip a new oil seal in gear lubricant, Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent and place it in the housing with the metal side facing outward. Drive the seal into the housing until the outer edge does not quite clear the snap ring groove.



5. Place the snap ring in the housing and drive on the ring using Tool T65P-3524-A1 until the snap ring seats in its groove.
6. Place the dust seal in the housing with the dished side (rubber side) facing out. Drive the dust seal into place using Tool T65P-3524-A1. When properly installed, the seal will be located behind the undercut in the input shaft.
7. Apply a generous amount of Ford Multi-Purpose Grease DOAZ-19584-AA (ESR-M1C159-A) or equivalent to the area between the two seals.

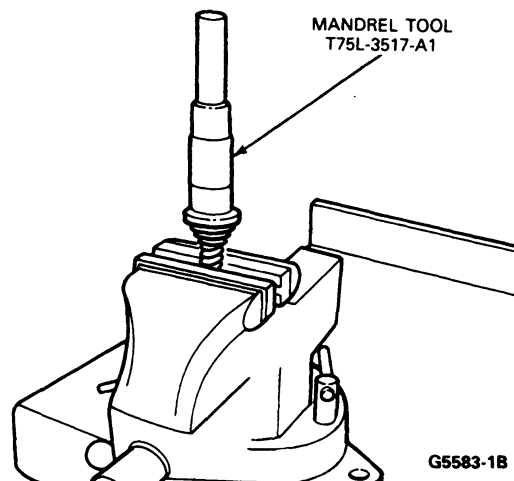
DISASSEMBLY AND ASSEMBLY (Continued)**Worm and Valve Sleeve****Disassembly**

1. Remove valve sleeve seals from sleeve by inserting the blade of a small pocket knife under them and cutting them off.

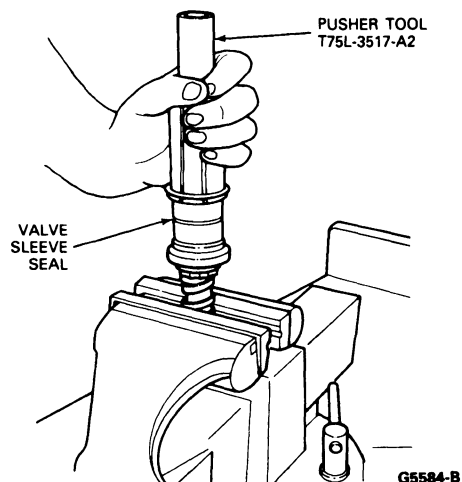
**Assembly**

1. Mount the worm end of the worm and valve sleeve assembly into a soft-jawed vise.
- NOTE: Failure to use proper seal installation tools and procedures may damage the seals and cause a fluid leak.

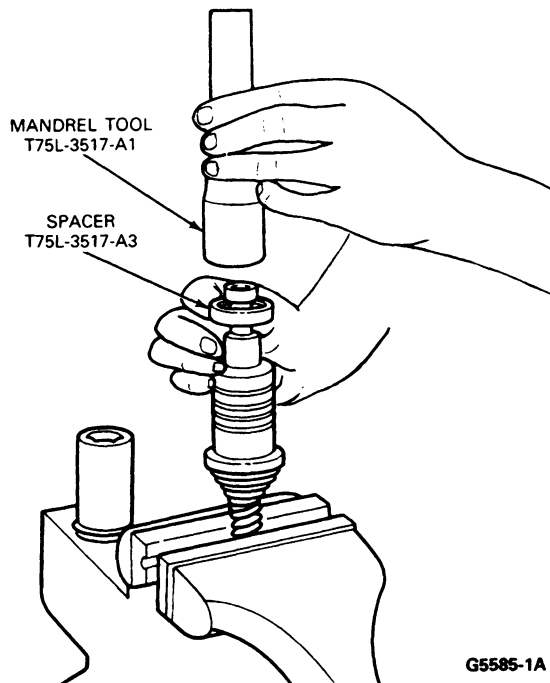
2. Install Mandrel Tool T75L-3517-A1 from the Seal Installation Set T75L-3517-A over the sleeve; slide one valve sleeve seal over the tool.



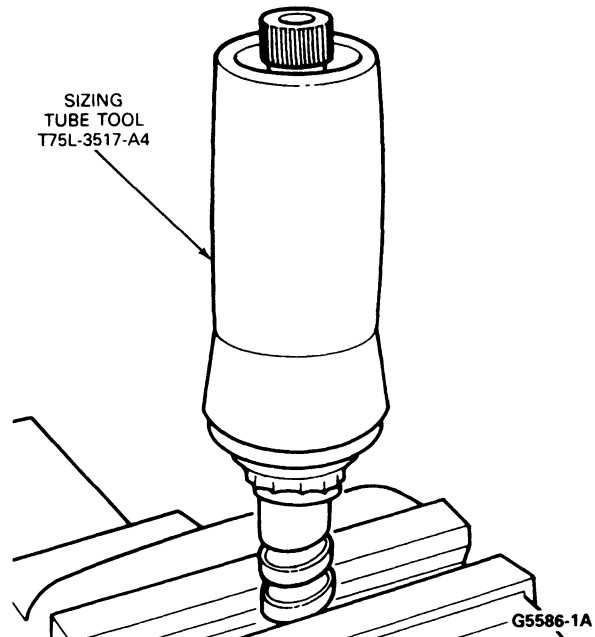
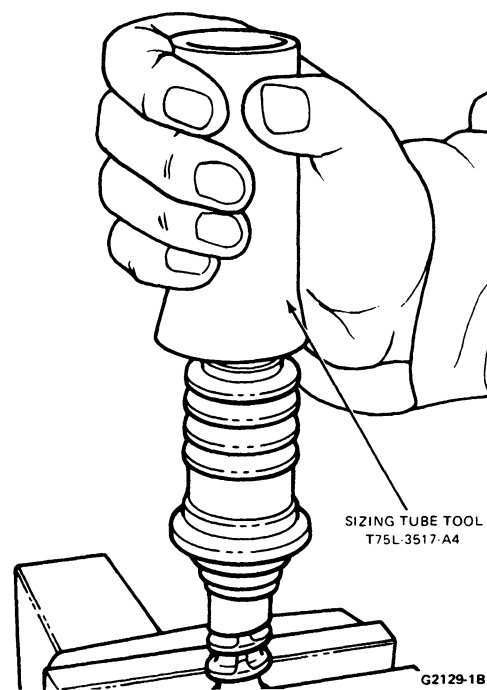
3. Slide Pusher Tool T75L-3517-A2 over the mandrel; rapidly push down on the pusher tool, forcing the seal down the ramp and into the fourth groove of the valve sleeve. Repeat this step three more times and each time add one of the Spacer Tools T75L-3517-A3, under the mandrel tool. By adding the spacer each time, the mandrel tool will line up with the next groove of the valve sleeve.



DISASSEMBLY AND ASSEMBLY (Continued)



4. After installing the four valve sleeve seals, apply a light coat of Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent to the sleeve and seals.
5. Install one Spacer T75L-3517-A3 over the input shaft as a pilot for installing the sizing tube. Slowly install the sizing tube Tool T75L-3517-A4 over the sleeve valve end of the worm shaft onto the valve sleeve seals. Make sure that the seals are not being bent over as the tube is slid over them. Allow the sizing tube to sit over the seals for five minutes.



6. Remove the sizing tube and check the condition of the seals. Make sure that the seals turn freely in the grooves.

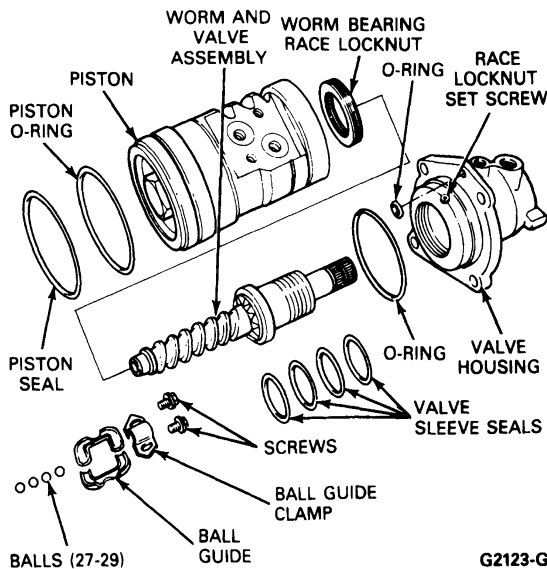
NOTE: No further service or disassembly of the worm valve assembly is possible. Valve centering will be destroyed if disassembly is attempted.

DISASSEMBLY AND ASSEMBLY (Continued)**Piston****Disassembly**

1. Remove the Teflon® piston seal and O-ring from the piston and ball nut. Discard both seal and O-ring.

Assembly

1. Dip a **new** O-ring in Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) and install it on the piston and ball nut.
2. Install a **new** Teflon® piston seal on the piston and ball nut being careful not to stretch it any more than necessary.

**Adjustment In-Vehicle**

Adjust total on center load to eliminate excessive lash between the sector and rack teeth as follows. See meshload specifications below for checking and setting values. This is the only adjustment required.

1. Disconnect the pitman arm from the sector shaft using Pitman Arm Puller T64P-3590-F.
2. Disconnect the fluid return line at the reservoir and cap the reservoir return line pipe.
3. Place the end of the return line in a clean container and turn the steering wheel from stop-to-stop several times to discharge the fluid from the gear. Discard the fluid.
4. Turn the steering wheel to 45 degrees from the right stop.
5. Attach an inch-pound torque wrench to the steering wheel nut and determine the torque required to rotate the shaft slowly approximately one-eighth turn toward center from the 45 degree position.
6. Turn the steering gear back to center and determine the torque required to rotate the shaft back and forth across the center position ($\pm 90^\circ$). Refer to the following chart for checking and resetting specifications. If reset is required, loosen the adjuster locknut and turn the sector shaft adjuster screw until the reading is the specified value greater than the torque at 45 degrees from the stop. Hold the sector shaft screw in place, and tighten the locknut.

ADJUSTMENTS**Meshload**

During the vehicle breaking-in period, some factory adjustments may change. These changes in adjustment will not necessarily affect operation of the steering gear assembly. If excessive steering lash is encountered, then a meshload adjustment may be required.

ADJUSTMENTS (Continued)

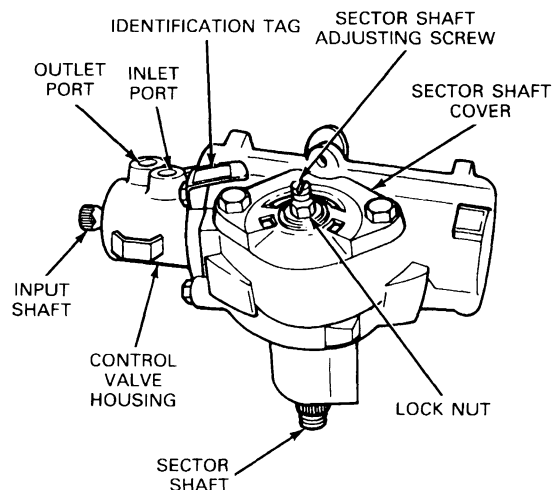
MESHLOAD CHECKING AND SETTING

Vehicles with 0-8046 km (0-5000 Miles)	Vehicles with More Than 8046 km (5000 Miles) or Where Sector Shaft Has Been Replaced
CHECKING: Reset if total meshload over mechanical center is less than 1.7 N·m (15 in-lb) or greater than 2.7 N·m (24 in-lb).	CHECKING: Reset if meshload measured while rocking input shaft over center is less than 0.8 N·m (7 in-lb) greater than the torque 45° from the right stop.
RESET: Set torque measured rocking across center to a value of 1.2-1.7 N·m (11-15 in-lb) greater than that measured 45° from the right stop.	RESET: Set torque measured rocking across center to a value 1.13-1.6 N·m (10-14 in-lb) greater than that measured 45° from the right stop.

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- Re-check torque readings and replace the pitman arm and steering wheel hub cover.
- Connect the fluid return line to the reservoir and fill the reservoir to specifications listed in Section 11-00. Adjust belt tension, if necessary.

CAUTION: Do not pry against the reservoir to obtain proper belt load. Pressure will deform the reservoir and cause it to leak.



G4728-B

- Check the fluid level in the reservoir and add Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent if necessary.
- Start the engine and turn the steering wheel from stop-to-stop to bring the steering fluid to normal operating temperature. Turn off the engine and re-check the fluid level. Add Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent if necessary.
- With the engine running at approximately 1000 rpm and the steering wheel centered, attach an inch-pound torque wrench to the steering wheel nut. Apply sufficient torque in each direction to get a gauge reading of 1723 kPa (250 psi).
- The torque wrench readings should be the same in both directions at 1723 kPa (250 psi). If the difference between the readings exceeds 0.68 N·m (6 in-lb), remove the steering gear and replace the shaft and control assembly.
- When performing the valve centering check outside the vehicle, use the procedures described above, except take the torque and pressure readings at the right and left stops instead of either side of center.

NOTE: A hissing noise is a normal characteristic of rotary valve steering gears and in no way effects steering. Do not replace the shaft and control assembly unless the hiss is **EXTREMELY** objectionable. A replacement valve will also exhibit slight noise, and is not always a cure for the complaint. Any metal-to-metal contacts, such as column grounding, coupling grounding, or sheet metal to steering components will transmit valve hiss noise into the passenger compartment.

The only service that can be performed on the new valve assembly is the replacement of the four valve sleeve O-rings on the valve sleeve and replacement of the control valve housing.

Rotary Valve Centering Check

- Install a 0-13,789 kPa (0-2000 psi) pressure-gauge Power Steering Analyzer Tool D79L-33610-A or equivalent in the pressure line between the power steering pump outlet port and the integral steering gear inlet port. Be sure that the valve on the gauge is fully open.

SPECIFICATIONS

Refer to the following charts for steering gear specifications.

FORD INTEGRAL POWER STEERING GEAR SPECIFICATIONS

Description	
Type	Recirc. Ball Torsion Bar
Ratio	17:1
Turns of Steering Wheel (Lock to Lock — Linkage Disconnected)	4
Fluid Capacity (Included in Pump Reservoir Fill)	.75L (1.6 Pint Approx.)
Fluid Specification	ESW-M2C33-F ②
Worm Bearing Preload (Overall Input Shaft Torque with Sector Shaft Removed)	0.45-1.0 N•m (4-9 In-Lbs) ①
Worm to Piston Preload	0.11-0.34 N•m (1-3 In-Lbs) ①

- ① Not adjustable in field. Specification given for inspection purposes only.
 ② Premium Power Steering Fluid, E6AZ-19582-AA (ESW-M2C33-F) or equivalent.

FORD INTEGRAL POWER STEERING GEAR TORQUE LIMITS

Description	Torque Limits	
	(Ft-Lbs)	N•m
Gear to Flex Coupling Bolt	30-42	41-57
Steering Gear to Frame Bolt	54-66	73-90
Sector Shaft Cover Bolts	55-70	75-94
Mesh Load Adjusting Screw Lock Nut	35-45	48-61
Valve Housing to Gear Housing Bolt	35-50	48-67
Race Retaining Nut	55-90 ①	75-122
Piston End Cap	70-110	95-149
Pressure Hose to Gear	20-30	27-41
Return Hose to Gear	20-30	27-41
Pitman Arm to Sector Shaft Nut	170-228	230-310
	(In-Lbs)	N•m
Ball Return Guide Clamp Screw	42-70	4.8-7.9
Set Screw Race Nut	15-25	1.7-2.8
Hose Clamps	13-23	1.4-2.7

- ① Specified Torque — Because the length of the tool required to torque the nut will affect the observed torque reading on the torque wrench, the torque reading should be computed using the length of the torque wrench and the nominal specified torque as follows:

$$\text{Torque Reading} = \frac{\text{Length of Torque Wrench} \times 72 \text{ ft-lbs}}{\text{Length of Torque Wrench} + 5.5 \text{ inches}} \quad (\text{Using Tool T66P-3553-B})$$

Example: With 13 inch torque wrench
 $\frac{13 \text{ in.} \times 72 \text{ ft-lbs}}{13 \text{ in.} + 5.5 \text{ in.}} = \frac{13 \text{ in.} \times 72 \text{ ft-lbs}}{18.5 \text{ in.}} = 0.703 \times 72 \text{ ft-lbs} = 50 \text{ ft-lbs}$

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MESHLOAD CHECKING AND SETTING

Vehicles with 0-8046 km (0-5000 Miles)	Vehicles with More Than 8046 km (5000 Miles) or Where Sector Shaft Has Been Replaced
CHECKING: Reset if total meshload over mechanical center is less than 1.7 N•m (15 in-lb) or greater than 2.7 N•m (24 in-lb).	CHECKING: Reset if meshload measured while rocking input shaft over center is less than 0.8 N•m (7 in-lb) greater than the torque 45° from the right stop.
RESET: Set torque measured rocking across center to a value of 1.2-1.7 N•m (11-15 in-lb) greater than that measured 45° from the right stop.	RESET: Set torque measured rocking across center to a value 1.13-1.6 N•m (10-14 in-lb) greater than that measured 45° from the right stop.

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SPECIAL SERVICE TOOLS

The following chart illustrates the special tools described in this section.

SPECIAL SERVICE TOOLS

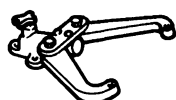
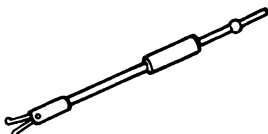

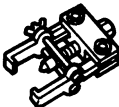
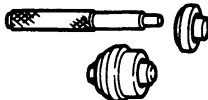


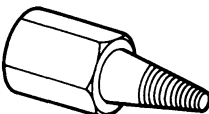

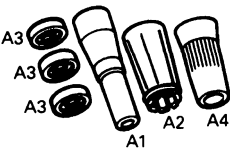

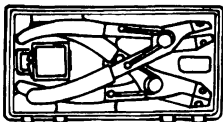

ILLUSTRATION	TOOL NUMBER/DESCRIPTION
	T57L-500-B BENCH MOUNTED HOLDING FIXTURE (7020)
	T58L-101-B PULLER ATTACHMENT
	T59L-100-B IMPACT SLIDE HAMMER
	T64P-3590-F PITMAN ARM PULLER
	T65P-3524-A INPUT SHAFT BEARING/SEAL TOOL
	T66P-3553-B ADJUSTER & LOCKNUT WRENCH
	T66P-3553-C SPACER-VALVE HOUSING TO PISTON

ILLUSTRATION	TOOL NUMBER/DESCRIPTION
	T74P-3504-L BRASS TUBE SEAT REMOVER
	T74P-3504-M BRASS TUBE SEAT REPLACER
	T75L-3517-A SEAL INSTALLATION SET
	T77L-3576-A SECTOR SHAFT SEAL REPLACER
	D79L-7000-A RETAINING RING PLIERS
	D79L-33610-A POWER STEERING ANALYZER 0-2000 P.S.I. .5-4 G.P.M.

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SECTION 11-02D Steering Pump, Power, Saginaw

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Drive Belt Tension	11-02D-9	Power Steering Pump	11-02D-2
DESCRIPTION AND OPERATION	11-02D-1	Power Steering Pump Pulley	11-02D-5
DIAGNOSIS AND TESTING	11-02D-1	Rotor Shaft Seal	11-02D-6
DISASSEMBLY AND ASSEMBLY		SPECIAL SERVICE TOOLS	11-02D-10
Power Steering Pump	11-02D-6	SPECIFICATIONS	11-02D-10
REMOVAL AND INSTALLATION		VEHICLE APPLICATION	11-02D-1
Drive Belt, Automatically Tensioned Belts			
(4.9L, 5.0L, 5.8L, 7.5L)	11-02D-6		

VEHICLE APPLICATION

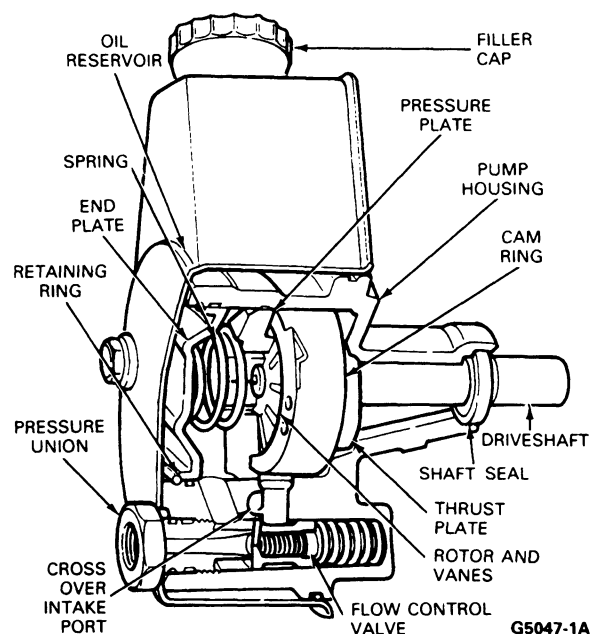
E-150-250-350 Vehicles with 4.9L, 5.0L, 5.8L, and 7.5L Engines

DESCRIPTION AND OPERATION

The power steering pump is a constant displacement vane type providing hydraulic pressure for the steering system. The housing and internal parts of the pump are inside the reservoir so the pump parts operate submerged in oil. The reservoir is sealed against the pump housing, leaving the housing face and the shaft hub exposed. The reservoir has a filler neck with a cap.

The driveshaft is fitted with a pulley and is belt driven from the engine's crankshaft. The rotor is loosely splined to the driveshaft and secured with a retaining ring. Ten vanes are mounted in radial slots in the rotor.

An identification label showing the pump model number is located on the outboard side of the pump reservoir.



DIAGNOSIS AND TESTING

Refer to Section 11-00.

REMOVAL AND INSTALLATION

Power Steering Pump

Removal

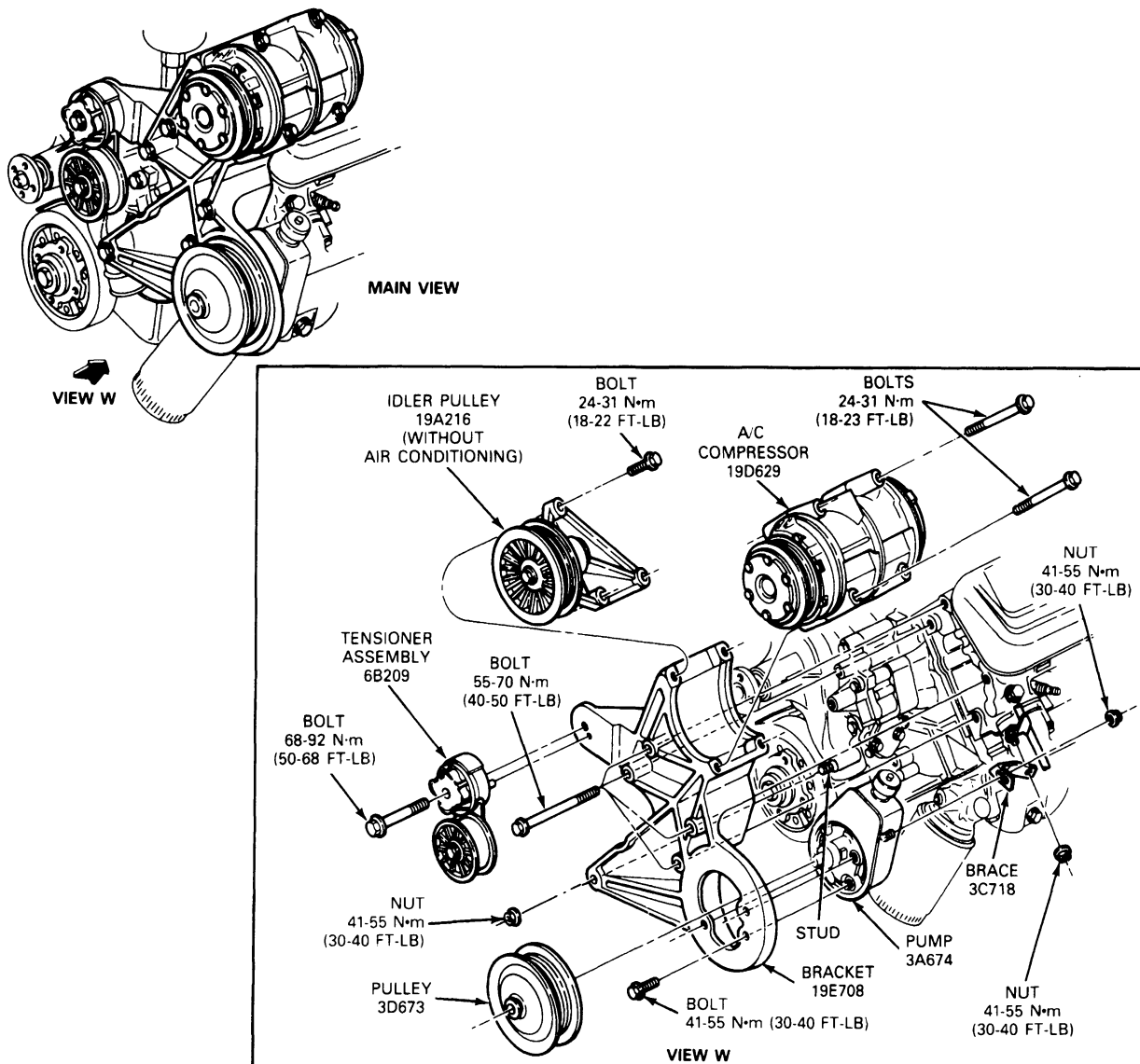
1. To remove the power steering fluid from the pump reservoir, disconnect the fluid return hose at the reservoir and drain the fluid into a container.
2. Remove the pressure hose from the pump.
3. Remove drive belt as described in this section.
4. Remove the power steering pulley as described in this section.

5. Remove power steering attaching bolts and remove the power steering pump.

For installation, follow removal procedures in reverse order. Refer to illustrations and charts in this section for torque values.

Fill the reservoir with Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent. Start engine and turn the steering wheel from stop to stop to remove air from the system.

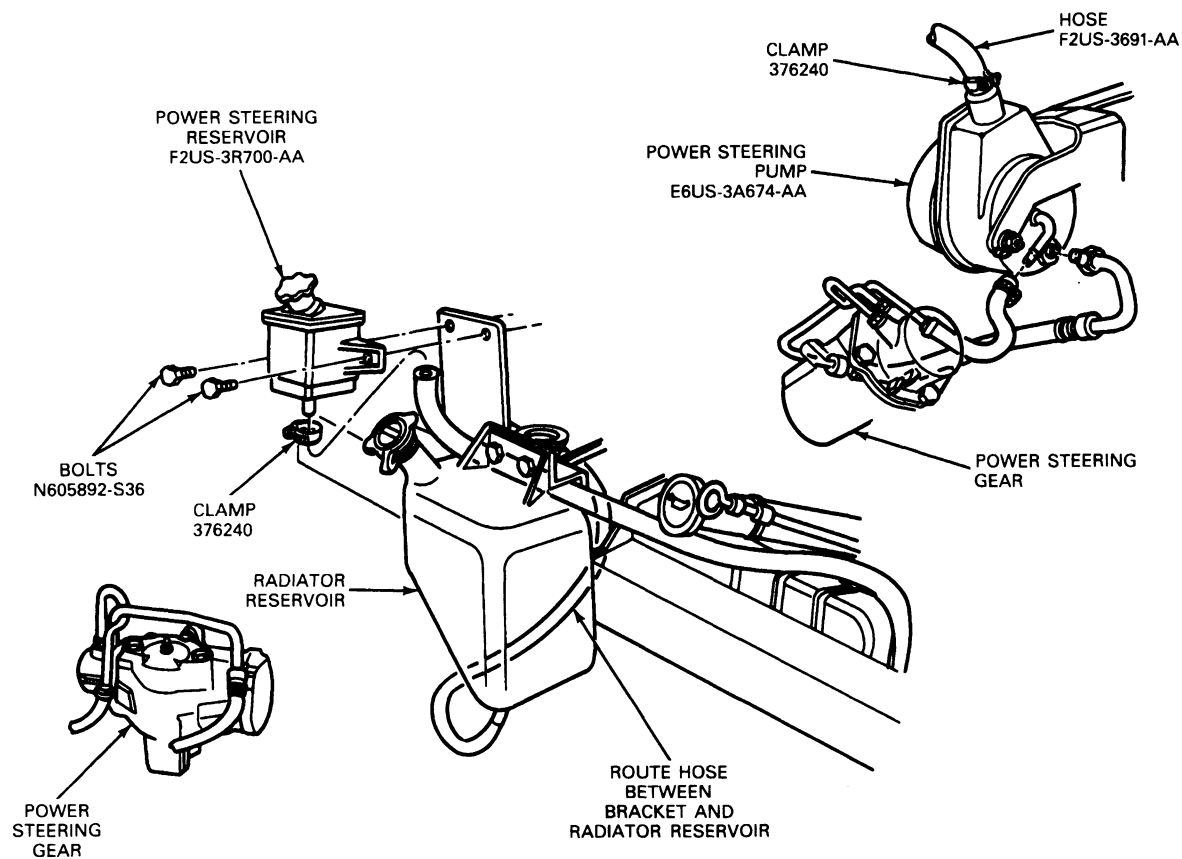
Power Steering Pump Installation, 7.5L MFI Engine



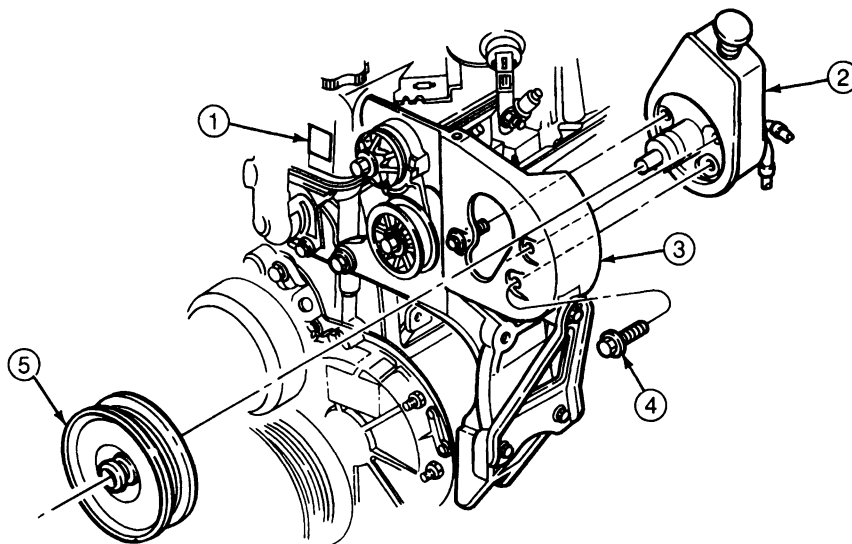
G6333-D

REMOVAL AND INSTALLATION (Continued)

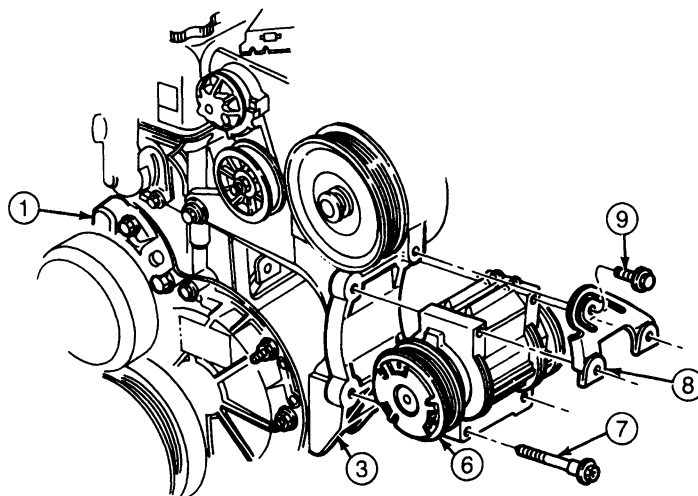
Power Steering Pump and Reservoir, Econoline RV Stripped Chassis



G8338-A

REMOVAL AND INSTALLATION (Continued)**Power Steering Pump Installation, 4.9L MFI Gasoline Engine**

VIEW WITHOUT AIR CONDITIONING



VIEW WITH AIR CONDITIONING

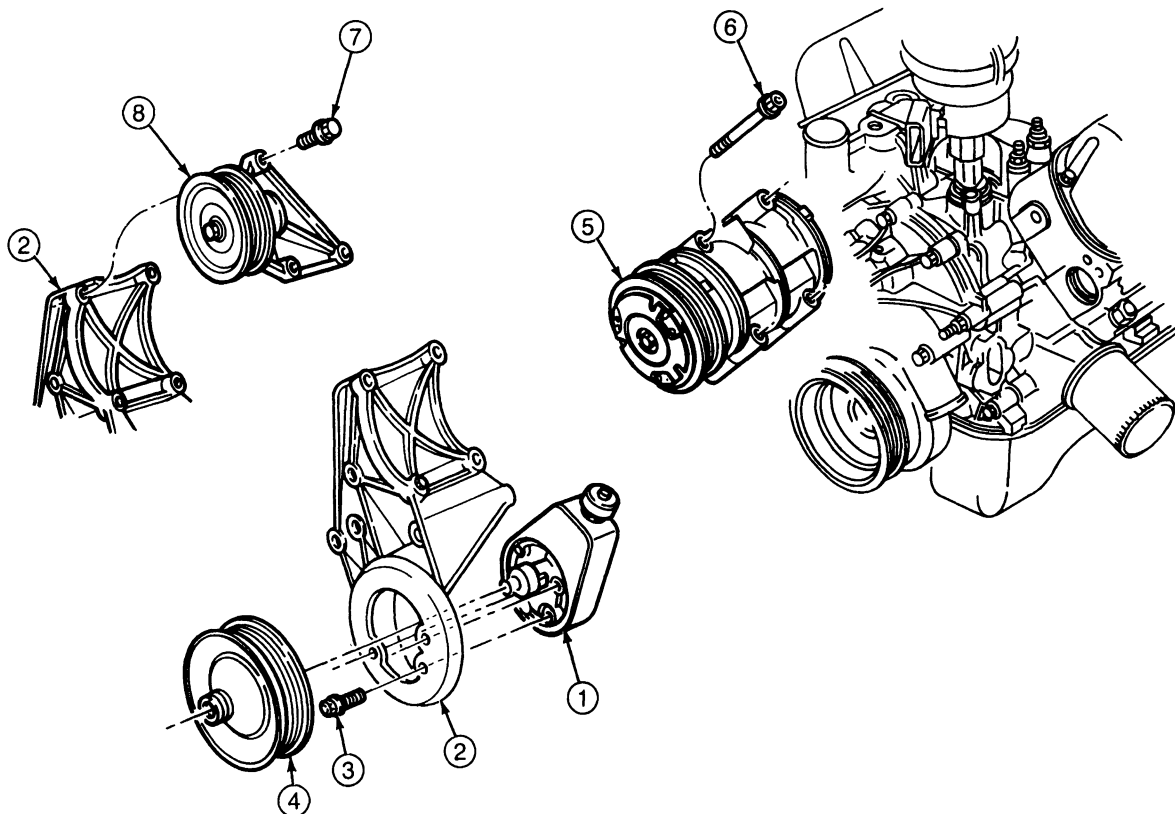
G7622-A

Item	Part Number	Description
1	6007	Engine Assembly
2	3A674	Power Steering Pump
3	19E708	Mounting Bracket
4	N801179-S2	Bolt 41-55 N·m (30-40 Ft-Lb)
5	3D673	Power Steering Pump Pulley

(Continued)

Item	Part Number	Description
6	19D629	A/C Compressor
7	N806020-S2	Bolt 24-31 N·m (18-22 Ft-Lb)
8	3C718	Brace
9	N605790	Screw 24-31 N·m (18-22 Ft-Lb)

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REMOVAL AND INSTALLATION (Continued)**Power Steering Pump Installation, 5.0L and 5.8L MFI Gasoline Engine**

G7624-A

Item	Part Number	Description
1	3A674	Power Steering Pump
2	3C511	Support Bracket
3	N801179-S2	Screw 41-55 N·m (30-40 Ft·Lb)
4	3D673	Power Steering Pump Pulley

(Continued)

Item	Part Number	Description
5	19D629	A / C Compressor
6	N806020-S2	Bolt 24-31 N·m (18-22 Ft·Lb)
7	N605790-S2	Bolt 24-31 N·m (18-22 Ft·Lb)
8	19A216	Drive Belt Idler Assembly

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Power Steering Pump Pulley**Removal**

1. Remove the drivebelt as described in this section.
2. On some models, it may be necessary to remove the fan shroud to allow for proper installation and operation of the power steering pump pulley remover tool.
3. Install Steering Pump Pulley Remover Tool T69L-10300-B on the power steering pump pulley hub.
4. While holding the nut of the remover tool stationary with a wrench, rotate the inner spindle of the remover tool clockwise until the pulley is pulled off the shaft of the power steering pump.

Installation

1. Place the pulley on the pump shaft.
2. Screw stud of Steering Pump Pulley Replacer T65P-3A733-C into end of power steering pump shaft.
3. While holding the inner spindle of the replacer stationary with a wrench, rotate the tool nut clockwise to install the pulley on the shaft. The pulley hub face must be flush within $\pm 0.25\text{mm}$ ($\pm 0.010\text{ in.}$) of the end of the pump shaft.
4. Remove the tool and verify that the hub is flush with the end of the pump shaft.

REMOVAL AND INSTALLATION (Continued)

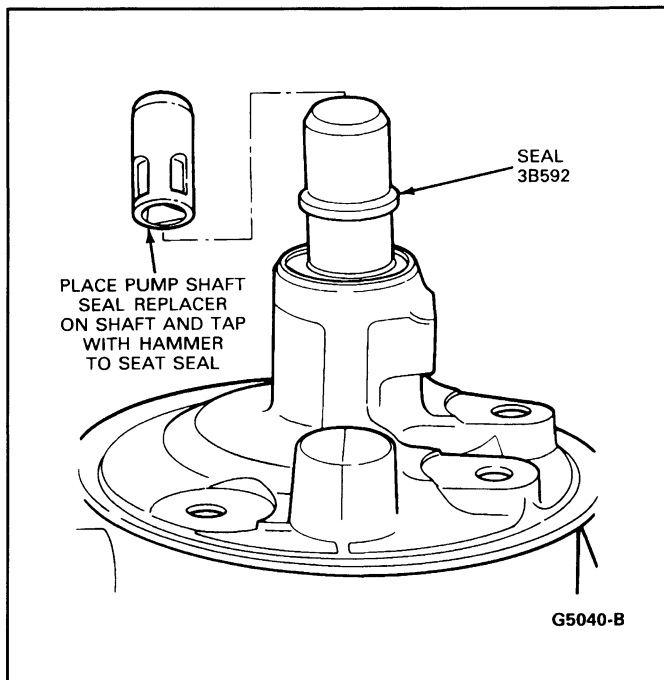
5. If it has been installed too far onto the shaft then pull it back slightly using the Steering Pump Pulley Remover T69L-10300-B.
6. Install belt as outlined in this section.

Drive Belt, Automatically Tensioned Belts (4.9L, 5.0L, 5.8L, 7.5L)**Removal and Installation**

1. Install closed-end wrench on the tensioner pulley bolt and lift the tensioner arm away from the belt.
2. Remove belt. Release tensioner arm slowly.
NOTE: Do not allow arm to snap back after the belt is removed because this may damage the tensioner.

For installation, follow removal procedure in reverse order.

NOTE: Make sure seating is correct on all pulleys. One revolution of the engine with an incorrectly seated belt may snap tensile members in the belt.

**Rotor Shaft Seal**

Remove the pump as outlined in this section to replace the rotor shaft seal.

Removal

1. Drain as much fluid as possible through the filler tube.
2. Remove the pulley from the pump following the procedures described in this section.
3. Insert a sharp tool between the rotor shaft seal and the pump housing. Pry out the seal. **Do not pry against the shaft or housing bore.**

Installation

1. Remove the pump and bracket from the vise and lay it flat on the workbench.
2. Place a new rotor shaft seal on the shaft with the metal backing facing the pulley end of the shaft.
3. Install the seal using Shaft Seal Installer T65P-3D642-A. Tap the tool lightly with a small hammer until the seal is properly seated in the shaft hub.
4. Install the pulley using Steering Pump Pulley Replacer T65P-3A733-C.

DISASSEMBLY AND ASSEMBLY

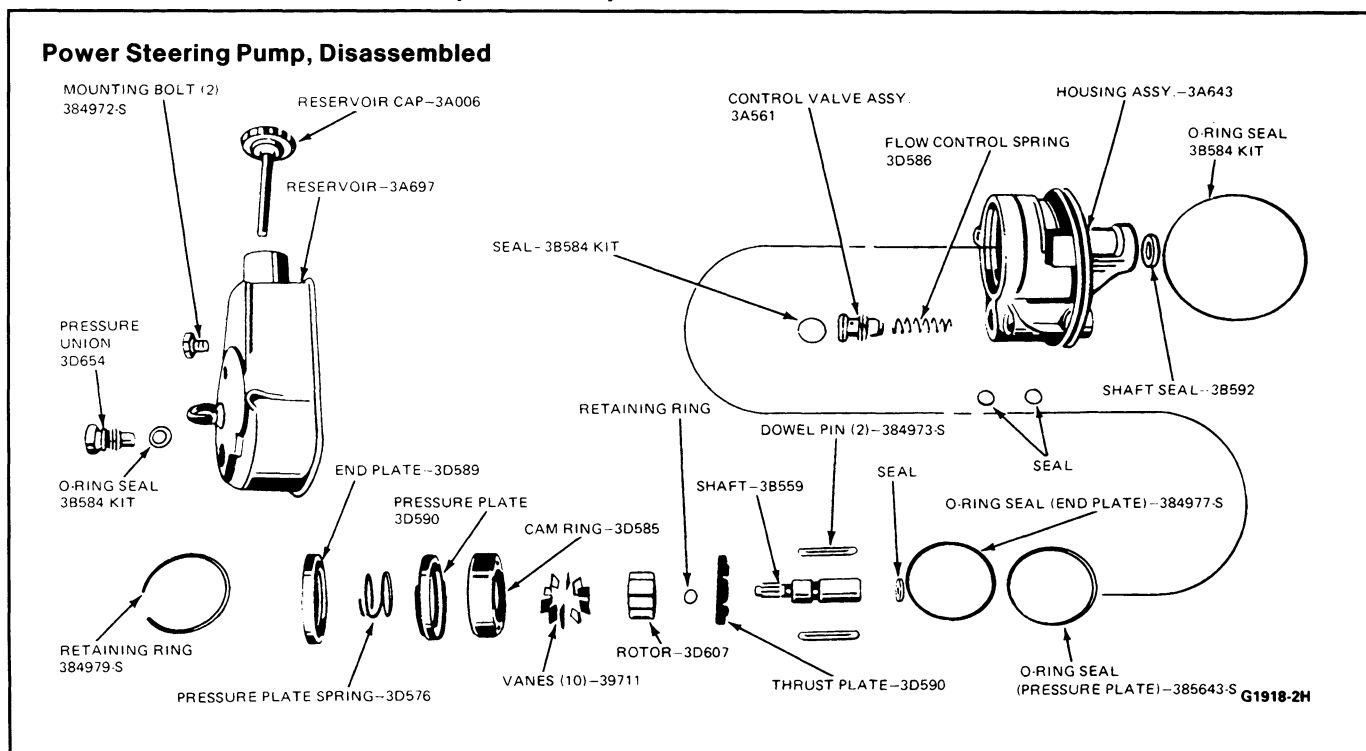
Take the following precautions when servicing the power steering pump:

NOTE: Use a clean work bench and tools.

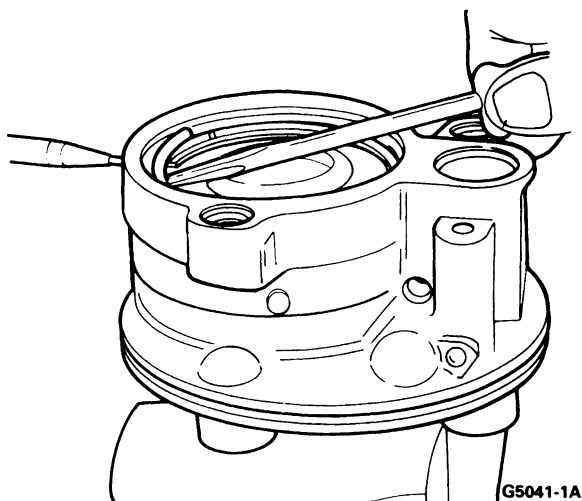
1. Clean the exterior of the unit with solvent. Drain as much fluid as possible.
2. If only the rotor shaft seal is being replaced, follow the procedures under Rotor Shaft Seal Removal and Installation in this section.
3. Do not use solvent on seals.

Power Steering Pump**Disassembly**

1. Clamp the front hub of the pump in a vise so the extending portion of the shaft points down.
CAUTION: Do not clamp the pump too tightly or bearing damage may result.
2. Remove the pressure union, O-ring assembly, and both mounting bolts from the back of the reservoir. Discard all seals and O-rings.
3. Rock the reservoir slightly back and forth to unseat the O-ring seal. Remove the O-ring and discard. Remove the reservoir.
4. Remove the mounting bolt and pressure union seals from the counterbored spaces in the pump housing. Discard the seals.

DISASSEMBLY AND ASSEMBLY (Continued)

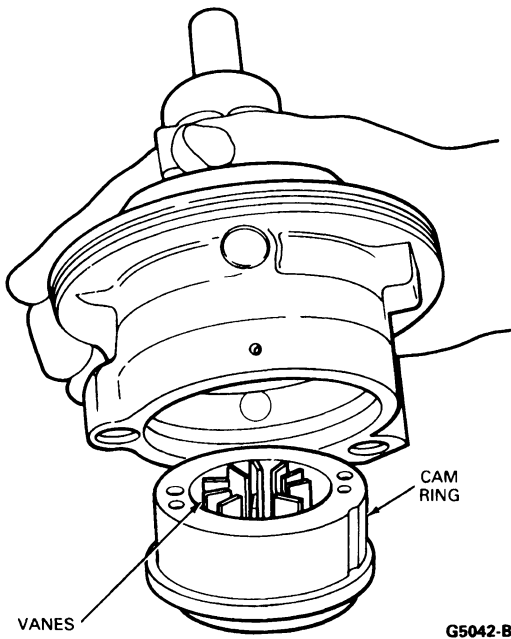
5. Rotate the end plate retaining ring so one end of the ring is over the hole in the housing. Insert a small punch in the 3.175mm (1/8-inch) diameter hole in the housing side opposite the flow control valve hole. Compress the retaining ring with the punch and remove the ring by twisting a screwdriver under the ring.



6. Remove the end plate. The end plate is spring loaded and will generally sit above the housing level for easy removal. If the plate sticks, rock it back and forth lightly to free it.
7. Remove the pressure plate spring.
8. Remove the pump from the vise and turn it over allowing the flow control valve and spring to fall out. Do not disassemble the flow control valve. Service it as a unit.
9. With the end plate O-ring removed, tap very lightly on the end of the shaft until the pressure plate falls free.
10. Remove the cam ring and vanes.

DISASSEMBLY AND ASSEMBLY (Continued)

11. Remove shaft and rotor assembly by pushing end of shaft through housing.

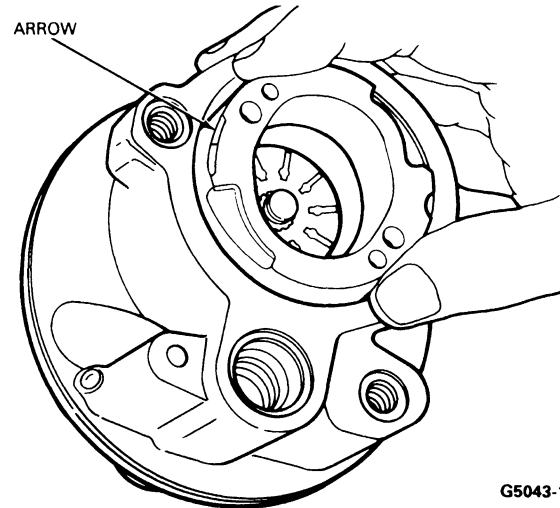


12. Remove the retaining ring by clamping the shaft in a soft-jawed vise and prying the ring off the shaft with a pair of long nose pliers or a screwdriver. Do not damage the shaft with the vise jaws. Discard the retaining ring.
13. Remove the rotor and thrust plate from the shaft.
14. Remove both dowel pins from the housing.
15. Remove the pressure plate and end plate O-ring seals from the housing bore and discard them.
16. Remove the shaft seal only if it is worn or damaged. Removal will destroy the seal.

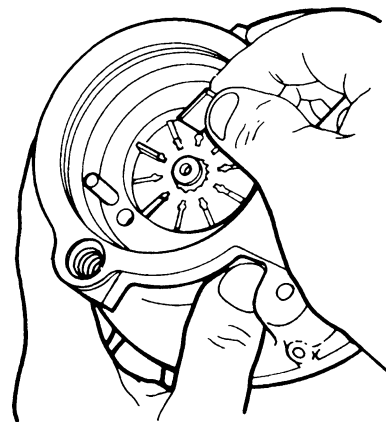
Assembly

- Clean all metal parts with solvent.
- If the shaft seal was removed, install a new seal following the instructions under Rotor Shaft Seal Removal and Installation in this section.
- Lubricate a new pressure plate O-ring seal with Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent and install it in the third groove from the rear of the housing.
- Clamp the end hub of the housing in a vise so the extending portion of the shaft points down. Do not clamp the bearing too tightly or damage may occur.
- Insert both dowel pins.
- Install the thrust plate on the shaft with the ports toward the splined end of the shaft.
- Install the rotor on the shaft with the counterbored end toward the thrust plate.

- Clamp the shaft in a soft-jawed vise. Install a new retaining ring on the splined end of the shaft by prying the ring open and sliding it down over the shaft until it seats in the ring groove. Use the round wire ring from the retaining ring service kit. **Do not damage the shaft.**
- Lubricate shaft with power steering fluid, and insert the shaft in the housing. Make certain the thrust plate slides properly on the dowel pins.
- Install the cam ring on the dowel pins with the rotation arrow toward the rear of the housing.



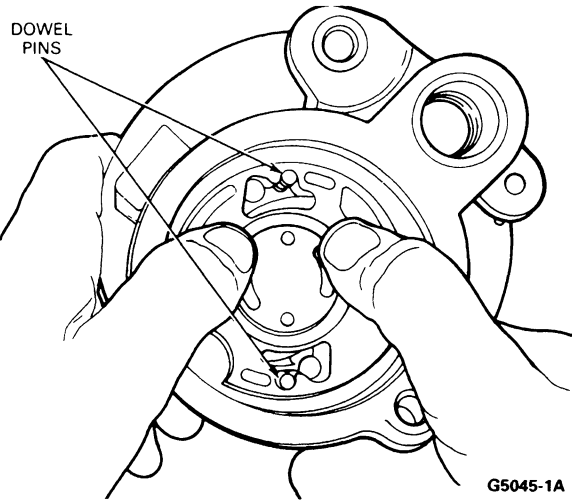
11. Install the vanes in the rotor slots with the rounded edge of the vanes outward. Be sure the vanes slide freely.



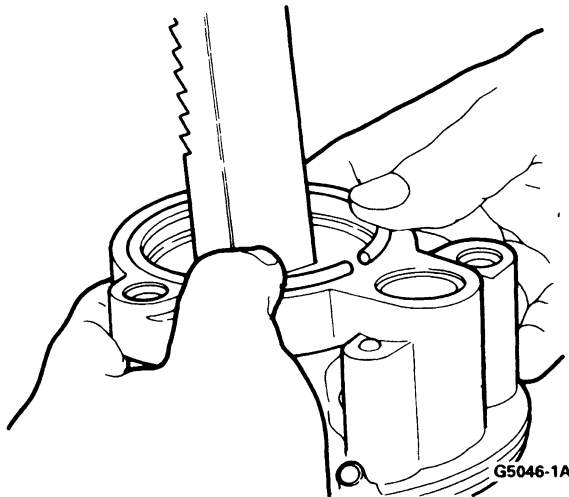
12. Lubricate the pressure plate with Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent to prevent damage to the pressure plate O-ring seal.

DISASSEMBLY AND ASSEMBLY (Continued)

13. Install the pressure plate on the dowel pins with the circular spring depression toward the rear of the housing. The narrow slots in the plate should engage the dowel pins. To seat pressure plate, press it about 1.19mm (1/16-inch) over the O-ring. Installing the Pressure Plate



14. Lubricate a new end plate O-ring with Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent and install it in the second groove from the rear of the housing.
15. Install the pressure plate spring in the groove in the pressure plate.
16. Lubricate the end plate with power steering fluid to prevent damage to the O-ring, and press it into the housing with an arbor press. Depress the end plate only far enough to allow installation of the retaining ring in its groove.



17. Install the end plate retaining ring. Release the arbor press.
18. Place the control valve spring in its hole and insert the control valve with the screened end toward the front of the housing.
19. Install new mounting bolt and pressure union seals in the countersunk holes. Lubricate a new reservoir O-ring seal with Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent, and install it on the housing.
20. Lubricate the inside edge of the reservoir with power steering fluid and install it on the housing. Align the holes in the reservoir and housing. Replacement reservoirs do not have an identification number. If a new reservoir is installed, imprint the model number of the worn or damaged reservoir on the new part for future identification.
21. Insert the mounting bolts and tighten to 47 N·m (35 ft-lb).
22. Lubricate a new O-ring with Premium Power Steering Fluid E6AZ-19582-AA (ESW-M2C33-F) or equivalent and install it on the pressure union in the groove next to the head hex. Insert the pressure union in the flow control valve hole in the back of the reservoir and tighten to specification listed at the end of this section.

ADJUSTMENTS**Drive Belt Tension**

The 4.9L, 5.0L, 5.8L and 7.5L engines are equipped with automatic tensioners requiring no adjustment.

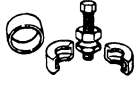
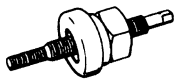
SPECIFICATIONS

SAGINAW POWER STEERING PUMP TORQUE LIMITS



Description	Engine				Torque	
	4.9L (300 CID) I-6	5.0L (302 CID) V-8	5.8L (351 CID) V-8	7.5L (460 CID) V-8	N-m	Ft-Lbs
Pump to Support Bracket Bolt	X	X	X	X	41-55	30-40
Pump to Adjusting Bracket Nut	—	X	X	X	41-55	30-40
Pressure Line to Pump Nut	X	X	X	X	30-40	22-29
Pressure Line to Gear Nut	X	X	X	X	30-40	22-29
Return Line to Gear Nut	X	X	X	X	30-40	22-29
Pump Rear Stud Nut	—	—	—	X	41-55	30-40
Brace to Engine Stud Nut	—	—	—	X	41-55	30-40
A/C Compressor Bolt	X	X	X	X	24-31	18-22
Power Steering Pump Brace to Mounting Bracket Screw	X	—	—	—	24-31	18-22
Idler Pulley Without A/C	—	—	—	X	24-31	18-22
Drive Belt Idler Assembly	—	X	X	—	24-31	18-22
Tensioner Assembly	—	—	—	X	68-92	50-68

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SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
T65P-10300-B Steering Pump Pulley Remover	 T65P-10300-B
T65P-3A733-C Steering Pump Pulley Replacer	 T65P-3A733-C

(Continued)

Tool Number / Description	Illustration
T71P-19703-C O-Ring Tool	 T71P-19703-C
765P-3D642-A Shaft Seal Replacer	 T65P-3D642-A

SECTION 11-02E Steering Pump, Power, ZF

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	11-02E-1	DISASSEMBLY AND ASSEMBLY	
DIAGNOSIS AND TESTING		Power Steering Pump	11-02E-5
External Leak Checks.....	11-02E-1	REMOVAL AND INSTALLATION	
Noise.....	11-02E-2	Power Steering Pump	11-02E-3
Reservoir Leak Checks.....	11-02E-1	SPECIAL SERVICE TOOLS	11-02E-8
		VEHICLE APPLICATION	11-02E-1

VEHICLE APPLICATION

All F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles

DESCRIPTION AND OPERATION

The ZF power steering pump has been specially designed to supply pressurized oil to power steering and brake hydro-boost units.

The ZF power steering pump is belt driven by the engine's crankshaft. As the driven shaft rotates the rotor, the slipper vanes inside the pump also move. The centrifugal force and pressurized oil forces the slipper vanes against the track of the cam ring. The oil passes from the two pressure chambers to the area between the rear cover and faceplate, thus pressing this plate against the cam ring at operating pressure. The oil then passes through a flow-limiting valve to the pressure line.

DIAGNOSIS AND TESTING

Refer to Section 11-00 for diagnostic and testing procedures.

External Leak Checks

1. With vehicle engine off, wipe power steering hoses, steering gear, Hydro-boost lines and reservoir to aid in leak detection.
2. If power steering fluid does not already include dye, mix one teaspoon of oil-soluble aniline dye into power steering fluid and fill reservoir to specification, if necessary.

3. With engine running at 1000-1500 rpm, turn steering wheel all the way to the left and right several times.

CAUTION: Do not hold wheels against far right or left position for more than five seconds to prevent damage to pump.

4. Shut off engine. Check for leaks.
5. Determine exact source of leakage.

NOTE: Refer to Section 06-07C for Hydro-boost leak checking procedures.

Reservoir Leak Checks

1. If leakage exists at reservoir ports, check hose clamps for proper installation and reservoir ports for cracks.

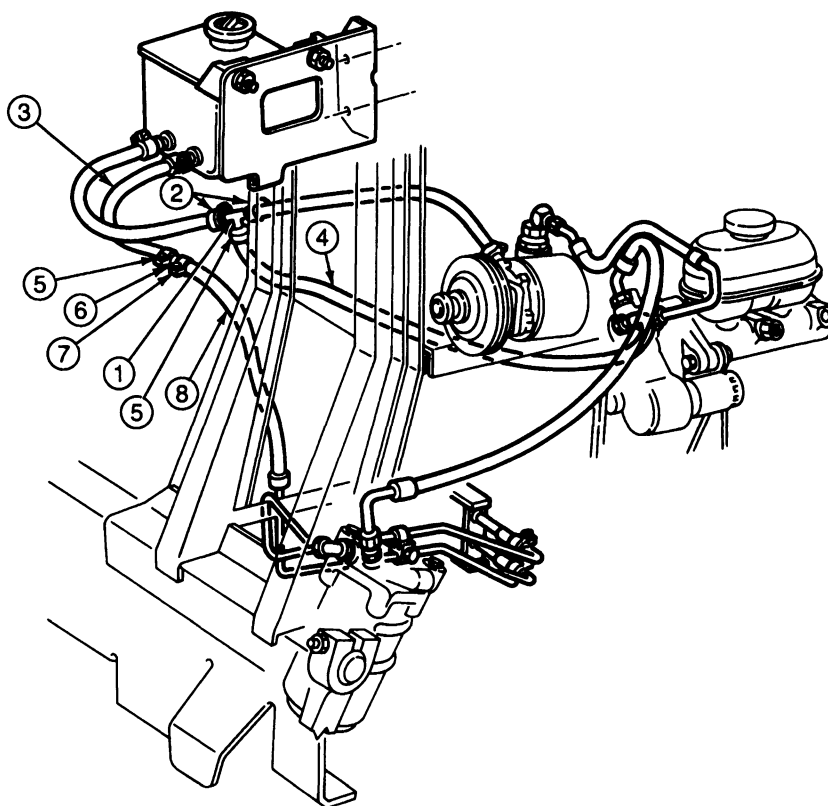
2. If leakage exists at reservoir cover / cap or dipstick, check fluid level for overfilling. Siphon excess fluid out with a suction gun to proper level. If leakage persists, provide proper sealing and tightness. If cover / cap remains loose, inspect cover / cap, gasket of reservoir for damage. Repair or replace as necessary.

DIAGNOSIS AND TESTING (Continued)**Noise**

1. If noise occurs during start-up, or continues for any length of time, check all lines for kinks or restrictions. The supply line from the reservoir to the pump will cause the pump to make noise.
2. If kinks are present, repair or replace lines as required.

REMOVAL AND INSTALLATION

Always tag pump hoses before removal so they can be easily connected to their proper ports during installation.

Power Steering System, Motorhome Chassis with 7.5L MFI Engine

G7729-A

Item	Part Number	Description
1	389344-S100	Tee
2	97241-S8	Clamp
3	3A005	Hose (23 In)
4	3A005	Hose (34 In)

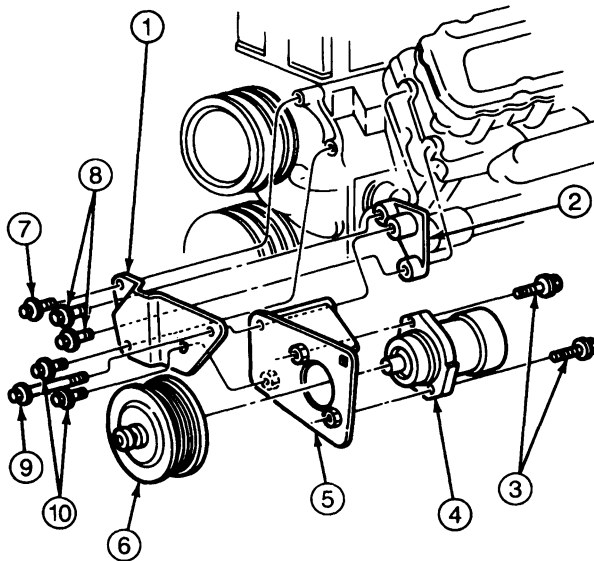
(Continued)

Item	Part Number	Description
5	390462-S100	Clamp
6	3A766	Adapter
7	376240-S	Clamp
8	3A713	Tube Assembly

TG7729A

REMOVAL AND INSTALLATION (Continued)**Power Steering Pump****Removal**

1. Using a suction gun, remove as much fluid as possible from the reservoir through the filler opening or remove the return hose to drain the reservoir.
2. Disconnect the pressure hose from the pump. Disconnect the return hose from the pump if it was not disconnected in Step 1. Position both hoses in a raised position or plug disconnected ends to prevent the fluid from draining out.
3. Loosen the power steering pump pivot bolt and adjusting bolt. Remove the drive belt.
4. Remove the two power steering pump mounting bolts and remove the complete pump and bracket assembly.

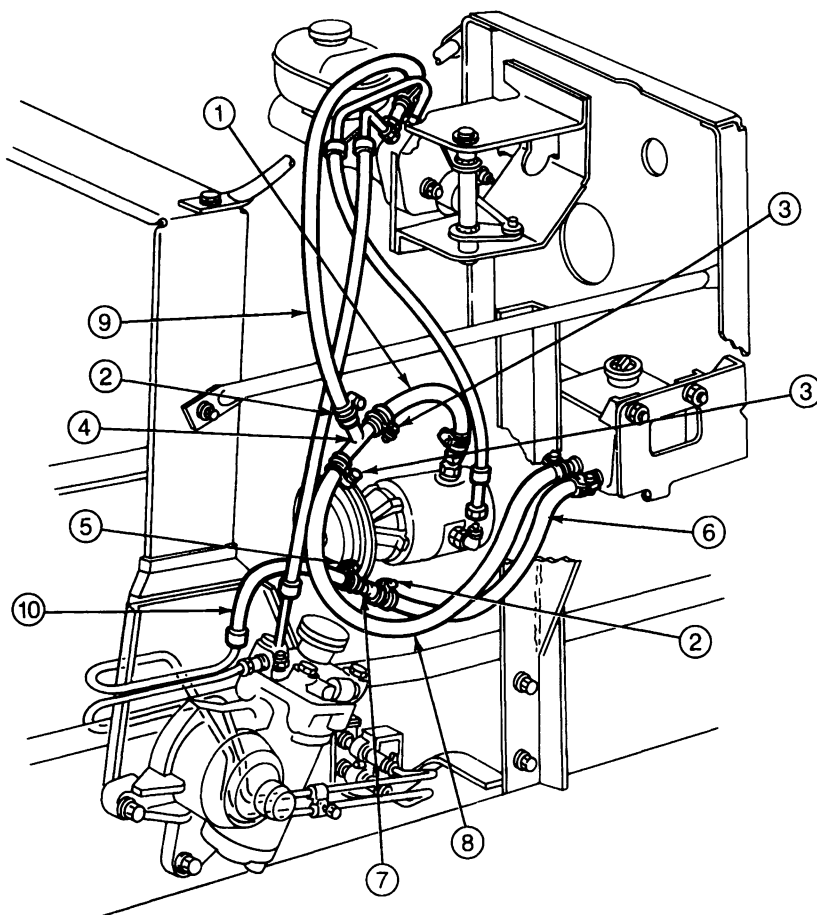
Power Steering Pump Installation, Motorhome Chassis, 7.5L MFI Gas Engine

G6749-B

Item	Part Number	Description
1	3C511	Pump Support
2	3E602	Pump Rear Support
3	N800199-S8M	Screw 41-61 N·m (30-45 Ft-Lb)
4	3A674	Power Steering Pump Assembly
5	3A732	Pump Mounting Bracket
6	3D673	Pump Pulley
7	370608-S2	Screw 28-39 N·m (22-30 Ft-Lb)
8	57727-S2	Bolt 41-61 N·m (30-45 Ft-Lb)
9	383721-S2	Bolt 41-61 N·m (30-45 Ft-Lb)
10	N605800-S2	Screw 41-61 N·m (30-45 ft-lb)

REMOVAL AND INSTALLATION (Continued)

Power Steering System, Commercial Chassis with 7.3L Diesel



G7731-A

Item	Part Number	Description
1	3691	Hose
2	390462-S100	Clamp
3	97241-S8	Clamp
4	389344-S100	Tee
5	376240-S	Clamp

(Continued)

Item	Part Number	Description
6	3A005	Hose
7	3A766	Connector
8	3691	Hose
9	3A005	Hose
10	3A713	Hose Assembly

TG7731A

Installation

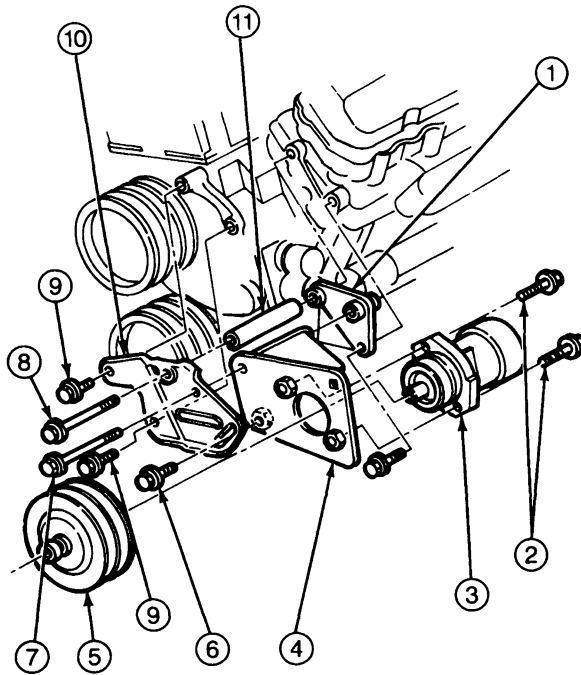
1. Install the pump and bracket assembly and tighten the pump mounting bolts to 41-61 N·m (30-45 ft-lb).
2. Adjust the pump belt tension as described in Section 03-05. Tighten the adjusting and pivot bolts.

NOTE: Motorhome has an automatic belt tensioner.

3. Connect all hoses to the pump, being sure to connect all lines to the correct ports.
4. Fill the reservoir to specifications as described in Section 11-00.

REMOVAL AND INSTALLATION (Continued)

Power Steering Pump Installation, Commercial Stripped Chassis, 7.3L Diesel Engine



G6535-C

Item	Part Number	Description
1	3E602	Pump Rear Support
2	N800199-S8M	Screw 41-61 N-m (30-45 Ft-Lb)
3	3A674	Power Steering Pump Assembly
4	3A732	Pump Adjusting Bracket
5	3D673	Pump Pulley
6	N605800-S2	Screw 41-61 N-m (30-45 Ft-Lb)
7	383721-S2	Bolt 41-61 N-m (30-45 Ft-Lb)
8	56557-S2	Bolt 28-39 N-m (22-30 Ft-Lb)
9	370608-S2	Screw 28-39 N-m (22-30 Ft-Lb)
10	3C511	Pump Support
11	386107	Spacer

DISASSEMBLY AND ASSEMBLY

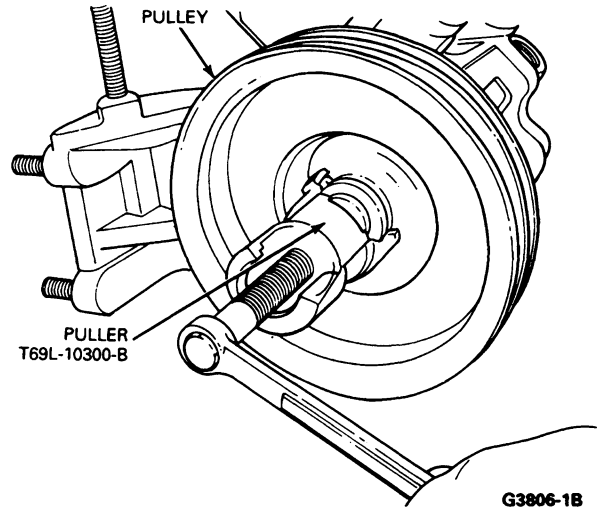
Power Steering Pump

Disassembly

Clean all dirt and oil from the external surface of the pump after removal. Handle all pump parts carefully to avoid nicks, burrs, scratches and dirt.

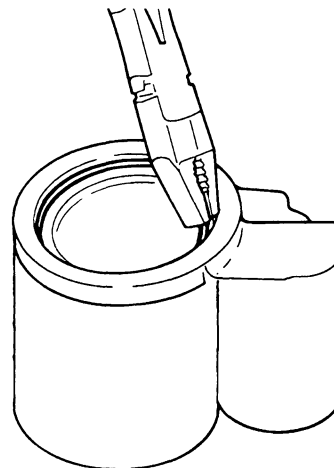
CAUTION: To ensure correct reassembly, record or mark all information as specified in the procedure.

1. For pumps with remote reservoirs, tip the pump to drain all oil from the intake tube. Rotate shaft to remove oil from internal cavities.
2. Using the pump mounting bracket, clamp the pump assembly into a bench vise in such a position as to facilitate pump disassembly.
CAUTION: Do not clamp on the pump or pulley.
3. Remove pulley with Steering Pump Pulley Remover T69L-10300-B.



G3806-1B

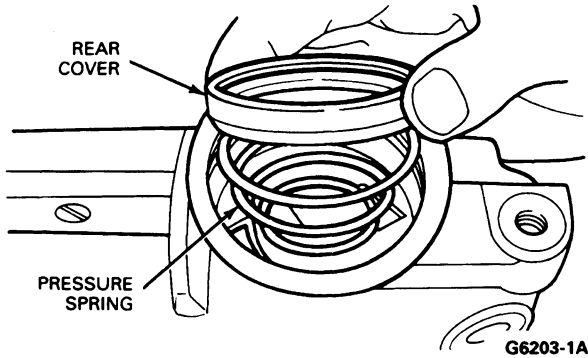
4. Push in on the pump rear cover to compress the internal spring.
5. Remove hook spring ring from radial groove in housing using pliers.



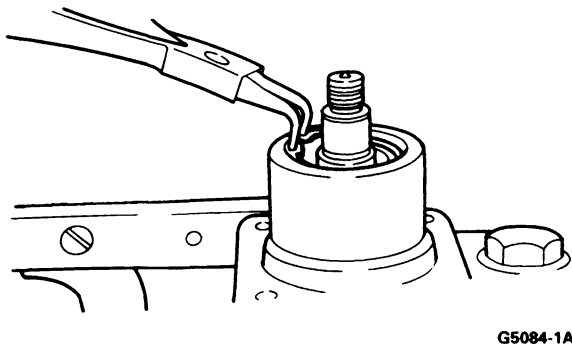
G6202-1A

DISASSEMBLY AND ASSEMBLY (Continued)

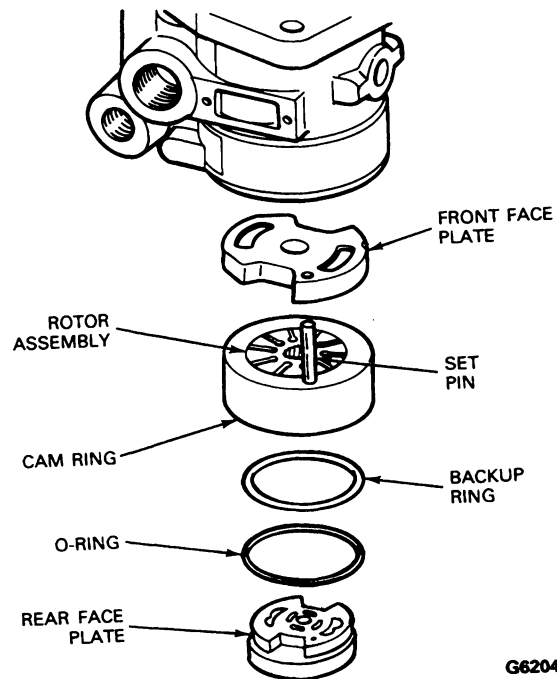
6. Remove cover and pressure spring. Remove internal O-ring and backup ring from rear cover.
NOTE: O-ring is inboard of backup ring.



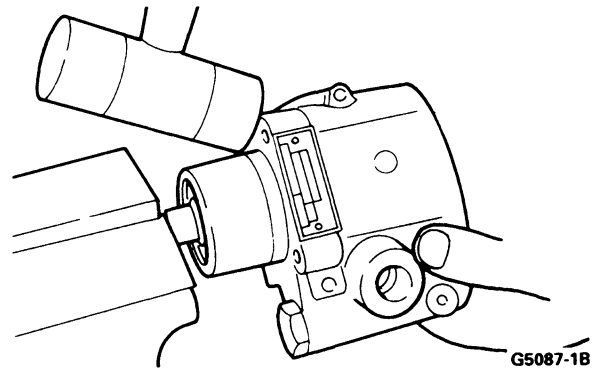
7. Remove the circlip from the groove.



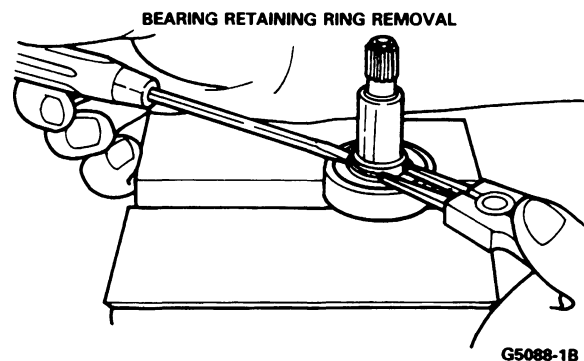
8. Turn the housing over and remove the rear face plate. Remove O-ring and backup ring for the rear face plate from the housing. Remove the rotor assembly (rotor, cam ring, vanes and set pin) and front face plate from the housing.
NOTE: This O-ring is outboard of the backup ring.
NOTE: Check direction of rotation (arrow on cam ring) and location of the set pin.



9. Clamp driveshaft in vice (use soft jaws) and with a soft mallet, tap on the housing to remove the driveshaft from the housing.



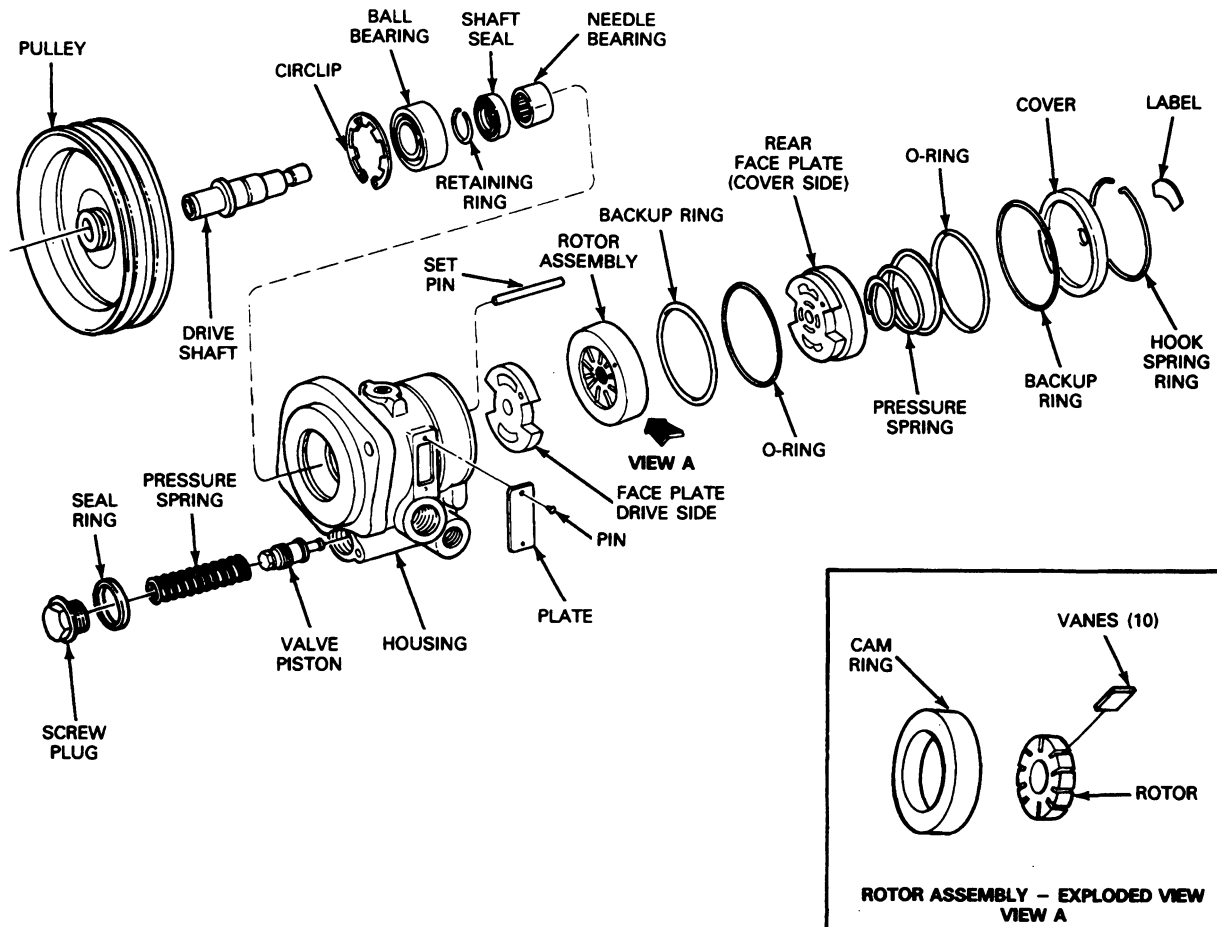
10. If the ball bearing is to be replaced, remove the retaining ring and press the bearing from the driveshaft.



DISASSEMBLY AND ASSEMBLY (Continued)

11. If the shaft seal requires service, pry the seal from the housing. Discard the seal.

12. If the needle bearing requires service, press the needle bearing from the housing.



G6637-2A

Assembly

1. If removed, press a new needle bearing in the housing.
2. If removed, install a new shaft seal in the housing.
3. If removed, press a new bearing onto the driveshaft. Install the retaining ring in the driveshaft groove.
4. Install the driveshaft and bearing assembly into the housing.
5. Install the bearing circlip in the groove.
6. Install O-ring and backup ring on the rear faceplate in accordance with exploded view.
7. Install the set pin, front faceplate and rotor assembly into the housing.


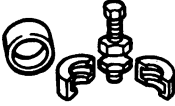
NOTE: The cam ring of the rotor assembly must be installed with the arrow pointed in the direction of rotation.

8. Install the O-ring and backup ring in the rear cover housing in accordance with exploded view. Place the rear pressure spring in the rear face plate. Position the rear cover in the housing.
9. Press down on the rear cover plate and install the hook spring ring in the groove in the housing.
10. Press on the pulley with Steering Pump Pulley Replacer Tool T65P-3A733-C.

SPECIAL SERVICE TOOLS

The following chart illustrates the special tools described in this section.

SPECIAL SERVICE TOOLS

ILLUSTRATION	TOOL NUMBER/DESCRIPTION
	T65P-3A733-C STEERING PUMP PULLEY REPLACER
	T69L-10300-B STEERING PUMP PULLEY REMOVER

G7627-A

SECTION 11-03 Steering Linkage

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	11-03-1	REMOVAL AND INSTALLATION (Cont'd.)	
DIAGNOSIS AND TESTING	11-03-1	Steering Linkage Damper Assembly, F-350 4x4 and F-Super Duty Chassis Cab	11-03-12
REMOVAL AND INSTALLATION		Steering Linkage Shock Absorber, E-350 with Dual Rear Wheels	11-03-12
Drag Link	11-03-11	Steering Tie Rod	11-03-11
Drag Link Assembly, F-Super Duty Commercial and Motorhome Chassis	11-03-10	Tie Rod Adjusting Sleeve and Ball Stud	11-03-11
Pitman Arm	11-03-10	Tie Rod and Drag Link Assembly	11-03-1
Spindle Arm or Steering Arm, All Models	11-03-10	SPECIAL SERVICE TOOLS	11-03-14
Spindle Connecting Rod	11-03-10	SPECIFICATIONS	11-03-14
Spindle Connecting Rod End	11-03-9	VEHICLE APPLICATION	11-03-1

VEHICLE APPLICATION

F-150-250-350, E-150-250-350, Bronco and F-Super Duty Series Vehicles

DESCRIPTION

The steering linkage, which connects the pitman arm to the spindles, is composed of a drag link and tie rod. The pitman arm transfers the steering gear movements through the drag link and tie rod to the right and left spindles.

The F-150-250-350, Bronco, F-Super Duty Chassis Cab and E-150-250-350 steering linkage has adjustments in both the tie rod and the drag link.

The steering linkages on F-Super Duty Motorhome and Commercial Stripped Chassis Vehicles use spindle assemblies with separate steering and spindle arms.

These are of the tapered arm, or bolt-on arm types. A connecting rod, adjustable for toe-in, is connected between the left and right spindle arms. A drag link is connected between the steering arm on the left spindle assembly and the pitman arm on the steering gear.

DIAGNOSIS AND TESTING

Refer to Section 11-00 for diagnostic and testing procedures.

REMOVAL AND INSTALLATION

Tie Rod and Drag Link Assembly

Replace the drag link or tie rod if either the ball stud is excessively loose in the socket or the tie rod or drag link is bent or the taper for the tie rod is loose. Replace the boot seal if any nicks, cuts, or tears are present. Do not attempt to straighten a drag link or tie rod.

Removal

1. Remove the cotter pins and nuts from the drag link and tie rod ball studs.
2. Using Pitman Arm Puller T64P-3590-F, remove the drag link ball studs from the right hand spindle and the pitman arm. Remove the tie rod ball studs from the left hand spindle and the drag link.

3. When installing new drag link or tie rod end(s) or adjustment sleeve(s), turn the parts into the adjustment sleeve about the same distance used for the old assembly. Equalize the thread engagement of the short and long rod ends in the adjustment sleeve. This will provide an approximate toe-in setting.

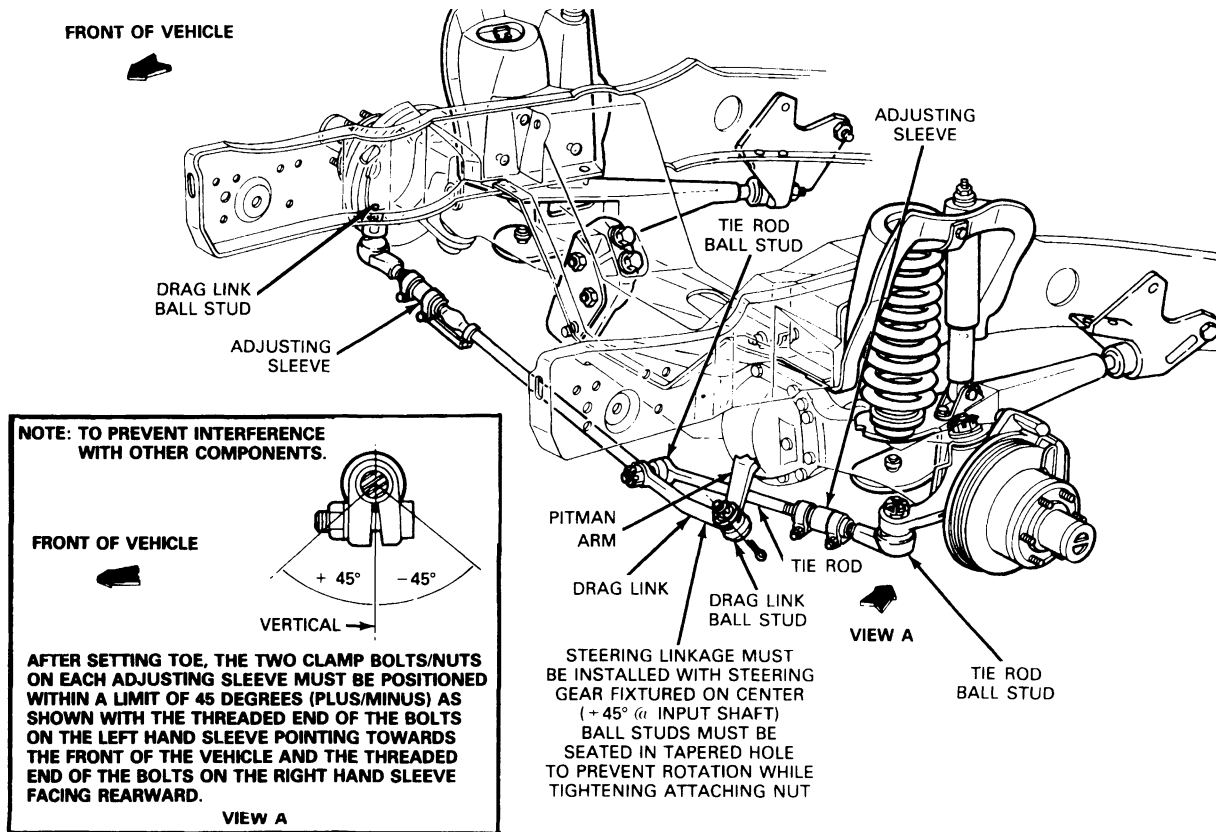
Installation

1. Position the drag link ball studs into the right hand spindle and the pitman arm. Position the tie rod ball studs into the left hand spindle and the drag link.
2. Seat the studs into the tapered hole before tightening the nuts. Tighten the nuts to 70-100 N·m (51-73 ft·lb).
3. Install new cotter pins.

REMOVAL AND INSTALLATION (Continued)

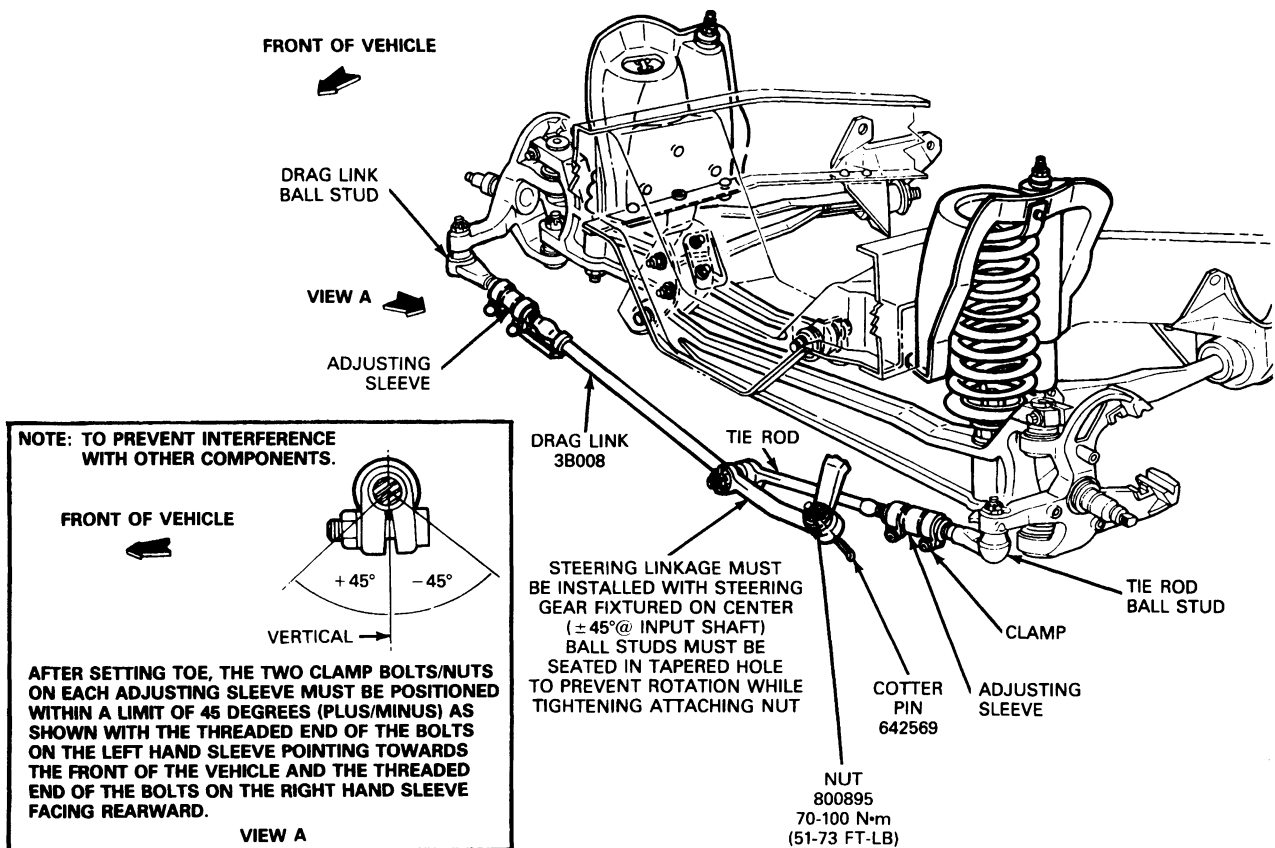
4. Check toe-in and set toe-in Clear Vision as described in Section 04-00.
5. After checking or adjusting toe-in, center the adjustment sleeve clamps between the locating nibs and position the clamps as shown to prevent clamp contact with surrounding components. Tighten the nuts to 40-57 N·m (30-42 ft·lb).

Steering Linkage, F-150 4x4 and Bronco



REMOVAL AND INSTALLATION (Continued)

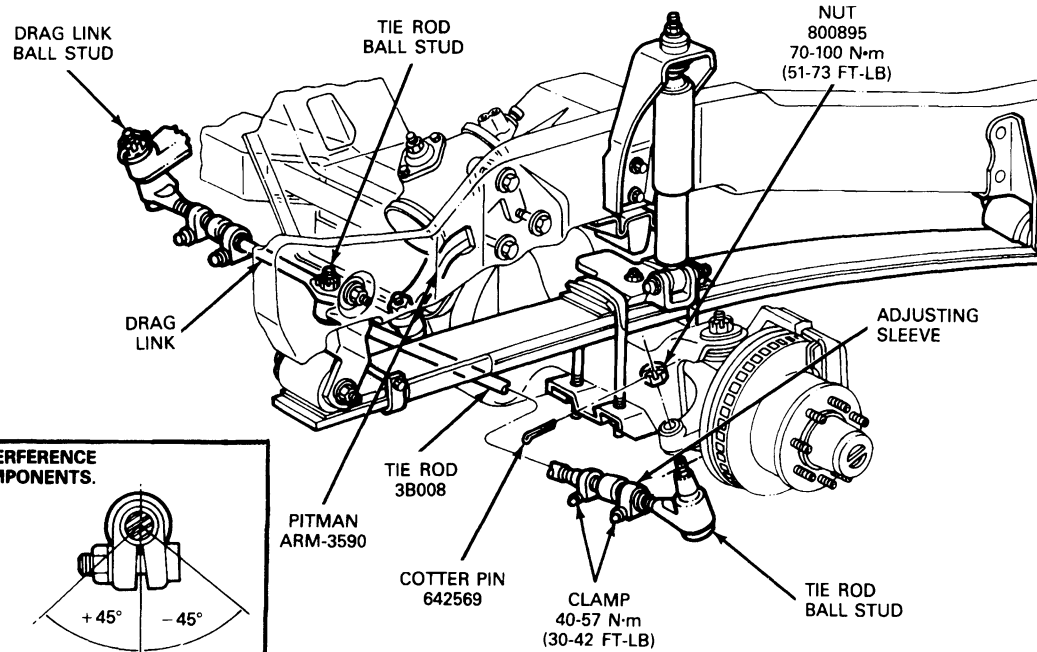
Steering Linkage, F-150-250-350 4x2



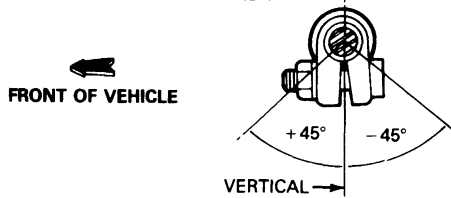
F2844-K

REMOVAL AND INSTALLATION (Continued)

Steering Linkage, F-250 4x4



NOTE: TO PREVENT INTERFERENCE WITH OTHER COMPONENTS.



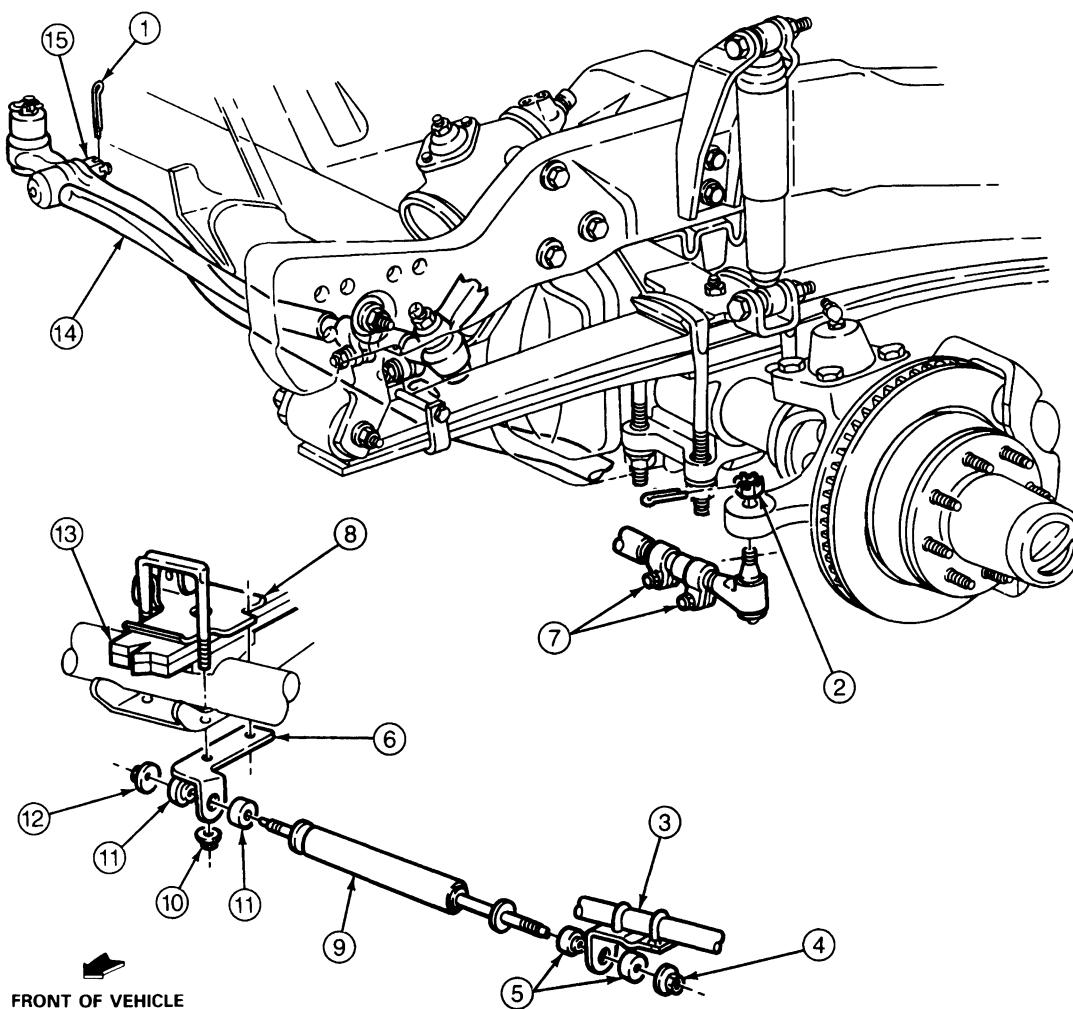
AFTER SETTING TOE, THE TWO CLAMP BOLTS/NUTS ON EACH ADJUSTING SLEEVE MUST BE POSITIONED WITHIN A LIMIT OF 45 DEGREES (PLUS/MINUS) AS SHOWN WITH THE THREADED END OF THE BOLTS ON THE LEFT HAND SLEEVE POINTING TOWARDS THE FRONT OF THE VEHICLE AND THE THREADED END OF THE BOLTS ON THE RIGHT HAND SLEEVE FACING REARWARD.

VIEW A

F3017-J

REMOVAL AND INSTALLATION (Continued)

Steering Linkage, F-350 (4x4) Monobeam Axle



F4581-E

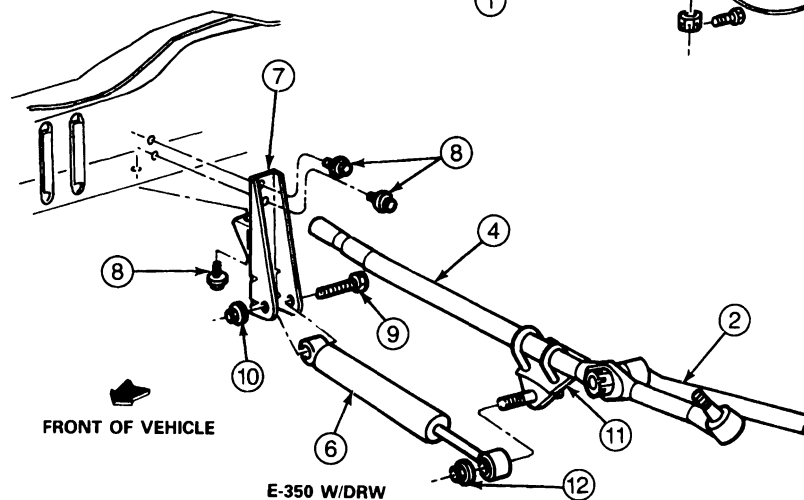
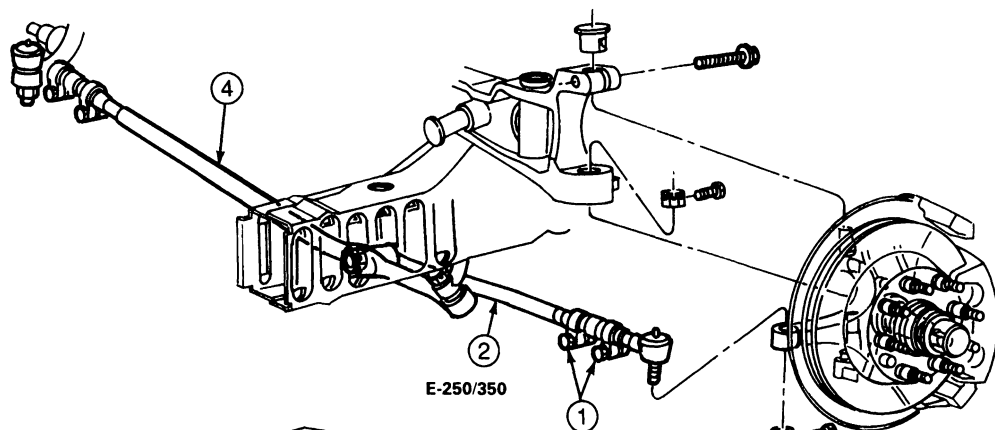
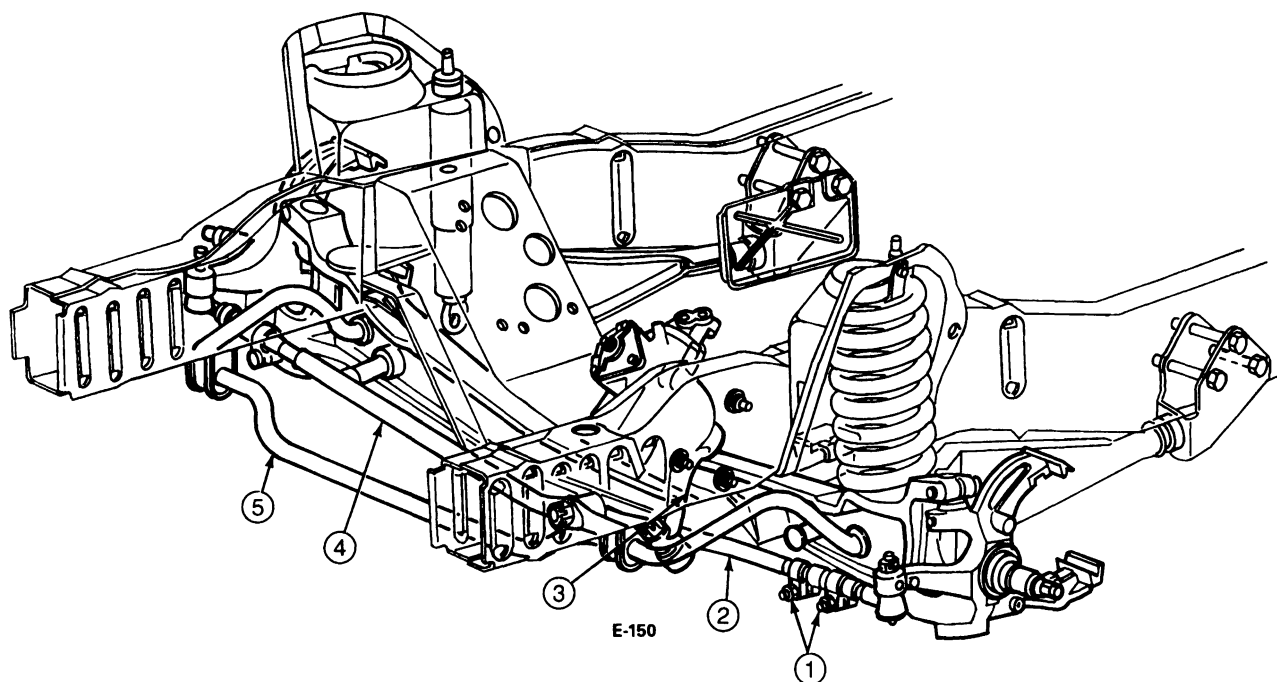
Item	Part Number	Description
1	N642569	Cotter Pin
2	N800895	Nut 70-100 N-m (51-73 Ft-Lb)
3	3B008-DA	Steering Rod and Link Assembly
3	3B008-EA	Steering Rod and Link Assembly (DRW Only)
4	N806888-S56	Nut and Washer 34-48 N-m (25-35 Ft-Lb)
5	N806889-S	Insulator
6	3E652	Steering Bracket, RH Bracket
7	—	Clamp 40-57 N-m (30-42 Ft-Lb)

(Continued)

Item	Part Number	Description
8	5458	Spring Plate Spacer
9	—	Steering Damper
10	N801342-S2	Nut 115-163 N-m (85-120 Ft-Lb)
11	N806889-S	Insulator
12	N806888-S56	Nut and Washer 34-48 N-m (25-35 Ft-Lb)
13	5310	Spring
14	3B008-DA	Steering Rod and Link Assembly
14	3B008-EA	Steering Rod and Link Assembly (DRW Only)
15	N800895	Nut 70-100 N-m (51-73 Ft-Lb)

REMOVAL AND INSTALLATION (Continued)

Steering Linkage, E-150-250-350 with Single Rear Wheel



G7640-A

REMOVAL AND INSTALLATION (Continued)

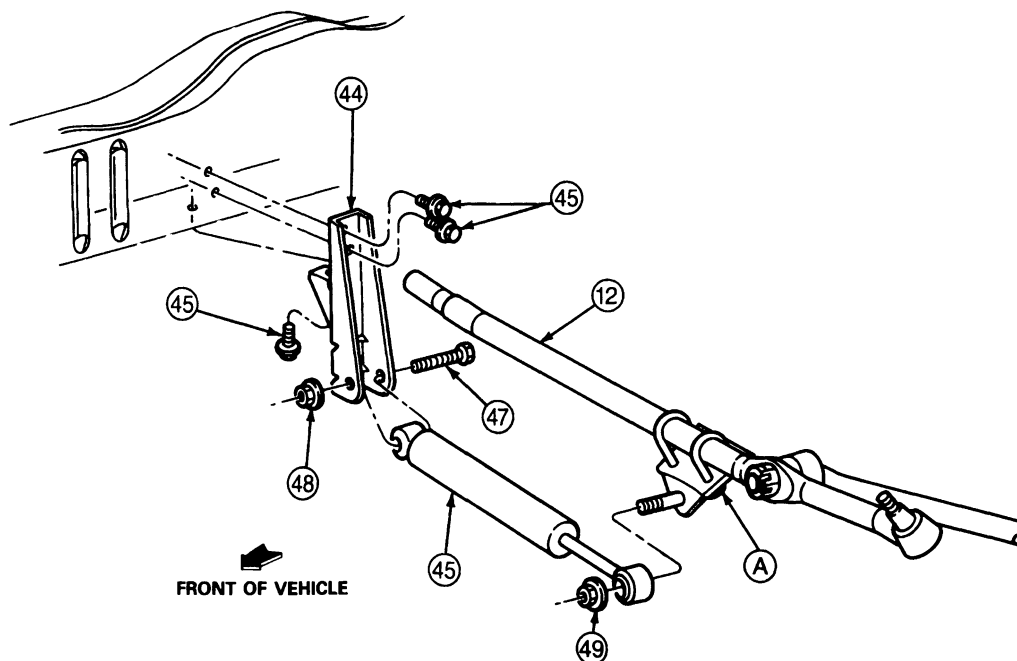
Item	Part Number	Description
1	3281	Adjusting Sleeve Clamp 40-57 N·m (30-42 Ft·Lb)
2	3B008	Steering Tie Rod and Link Assembly
3	3590	Pitman Arm
4	3304	Drag Link
5	05482	Stabilizer Bar
6	3E651	Shock Absorber (Steering Linkage)

(Continued)

Item	Part Number	Description
7	3E652	Steering Shock Absorber R.H. Bracket
8	W611645-S60	Screw 21-29 N·m (15-21 Ft·Lb)
9	N805704-S2	Bolt
10	N806496-S100	Nut and Washer 64-91 N·m (47-67 Ft·Lb)
11	—	U-Bolt Nut 25.5-34.5 N·m (18-25 Ft·Lb)
12	N806085-S8	Nut 64-91 N·m (47-67 Ft·Lb)

TG7640A

Steering Damper E-350 with Dual Rear Wheel



G7733-A

Item	Part Number	Description
12	3B008	Rod and Link Assembly, Steering
44	3E652	Bracket, Steering, Shock Absorber
45	W611645-S60	Bolt 21-29 N·m (15.5-21.3 Ft·Lb)
47	N806704-S2	Bolt

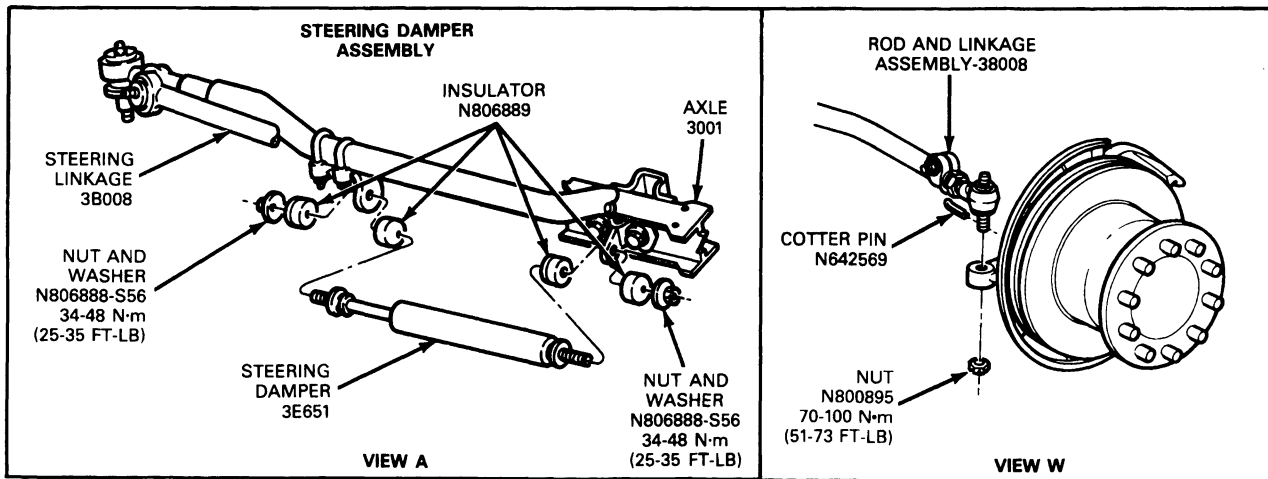
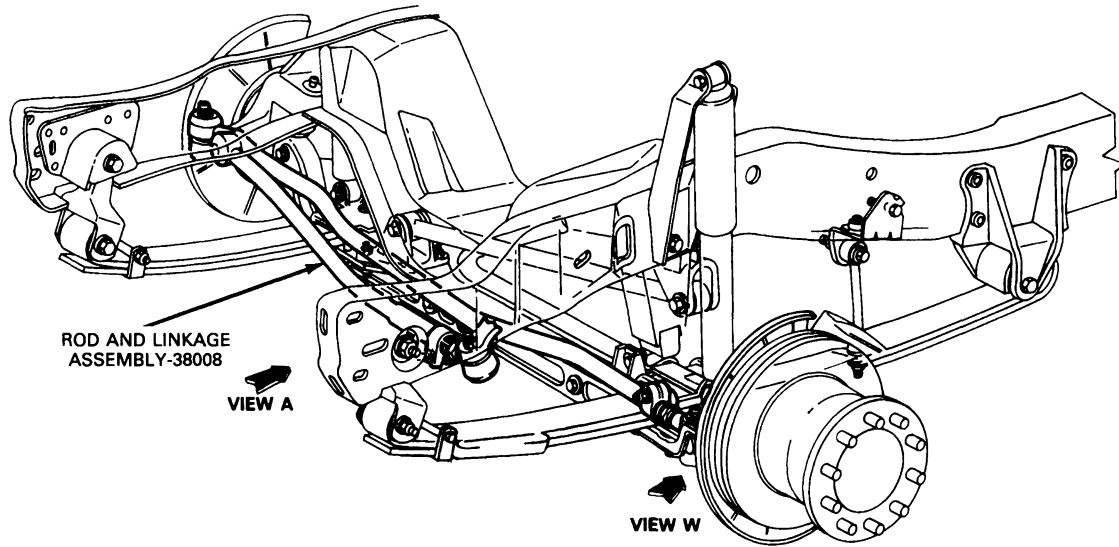
(Continued)

Item	Part Number	Description
48	N806498-S100	Nut and Washer 64-91 N·m (47.2-67.1 Ft·Lb)
49	N806085-S8	Nut 64-91 N·m (47.2-67.1 Ft·Lb)
A	—	25.5-34.5 N·m (18.9-25.4 Ft·Lb)

TG7733A

REMOVAL AND INSTALLATION (Continued)

Steering Linkage, F-Super Duty Chassis Cab



G6344-E

REMOVAL AND INSTALLATION (Continued)

- Check the toe-in and adjust, if necessary. **Be sure to tighten the rod end clamp after adjusting the toe-in.**

NOTE: If the staked ball stud requires replacement, it will be necessary to replace ball stud and connecting rod assembly.

Spindle Connecting Rod**Removal**

1. Loosen the connecting rod end clamp.
2. Unthread the connecting rod until the connecting rod drops off the end while counting the number of turns needed to remove the rod end.
3. Remove the cotter pin and nut from the staked end ball stud.
4. Remove the ball stud from the spindle arm.

Installation

1. Lubricate the threads on the connecting rod end and turn into the tube to about the same distance the old rod was installed. This will provide an approximate toe-in setting.
2. Install the ball studs in the spindle arms, tighten the nuts to specification and install the cotter pins.
3. Check the toe-in and adjust, if necessary. **Be sure to tighten the connecting rod end clamp after adjusting toe-in.** Refer to Section 04-00.

Spindle Arm or Steering Arm, All Models**Removal**

1. Remove the spindle connecting rod end ball stud or the drag link ball stud from the spindle or steering arm.
2. Remove the cotter pin and attaching nut from the arm.
3. Remove the arm from the spindle. Drive the arm out of the spindle, if necessary.

Installation

1. Install a new arm in the spindle. The spindle hole is slotted to align the arm with a key. Insert the key in the slot from the nut side of the spindle. Be sure that the key is flush with the slot face of the spindle.
2. Install the arm attaching nut and tighten to specification. Install a new cotter pin through the nut and ball stud.
3. Install the spindle connecting rod end ball stud or drag link ball stud in the arm. Install the ball stud nut and tighten to specification. Install a new cotter pin through the nut and ball stud.
4. Check the toe and adjust, if necessary. Refer to the procedure in Section 04-00.

5. Adjust and lock the steering stop adjusting bolts to specification.

NOTE: Some spindle arms have fixed steering stops and do not require adjustment.

Drag Link Assembly, F-Super Duty Commercial and Motorhome Chassis**Removal**

1. Remove the cotter pins and nuts from the drag link ball studs.
2. Using Pitman Arm Puller T64P-3590-F or equivalent remove the drag link ball studs from the pitman arm and steering arm.

Installation

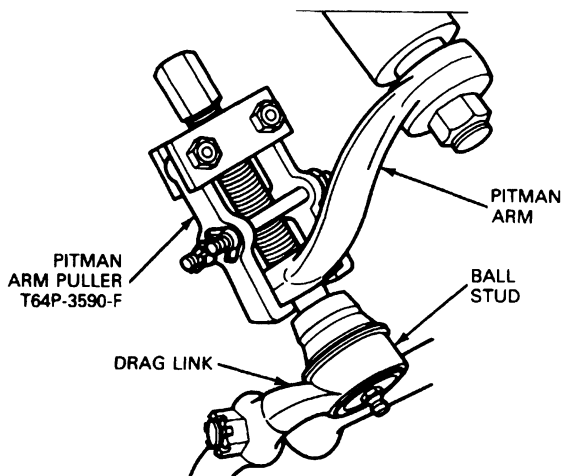
1. Install the ball studs in the pitman arm and steering.
2. Install the ball stud nuts and tighten to specification. Install new cotter pins through the nuts and ball studs.

Pitman Arm

Replace the pitman arm if it is bent. If the pitman arm is bent, also check the drag link, steering tie rod, tie rod adjustment sleeves and tie rod ball studs for signs of damage. Replace damaged steering linkage as required. **Do not attempt to straighten the pitman arm or any other steering linkage components.**

Removal

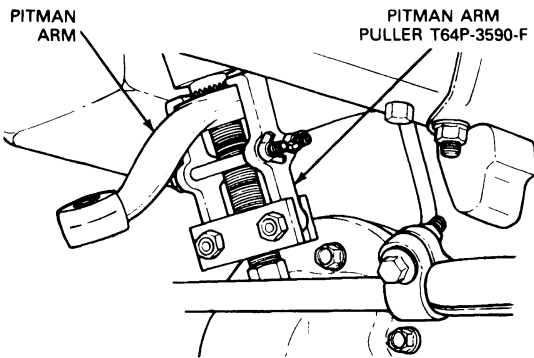
1. Remove the cotter pin and nut from the drag link ball stud at the pitman arm.
2. Disconnect the drag link ball stud from the pitman arm using Pitman Arm Puller T64P-3590-F or equivalent.



G7012-1A

REMOVAL AND INSTALLATION (Continued)

3. Remove the pitman arm attaching nut and washer from the steering gear output sector shaft. On F-Super Duty, remove nut and bolt.
4. Remove the pitman arm from the steering gear output sector shaft using Pitman Arm Puller T64P-3590-F.



G3480-D

Installation

1. Install the new pitman arm assembly on the output sector shaft with wheels in straight ahead position. Install the pitman arm attaching washer and nut or nut and bolt. Tighten the nut to specifications.
2. Install the drag link ball stud on the pitman arm. Tighten the nut to 70-100 N·m (51-73 ft-lb) and install the cotter pin.

Drag Link

Refer to the illustrations under Tie Rod and Drag Link Assembly in the Removal and Installation portion of this section.

Replace the drag link if the ball stud is loose in the socket, or the drag link is bent. Replace the boot seal if any nicks, cuts, or tears are present. Do not attempt to straighten a drag link.

Removal

1. Raise the vehicle on a hoist with the wheels in the straight ahead position. Refer to Section 50-04, Hoisting and Jacking, in the Pre-Delivery Truck Shop Manual.
2. Remove the cotter pins and nuts from the ball stud at the pitman arm and steering tie rod. Remove the ball studs from the linkage using Tie Rod End Remover TOOL-3290-D.
3. Loosen the bolts on the adjuster clamp if equipped. Count the number of turns it takes to remove the drag link from the adjuster.

Installation

1. Install the drag link the same number of turns it took to remove it from the adjusting sleeve. Note the position of the clamps. Tighten the adjuster clamp nuts to 40-57 N·m (30-42 ft-lb).
2. Make sure the ball studs are seated in the taper to prevent rotation while tightening. Install nuts and tighten to 70-100 N·m (51-73 ft-lb).
3. Install new cotter pins.
4. Check toe-in and adjust toe-in and Clear Vision as described in Section 04-00.

Steering Tie Rod

Refer to the illustrations under Tie Rod and Drag Link Assembly in the Removal and Installation portion of this section.

Replace the steering tie rod if the ball stud is loose in the socket or the rod is bent. Replace the boot seal if any nicks, cuts or tears are present. **Do not attempt to straighten a bent rod.**

Removal

1. Raise the vehicle on a hoist with the wheels in the straight-ahead position. Refer to Section 50-04, Hoisting and Jacking in the Pre-Delivery Truck Shop Manual.
2. Remove the nut and cotter pin from the tie rod ball stud on the drag link. Remove the ball stud from the drag link using Tie Rod End Remover TOOL-3290-D or equivalent.
3. Loosen the bolts on the adjusting sleeve clamps. Count the number of turns it takes to remove the tie rod from the adjusting sleeve. Remove the tie rod.

Installation

1. Install the tie rod in the adjuster sleeve the same number of turns it took to remove it. Tighten the tie rod nuts to 40-57 N·m (30-42 ft-lb).
2. Make sure the ball stud is seated in the taper to prevent rotation while tightening. Install nut and tighten to 70-100 N·m (51-73 ft-lb).
3. Install new cotter pins.
4. Check toe-in and adjust toe-in and Clear Vision as described in Section 04-00.

Tie Rod Adjusting Sleeve and Ball Stud

Replace the ball stud if it is loose in the socket or the tie rod is bent. Replace the boot seal if any nicks, cuts, or tears are present. **Do not attempt to straighten a bent tie rod.**

Removal

1. Raise the vehicle on a hoist with the wheels in the straight-ahead position. Refer to Section 50-04, Hoisting and Jacking in the Pre-Delivery Truck Shop Manual.

REMOVAL AND INSTALLATION (Continued)

2. Remove the nut and cotter pin from the tie rod ball stud at the spindle. Remove the ball stud from the spindle using Tie Rod End Remover TOOL-3290-D.
3. Loosen the nuts on the adjacent adjusting sleeve. Hold the tie rod adjustment sleeve and remove the tie rod ball socket from the adjustment sleeve. Count the number of turns it takes to remove the ball stud from the adjustment sleeve.
4. Remove the tie rod adjustment sleeve from the steering tie rod. Count the number of turns it takes to remove the sleeve from the steering tie rod assembly.

Installation

1. Install the adjusting sleeve on the steering tie rod the same number of turns it took to remove it.
2. Install the tie rod ball socket on the tie rod sleeve the same number of turns it took to remove it.
3. Tighten nuts to 40-57 N·m (30-42 ft·lb). Make sure the adjuster clamps are in the correct position.
4. Make sure the ball stud is seated in the taper to prevent it from rotating while turning. Install nut and tighten to specifications. Install new cotter pins.
5. Check toe-in and set toe-in and Clear Vision as described in Section 04-00.

Steering Linkage Damper Assembly, F-350 4x4 and F-Super Duty Chassis Cab**Removal**

1. Remove the nut that attaches the damper to the bracket on the steering linkage.
2. Remove the nut that attaches the damper to the right damper bracket (F-350) or axle bracket (F-Super Duty).
3. Remove the damper from the attaching brackets.
NOTE: The damper right bracket (F-350) or damper axle bracket (F-Super Duty) and the steering linkage bracket can be removed from the vehicle by removing the attaching bolts and nuts.

Installation

1. If the damper right bracket (F-350), axle bracket (F-Super Duty) or the steering linkage bracket was removed, install it on the vehicle. Refer to the illustrations under Steering Linkage, F-350 (4x4) Monobeam Axle, or Steering Linkage, F-Super Duty Chassis Cab in the Removal and Installation portion of this section for bolt tightening specifications.

NOTE: If a new steering linkage bracket is being installed, make sure that the bracket is properly positioned on the drag link before tightening the U-bolt attaching nuts.

2. Install the damper in the attaching brackets.
3. Install the nut that attaches the damper to the right bracket (F-350) or axle bracket (F-Super Duty) to 34-48 N·m (25-35 ft·lb).
4. Install the nut that attaches the damper to the steering linkage bracket to 34-48 N·m (25-35 ft·lb).
5. Rotate the steering wheel from stop to stop. Check that the steering linkage damper is not bottoming out and that the steering linkage reaches its full travel when the steering wheel is turned from stop to stop.

Steering Linkage Shock Absorber, E-350 with Dual Rear Wheels**Removal**

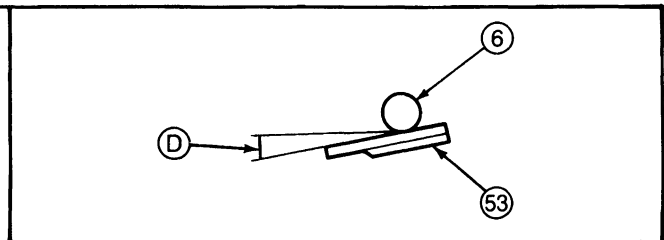
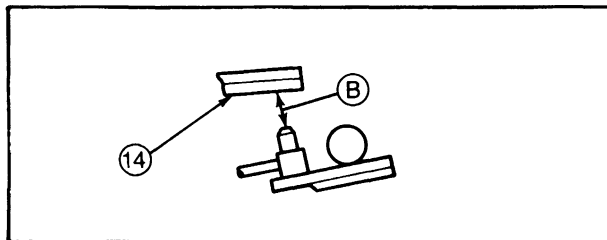
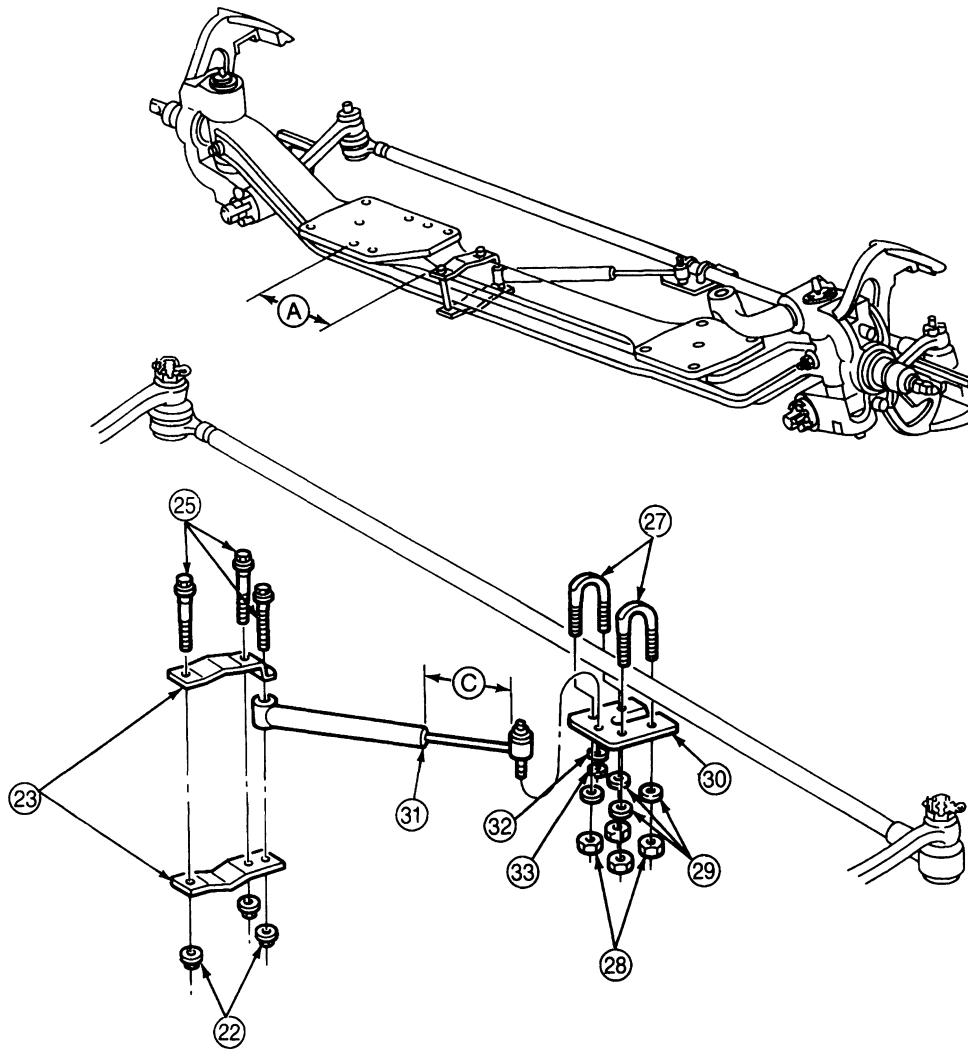
1. Remove the nut that attaches the damper to the bracket on the steering linkage.
2. Remove the nut and bolt that attaches the damper to the damper right bracket.
3. Remove the damper from the mounting brackets.
NOTE: The damper right bracket and the steering linkage bracket can be removed from the vehicle by removing the attaching bolts and nuts.

Installation

1. If the damper right bracket or the steering linkage bracket was removed, install it on the vehicle. Refer to the illustration under Steering Linkage, E-150-250-350 in the Removal and Installation portion of this section for bolt tightening specifications.
NOTE: If a new steering linkage bracket is being installed, make sure that the bracket is properly positioned on the drag link before tightening the U-bolt attaching nuts.
2. Install the damper in the attaching brackets.
3. Install the bolt and nut that attaches the damper to the right bracket and tighten to 64-91 N·m (47-67 ft·lb).
4. Install the nut that attaches the damper to the steering linkage bracket and tighten to 64-91 N·m (47-67 ft·lb).
5. Rotate the steering wheel from stop to stop. Check that the steering linkage damper is not bottoming out and that the steering linkage reaches its full travel when the steering wheel is turned from stop to stop.

REMOVAL AND INSTALLATION (Continued)

Steering Linkage Damper, F-Super Duty, Commercial Chassis and Motorhome Chassis



G7735-A

Item	Part Number	Description
6	—	Tie Rod
14	—	Spring
22	—	Nut 65-90 N·m (48-66 Ft·Lb)
23	3E653	Bracket

(Continued)

Item	Part Number	Description
25	—	Bolt
27	—	U-Bolt
28	—	Nut 21-30 N·m (15-22 Ft·Lb)
29	—	Flatwasher

(Continued)

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
30	—	Tie Rod Bracket
31	3E651	Damper Assembly
32	—	Lock Washer
33	—	Nut 65-90 N-m (48-66 Ft-Lb)
53	—	Bracket

(Continued)

Item	Part Number	Description
A	—	109.5mm
B	—	19mm
C	—	158.8mm
D	—	5°

TG7735A

SPECIFICATIONS

Refer to Section 11-00.

NOTE: The following torque specifications are for F-150-250-350, F-Super Duty, E-150-250-350 vehicles.

Description	N-m	Lb-Ft
Drag Link to Connecting Rod Ball Stud Nut	70-100	51-73
Drag Link to Pitman Arm Ball Stud Nut	70-100	51-73
Pitman Arm to Steering Gear Nut	230-310	170-228
Adjusting Sleeve Nuts	40-57	30-42
Adjusting Sleeve Nuts (F-Super Duty)	81-122	60-90
Tie Rod to Spindle Ball Stud Nut	70-100	51-73
Adjusting Sleeve Clamp	40-57	30-42
Shock Absorber RH Screw	21-29	15-21
Steering Linkage to Bracket Nut and Washer	21-29	15-21
U-Bolt Nut	25.5-34.5	18-25
Steering Linkage Nut to U-Bolt	64-91	47-67
Steering Damper Bracket Nut	115-163	85-120
Steering Damper Nut and Washer	34-48	25-35



NOTE: The following torque specifications are for F-Super Duty Commercial Chassis and Motorhome Chassis vehicles.

Description	N-m	Lb-Ft
Drag Link to Steering Arm — Castellated Nut	70-100	51-73
Drag Link to Pitman Arm — Castellated Nut	70-100	51-73

(Continued)

Description	N-m	Lb-Ft
Pitman Arm Retaining Bolt and Nut	300-400	220-300
Steering Connecting Rod Ends to Spindle Arms — Castellated Nut	70-100	51-73
Steering Connecting Rod End Clamp — Bolt and Nut	81-122	60-90

SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
TOOL-3290-D Tie Rod End Remover	 TOOL-3290-D
T64P-3590-F Pitman Arm Puller	 T64P-3590-F

Tool Number	Description
D79P-3283-A	Tie Rod Adjustment Tool

SECTION 11-04A Steering Column

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Automatic Transmission Selector Indicator	11-04A-27	Steering Column, All Except Econoline Stripped Chassis	11-04A-5
Ignition Switch Adjustment	11-04A-28	Steering Column, Econoline Motorhome and Commercial Chassis	11-04A-8
Steering Column Alignment	11-04A-27	Steering Shaft, Intermediate	11-04A-12
DESCRIPTION AND OPERATION	11-04A-1	Steering Shaft, Intermediate, E-350 Commercial Chassis	11-04A-13
DISASSEMBLY AND ASSEMBLY		Steering Shaft, Intermediate, E-350 Motorhome Chassis	11-04A-12
Steering Column	11-04A-19	Steering Wheel With Air Bag, Econoline	11-04A-3
REMOVAL AND INSTALLATION		Steering Wheel Without Air Bag, Econoline	11-04A-4
Contact Assembly	11-04A-5	Tilt Lock Lever	11-04A-17
Gearshift Lever and Cover	11-04A-14	SPECIAL SERVICE TOOLS / EQUIPMENT	11-04A-28
Key Lock Cylinder Assembly	11-04A-18	SPECIFICATIONS	11-04A-28
Key Lock Cylinder Components	11-04A-15	VEHICLE APPLICATION	11-04A-1
Shaft Bearing, Intermediate	11-04A-16		
Shaft Bearing, Lower	11-04A-17		
Shaft Bearing, Upper	11-04A-16		

VEHICLE APPLICATION

F-150-250-350, E-150-250-350 and Econoline Stripped Chassis, Bronco and F-Super Duty vehicles

DESCRIPTION AND OPERATION

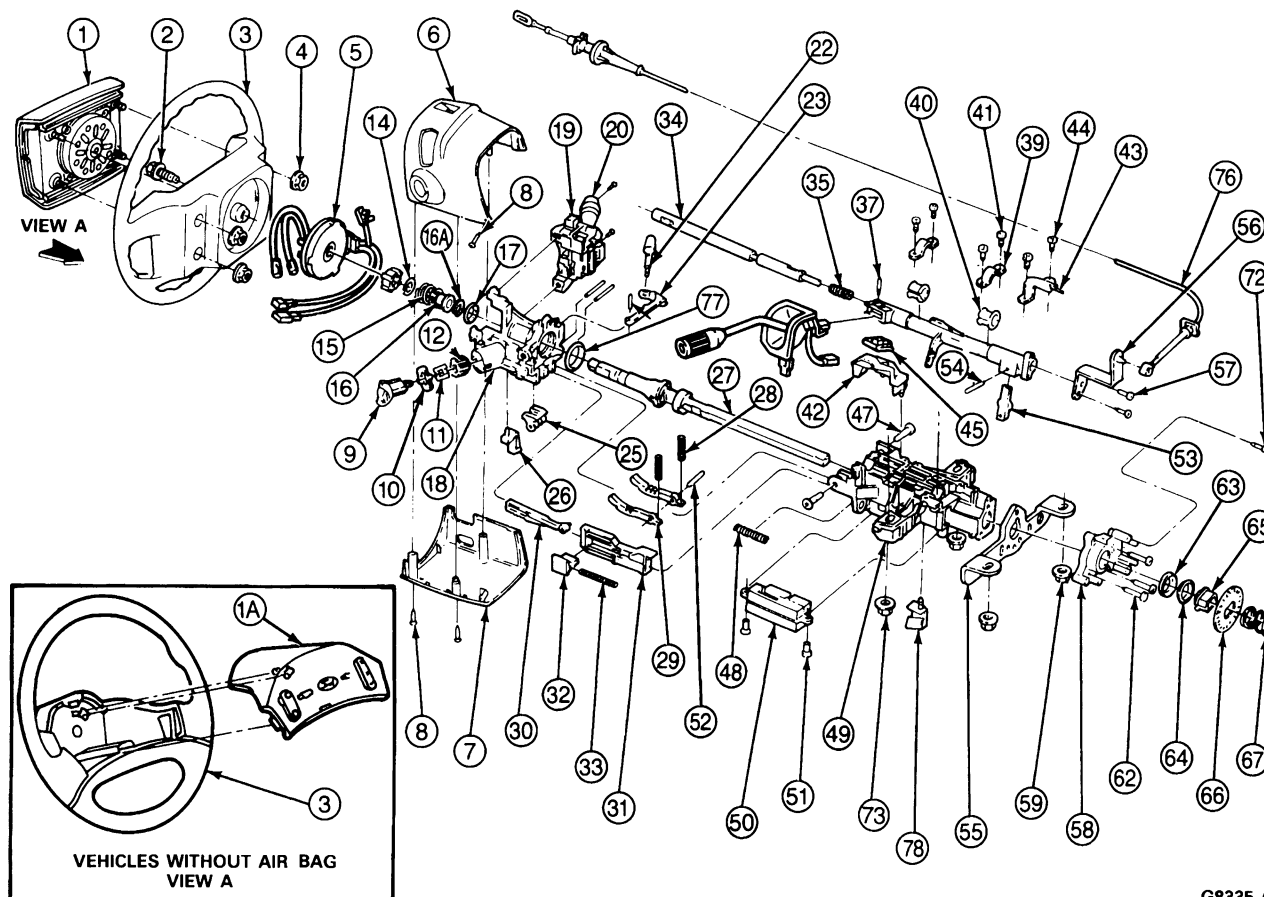
NOTE: All fasteners are important in that they could affect the performance of vital parts and systems, and/or could result in major service expenses. They must be replaced with fasteners of the same part number if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during assembly to make sure proper functioning of these parts.

The steering column has been redesigned for more efficient use of package space and improved strength. The structural part of the column is made of magnesium die castings. The column is attached to a support that is an integral part of the instrument panel. (For Econoline Stripped Chassis the steering column is attached to a steering column support structure.) The column lower attachments are through a bracket that bends during column collapse. The upper attachments are through plastic shear modules that separate from the main casting during column collapse. A clip and washer are attached to the shear modules to reduce column shake and to assist in column installation to the beam.

A unique shifter mechanism has been installed on the column. It has the insert plate located away from the shift lever and interacts with the shift lever through a linkage system. This system provides a positive interlock with no adjustments required.

DESCRIPTION AND OPERATION (Continued)

Steering Column, Column Shift, Exploded View



G8335-A

Item	Part Number	Description
1	—	Air Bag Module (Econoline)
1A	—	Steering Wheel Cover
2	N804385-S100	Steering Wheel Bolt
3	—	Steering Wheel
4	—	Air Bag Module Retaining Nuts
5	14A664	Air Bag Clockspring Contact Assembly
6	3530	Upper Column Shroud
7	3533	Lower Column Shroud
8	55929	Shroud Retaining Screws
9	11572	Ignition Lock Cylinder Assembly
10	3F579	Retainer
11	3E700	Bearing
12	3E717	Gear — Steering Lock
13	13318	Turn Single Cancelling Cam
14	3C610	Snap Ring
15	3520	Spring — Upper Bearing
16	3518	Sleeve
16A	3L539	Ring
17	3517	Bearing — Upper (Small)
18	3F642	Lock Cylinder Housing

(Continued)

Item	Part Number	Description
19	13K359	Multi-Function Switch
20	390345-S36	Screws
22	3F527	Tilt Release Lever
23	3D544	Tilt Actuator Lever
24	3F530	Tilt Actuator Lever Pin
25	3E695	Cam Steering Column Lock
26	14A163	Clip Wiring — Upper
27	3D657	Steering Shaft Assembly
28	3C732	Spring Lock Lever
29	3B662 — RH 3D653 — LH	Lever Steering Column Lock
30	3E723	Lock Actuator Assembly — Upper
31	3E715	Lock Actuator — Lower
32	3E691	Pawl — Steering Column Lock (Shaft)
33	3E696	Spring — Steering Column Lock (Shaft)
34	7361	Plunger Trans Control Select
35	7B071	Spring — Trans Control Selector Return
36	7202	Shift Lever
37	7G357	Shift Lever Pin

(Continued)

DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
38	7215	Trans Selector Control Tube
39	7E400	Trans Gear Shift Tube Clamps
40	7335	Bushings
41	N805858	Screws
42	14A099	Shield
43	7A216	Trans Control Selector Position Insert
44	N805858	Screws
45	7C464	Clip-Trans Control Select Lever Spring
47	N805865	Tilt Pivot Screws
48	3D655	Spring — Steering Column Position Lock
49	3F723	Actuator Housing
50	—	Ignition Switch
51	N805858	Screws
52	3F530	Pin — Pivot Lever
53	3E691	Pawl Steering Column Lock Shifter
54	3B663	Pin — Steering Column Lock Shifter
55	3B632	Lower Column Bracket

(Continued)

Item	Part Number	Description
56	7D282	Trans Control Selector Lower Lever
57	805858	Screws
58	3E738	Lower Bearing Housing Retainer
59	N801555	Lower Column Mounting Nuts
62	805859	Lower Bearing Housing Retaining Screws
63	3A649	Lower Column Bearing Sleeve
64	3517	Lower Column Bearing
65	3L539	Tolerance Ring — Lower
66	3C131	Sensor Ring
67	3C674	Spring
72	805858	Shift Cable Bracket Mounting Screws
73	N806423	Upper Column Mounting Nuts
74	3E645	Absorber — Steering Column Impact Nuts
75	—	Nuts
76	—	Shift Cable Assembly
77	3517	Bearing — Upper (Large)
78	14A163	Clip Wiring — Lower
79	—	Horn Pad

DIAGNOSIS AND TESTING

For diagnostic procedures, refer to Section 11-00.

REMOVAL AND INSTALLATION

CAUTION: Do not remove the steering column, steering wheel, horn pad and air bag module as an assembly from the vehicle unless the column is locked to prevent rotation, or lower end of steering shaft should be wired in such a way to prevent the steering wheel from being rotated.

Steering Wheel With Air Bag, Econoline

Removal

- Center front wheels to the straight-ahead position.
- Discharge battery positive cable for one minute to let the air bag backup power supply discharge. Refer to Section 01-20B.

WARNING: THE BACKUP POWER SUPPLY MUST BE DISCHARGED BEFORE ANY AIR BAG COMPONENT IS SERVICED.

- Remove four air bag module retaining nuts from air bag module on back side of steering wheel, and lift module away from steering wheel.
- Disconnect air bag wire harness connector, and remove module from wheel.

- Disconnect horn / speed control wire harness connector in steering wheel.
- Remove steering wheel retaining bolt.
- Install Steering Wheel Puller T67L-3600-A and remove steering wheel. Route contact assembly wire harnesses through steering wheel as wheel is lifted off shaft.

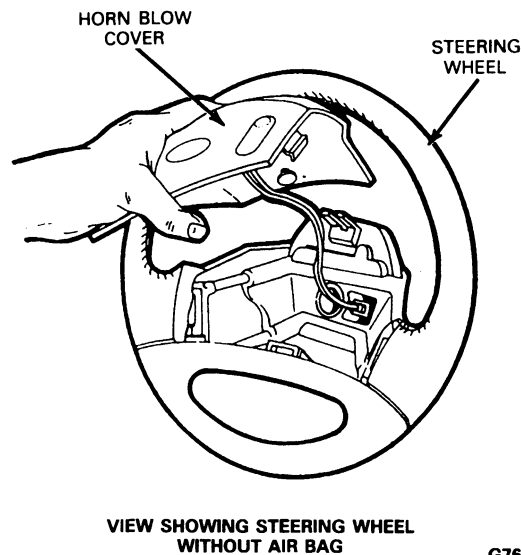
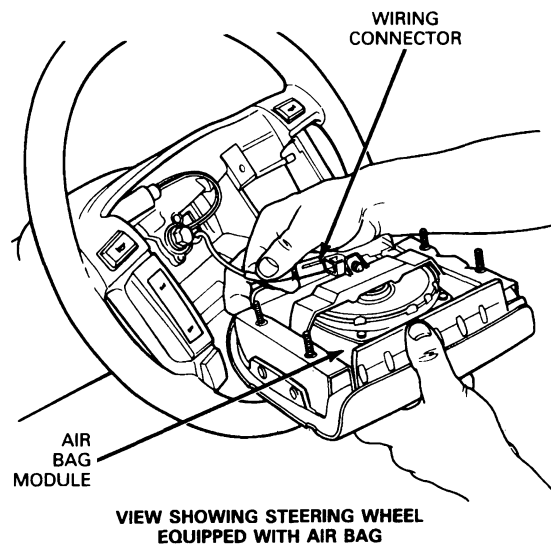
Installation

- Make sure that the vehicle's front wheels are in the straight-ahead position.
 - Route contact assembly wire harnesses through steering wheel opening at the three o'clock position. Position steering wheel on steering shaft so the alignment marks are aligned. Be sure air bag contact wire is not pinched.
 - Install new steering wheel retaining bolt and tighten to 31-45 N·m (23-33 ft-lb).
 - Connect horn / speed control wire harness to contact assembly wire harness, and snap connector onto steering wheel clip.
- CAUTION:** Be sure wiring does not get trapped between steering wheel and contact assembly.
- Connect air bag wire harness from contact assembly to air bag module and install module to steering wheel. Tighten module retaining nuts to 4-6 N·m (3-4 ft-lb).

REMOVAL AND INSTALLATION (Continued)

6. Connect battery positive cable. Verify air bag warning indicator.

NOTE: When the battery is disconnected and reconnected, some abnormal driving symptoms may occur while the powertrain control module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Steering Wheel

G7655-B

Steering Wheel Without Air Bag, Econoline**Removal**

1. Center front wheels to the straight-ahead position.
2. Disconnect the battery ground cable.
3. Unsnap the horn cover from the steering wheel by grasping the sides of the horn cover and pulling toward yourself.
4. Disconnect the horn / speed control wire harness connector from the contact assembly, and remove horn cover from wheel.
5. Remove steering wheel retaining bolt.
6. Install Steering Wheel Puller T67L-3600-A, and remove steering wheel.

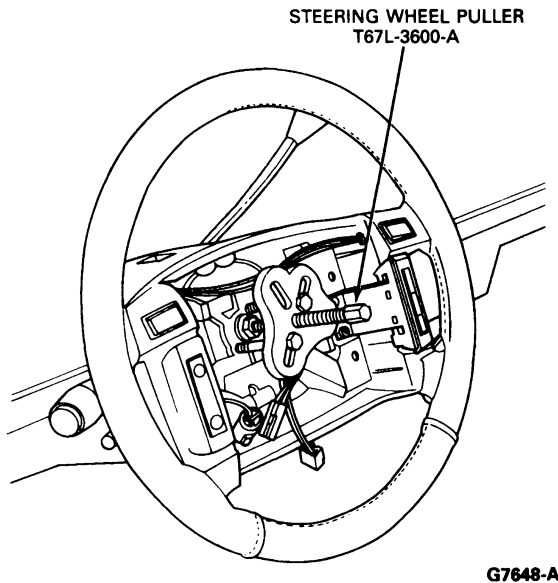
Installation

1. Make sure that the vehicle's front wheels are in the straight-ahead position.
2. Position steering wheel on steering shaft so the alignment marks are aligned.
3. Install new steering wheel retaining bolt and tighten to 31-45 N·m (23-33 ft-lb).
4. Connect horn cover horn / speed control wire harness to contact assembly connector.
5. Position horn cover over steering wheel and snap into place.

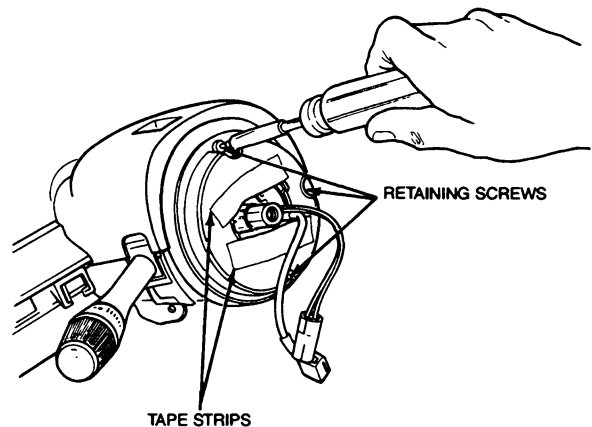
REMOVAL AND INSTALLATION (Continued)

6. Re-connect the battery ground cable.

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

**Contact Assembly****Removal**

1. Make sure that vehicle's front wheels are in the straight-ahead position and steering column shaft alignment mark is at the 12 o'clock position.
2. Disconnect battery positive cable for one minute and let the air bag (if equipped) backup power supply discharge.
3. Remove steering wheel as outlined in this section.
4. Remove lower right and left mouldings from instrument panel by pulling up and snapping out of retainer.
5. Remove instrument panel lower trim panel and lower steering column shroud.
6. Disconnect contact assembly wire harness.
7. Apply two strips of tape across contact assembly stator and rotor to prevent accidental rotation.
8. Remove three contact assembly retaining screws and pull contact assembly off steering column shaft.



G5555-A

Installation

1. Make sure that vehicle's front wheels are in the straight-ahead position and steering column shaft alignment mark is at the 12 o'clock position.
2. Align contact assembly to column shaft and mounting bosses and slide contact assembly onto the shaft.
3. Install three retaining screws. Tighten screws to 4-5.6 N·m (36-50 lb-in). Remove tape strips.
4. Route contact assembly down column assembly and connect to wire harness.

NOTE: If a new contact assembly is being installed, remove the plastic lock mechanism after contact assembly is secured to column.

5. Install lower shroud and instrument panel cover.
6. Install steering wheel as outlined in this section.
7. Connect battery positive cable. Refer to Section 01-20B.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

8. Verify air bag warning indicator.

Steering Column, All Except Econoline Stripped Chassis

Make sure that vehicle front wheels are in the straight-ahead position.

Removal

NOTE: All steering column components are assembled with fasteners. They are designed with a thread locking system to prevent loosening due to vibrations associated with normal vehicle operation.

1. Disconnect battery ground cable.

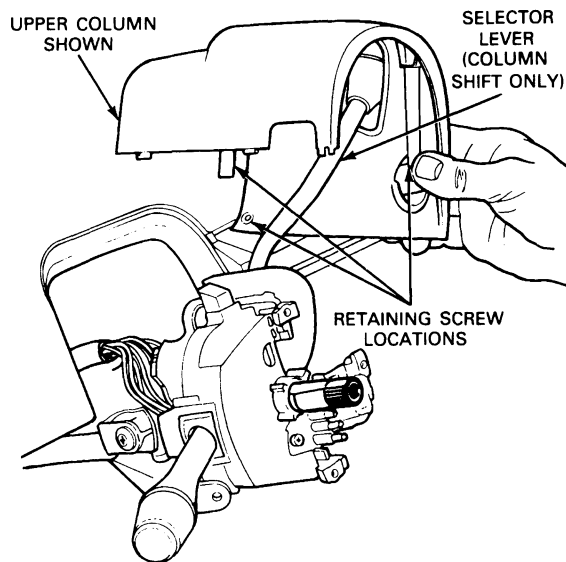
REMOVAL AND INSTALLATION (Continued)

2. Remove steering wheel as outlined in this section.
3. Remove right and left lower mouldings from instrument panel by pulling up and snapping out of retainers if so equipped.

NOTE: On right lower moulding a screw will also have to be removed in order to remove moulding from instrument panel.

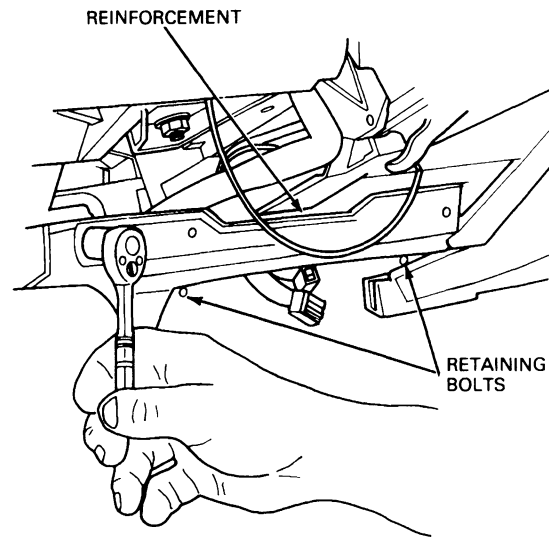
4. Remove instrument panel lower trim cover.
5. Remove clockspring contact assembly as outlined in this section.
6. Remove tilt lever by unscrewing it from column.
7. Rotate ignition lock cylinder to RUN position. Using a 1/8-inch drift, depress lock cylinder retaining pin through access hole in lower shroud and remove lock cylinder.
8. Remove four retaining screws from lower shroud and remove column shrouds.

NOTE: For F-Series and Bronco vehicles with an E4OD transmission, a protective cover (such as a rag) must be placed between the shift lever and shroud opening during shroud removal. This will prevent damage to the shift lever shrink wrap.



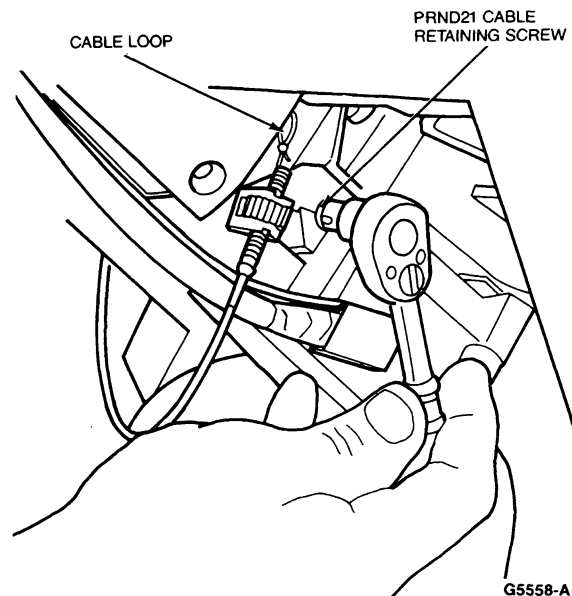
G7739-A

9. Remove (if equipped) six instrument panel reinforcement brace retaining bolts. Remove reinforcement.



G7649-A

10. Disconnect PRND21 cable from actuator housing by removing one screw.

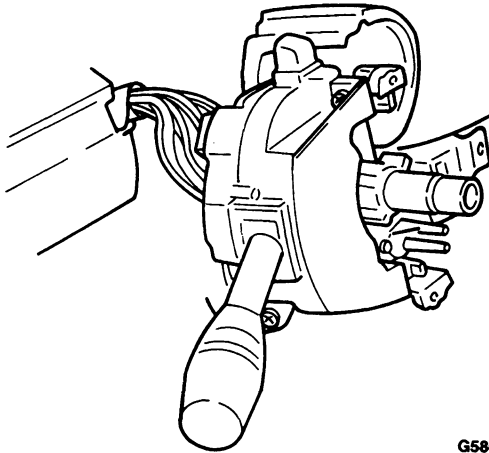


G5558-A

11. Disconnect PRND21 cable loop from shift lube hook.

REMOVAL AND INSTALLATION (Continued)

12. Remove two multi-function switch retaining screws and two electrical connectors from switch. Remove switch from column.

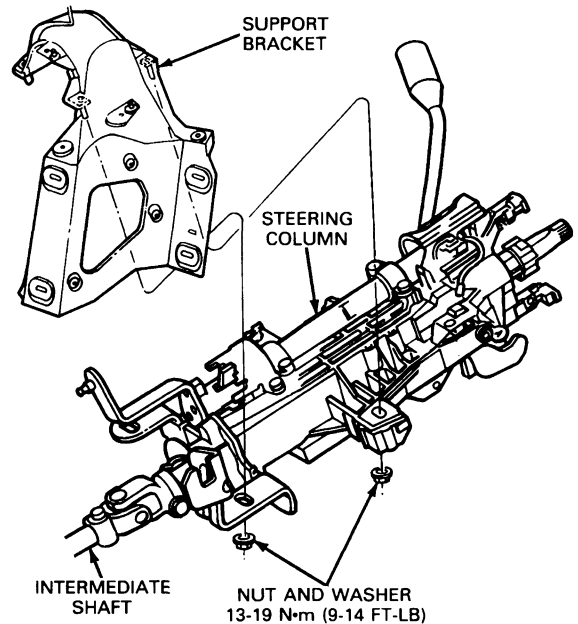


G5809-A

13. Remove pinch bolt from steering shaft flex coupling.
14. Disconnect shift cable from selector lever pivot.
15. Remove shift cable from shift cable bracket by pushing tab on cable in and sliding cable off bracket.
16. Disconnect ignition switch wiring by loosening bolt and removing connector.
NOTE: Bolt is part of connector and is not removable.
17. While supporting column assembly, remove four column assembly retaining nuts.
18. Disconnect collapsible intermediate shaft from U-joint at lower end of steering column.
19. Remove column from vehicle.

Steering Column Support Bracket

F-150-250-350 AND BRONCO SHOWN
E-150-250-350 SIMILAR



G7657-B

Installation

1. Align column lower universal joint to lower shaft. Install one bolt and tighten to 41-57 N·m (30-42 ft-lb).
2. Support column assembly to column support bracket. Install four retaining nuts and tighten to 13-19 N·m (10-14 ft-lb).
3. Install shift cable on shift cable bracket.
4. Snap shift cable onto shift selector pivot ball.
5. Connect two multi-function switch electrical connectors and position multi-function switch and install two retaining screws. Tighten to 2-3 N·m (18-26 in-lb).
6. Connect all electrical connectors.
7. Attach PRND21 cable loop on shift selector hook, and install PRND21 cable bracket to actuator housing. Install retaining screw and tighten to 7-11 N·m (5-8 ft-lb).
8. Install instrument panel reinforcement brace and secure with five retaining bolts. Tighten to specification.
9. Install upper and lower column shrouds.
NOTE: Series and Bronco vehicles with an E4OD transmission, a protective cover (such as rag) must be placed between the shift lever and shroud opening during shroud removal. This will prevent damage to the shift lever shrink wrap.
10. Install lower instrument panel cover.

REMOVAL AND INSTALLATION (Continued)

11. Snap right and left lower instrument panel mouldings into place.
NOTE: On right lower moulding a screw will also have to be installed.
12. Install lock cylinder assembly as outlined in this section.
13. Install tilt lever onto column.
14. Install air bag clockspring contact assembly screws, if so equipped. Tighten to 2-3 N·m (18-26 in·lb).
15. Install steering wheel onto column shaft. Install a new bolt and tighten to 31-48 N·m (23-33 ft·lb).
16. On vehicles equipped with an air bag, position air bag module to wheel. Install four retaining nuts. Tighten to 4-6 N·m (3-4 ft·lb).
17. On vehicles not equipped with an air bag, position horn cover to steering wheel and snap into place.
18. Connect battery ground cable and air bag backup power supply, if so equipped.
NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
19. Verify air bag warning indicator.

Removal

NOTE: All steering column components are assembled with fasteners that are designed with a thread locking system to prevent loosening due to vibrations associated with normal vehicle operation.

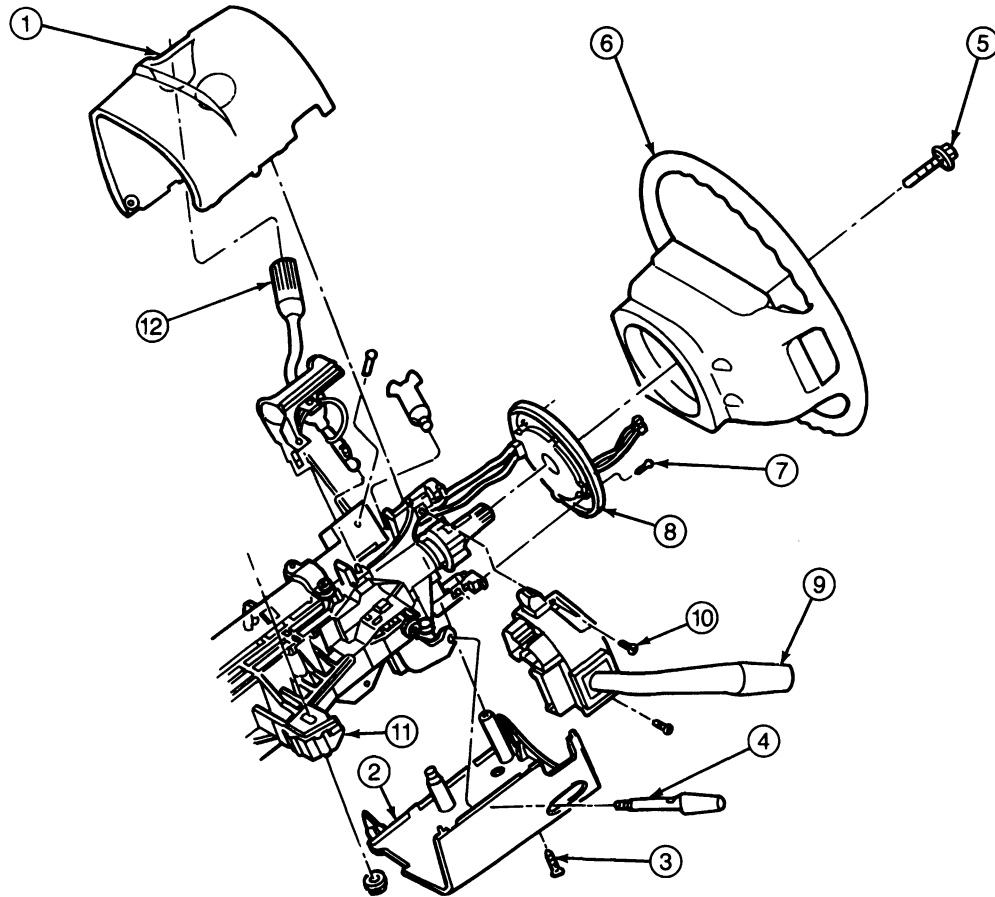
1. Set parking brake
2. Disconnect the battery ground cable.
3. Remove the steering wheel.
4. Remove the steering column lower trim cover if so equipped.
5. Remove the steering column lower shroud cover assembly — (Motorhome only).
6. Remove ignition switch wire connector and separate multi-function switch connector and clockspring connector at lower portion of column.
7. Remove the clockspring contact assembly.
8. Remove tilt lever by unscrewing if from column.
9. Rotate ignition lock cylinder to RUN position. Using a 1/8-inch drift depress lock cylinder retaining pin through access hole and remove lock cylinder.

Steering Column, Econoline Motorhome and Commercial Chassis

Make sure the vehicle front wheels are in the straight-ahead position.

REMOVAL AND INSTALLATION (Continued)

10. Remove four retaining screws from the lower half of the shroud and remove the column shrouds.



G7913-A

UPPER AND LOWER SHROUDS, LEVERS AND SWITCH (LEGEND)

Item No.	Part Number	Description
1	3530	Upper Shroud
2	3533	Lower Shroud
3	55929-S2	Screw 0.7-1.1 N•m (7-9 In-Lb)
4	3F609	Handle and Shank Assembly 3.5-5.0 N•m (31-44 In-Lb)
5	N804385-S100	Bolt 31-44 N•m (23-32 Ft-Lb)
6	3600	Wheel Assembly

Item No.	Part Number	Description
7	390345-S36	Screw 2-3 N•m (18-26 Ft-Lb)
8	14A664	Contact Assembly
9	13K359	Switch Assembly
10	390345-S36	Screw 2-3 N•m (18-26 Ft-Lb)
11	3C529	Column Assembly
12	7202	Lever Assembly

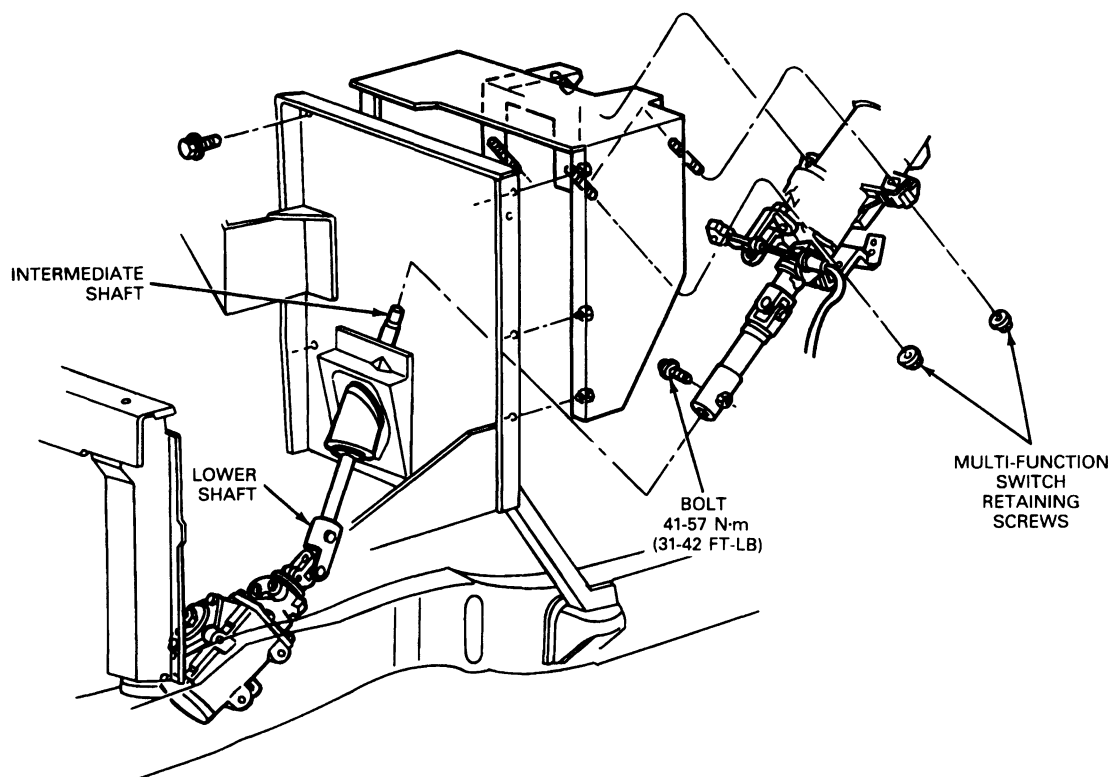
CG7914-A

11. Disconnect PRND21 cable from actuator housing by removing one screw.
12. Disconnect PRND21 cable loop from shift tube hook.
13. Remove two multi-function switch retaining screws and two electrical connectors from switch.
14. Remove switch from column.

15. Remove pinch bolt from upper intermediate shaft U-joint coupling
16. Disconnect shift cable from selector level pivot.
17. Remove shift cable from shift cable bracket by pushing tab on cable in and sliding cable off bracket.
18. While supporting column assembly, remove four column assembly retaining nuts.

REMOVAL AND INSTALLATION (Continued)

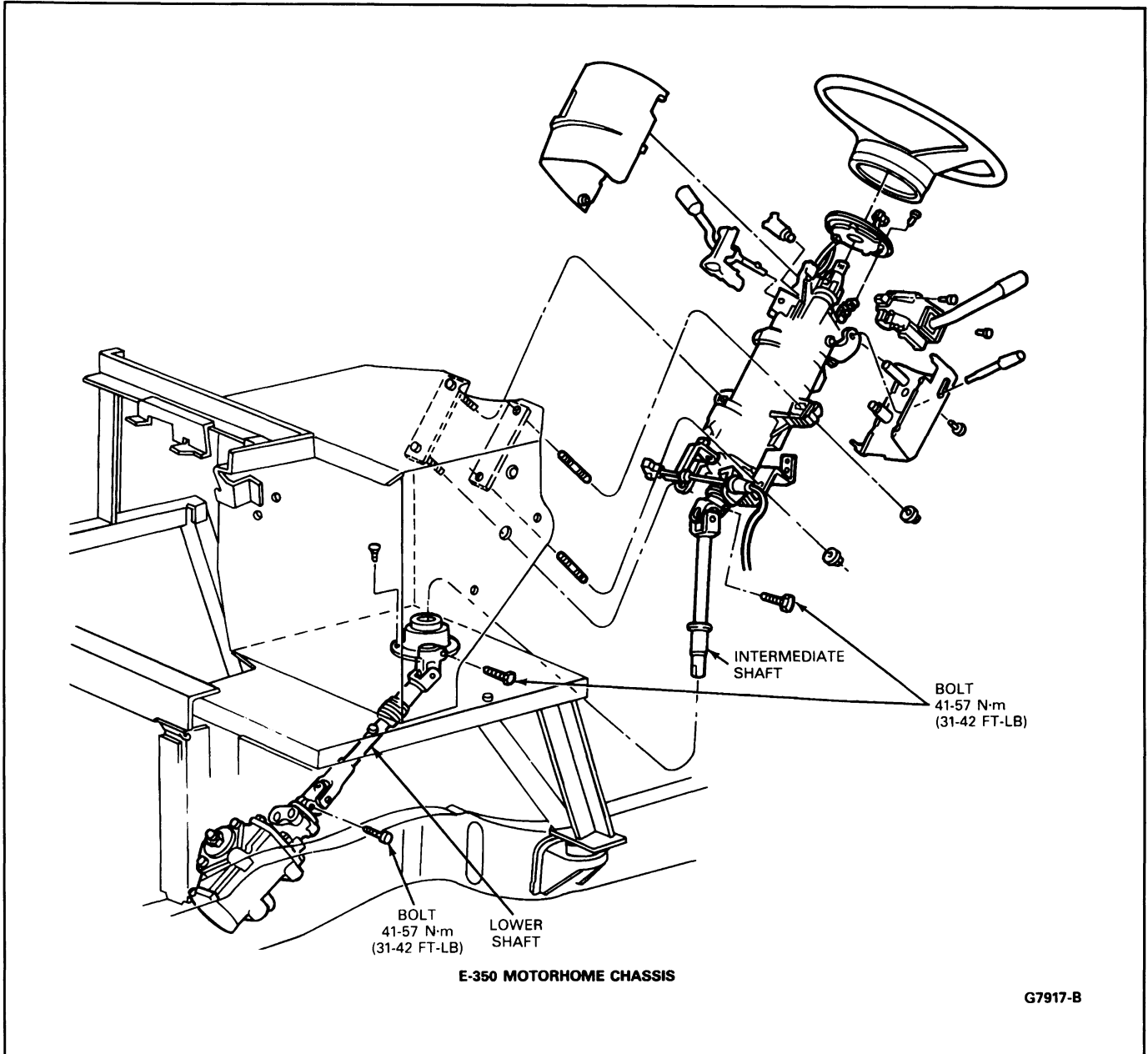
19. Remove column from vehicle.



E-350 COMMERCIAL CHASSIS

G7915-B

REMOVAL AND INSTALLATION (Continued)

**Installation**

1. Align steering column center shaft to intermediate shaft U-joint and install one bolt and tighten to 41-57 N·m (31-42 ft-lb).
2. Position column on four mounting studs on column support and install four retaining nuts and tighten to 13-19 N·m (10-14 ft-lb).
3. Install shift cable on shift cable bracket.
4. Snap shift cable onto shift selector pivot ball.
5. Connect two multi-function switch electrical connectors and position multi-function switch and install two retaining screws. Tighten to 2-3 N·m (18-26 in-lb).
6. Install clockspring contact assembly.
7. Connect all electrical connectors.
8. Attach PRND21 cable loop on shift selector hook, and install PRND21 cable bracket to actuator housing. Install retaining screw and tighten to 7-11 N·m (62-97 in-lb).
9. Position clockspring contact assembly on column and install three screws and tighten to 2-3 N·m (18-26 in-lb).
10. Install upper and lower column shroud sections and install four screws.
11. Install the steering column lower shroud cover assembly — (Motorhome only).
12. Install the steering column lower trim cover if so equipped.
13. Install lock cylinder assembly.

REMOVAL AND INSTALLATION (Continued)

14. Install tilt lever onto column.
15. Install steering wheel onto column shaft. Install new bolt and tighten to 31-45 N·m (23-33 ft-lb).
16. Connect horn pad electrical wires connector to clockspring contact assembly mounting boss at steering wheel hub.
17. Position horn cover to steering wheel and snap into place.
18. connect battery ground cable.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. the vehicle may need to be driven 10 miles or more to relearn the strategy.

Steering Shaft, Intermediate

F-150-250-350, Bronco Vehicles and Econoline Vehicles Not Equipped with an Air Bag

Removal

1. Remove bolt from upper U-joint-to-shaft connection. Collapse intermediate lower shaft.
CAUTION: Steering column should be in the locked position, or the lower end of the steering column is to be secured or wired in such a way as to prevent the steering wheel from rotating and damaging the clockspring contact assembly.
2. Remove bolt retaining intermediate lower shaft assembly to steering gear input shaft.
3. From inside of engine compartment, remove intermediate lower shaft.

Installation

1. From inside of engine compartment, install intermediate shaft through boot and to steering gear input shaft. Tighten bolt to 41-57 N·m (30-42 ft-lb).
2. Extend shaft and insert into upper assembly U-joint at end of steering column. Tighten bolt to 41-57 N·m (30-42 ft-lb).
3. Check steering column for proper operation.

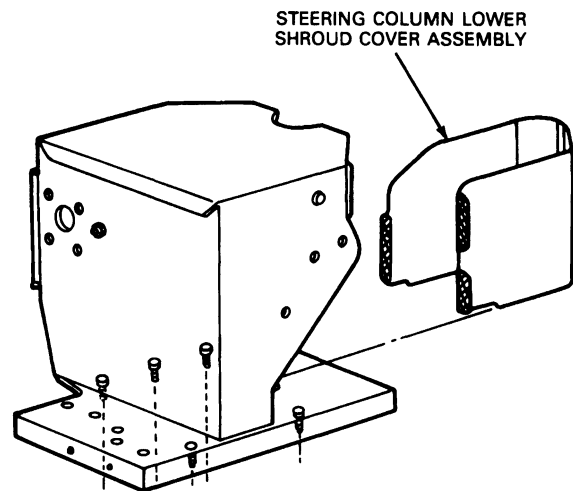
Steering Shaft, Intermediate, E-350 Motorhome Chassis**Removal**

1. Center front wheels to the straight-ahead position.
2. Set the parking brake.
3. Remove the battery cable from the negative post.
4. Remove steering column lower trim cover if so equipped.

5. Remove steering column lower shroud cover assembly.

NOTE: Steering column should be in the locked position or pin the lower end of the steering column center shaft to prevent the steering wheel from being turned. Turning of the steering wheel with the intermediate shaft removed can cause damage to the clockspring contact assembly.

6. Remove the bolt (in U-joint just below floor) retaining the upper shaft into the lower shaft.
7. Remove the bolt retaining the upper shaft to the lower end of the steering column center shaft.
8. Remove the upper section of the intermediate shaft from the steering column by rotating the shaft slightly forward while slipping the U-joint from the steering column.
9. Remove the upper section of the intermediate shaft from the center U-joint and slide up and out of the center bearing assembly.
10. Remove bolt retaining lower intermediate shaft to steering gear input shaft.
11. Remove lower shaft from steering gear.



E-350 MOTORHOME CHASSIS

G7919-A

Installation

1. Position the steering gear and front wheels in the straight-ahead position.
2. Align flat on U-joint with flat on steering gear input shaft and install lower intermediate shaft to steering gear. Install retaining bolt (hand start) and torque to 41-57 N·m (31-42 ft-lb).
3. Install upper section of intermediate shaft down through center bearing and slide U-joint onto end of steering column center shaft. Install retaining bolt and torque to 41-57 N·m (31-42 ft-lb).
4. Install lower shaft U-joint onto upper shaft, install retaining bolt and torque to 41-57 N·m (31-42 ft-lb).

REMOVAL AND INSTALLATION (Continued)

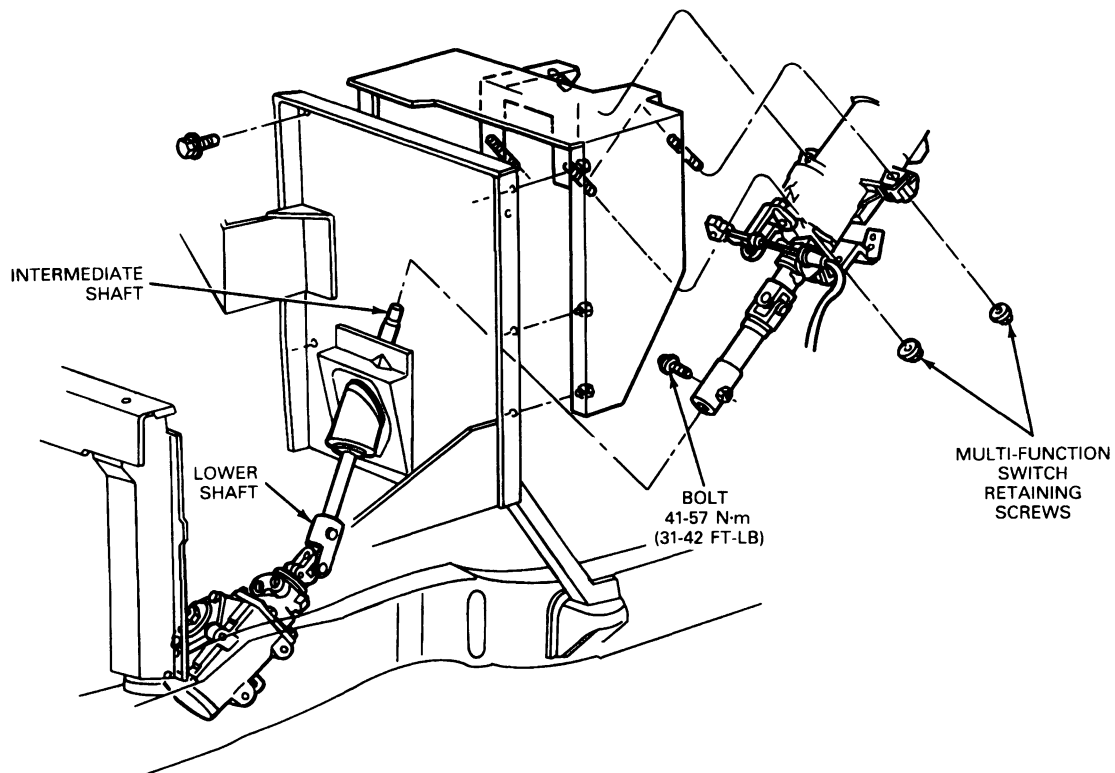
- | | |
|--|---|
| <ol style="list-style-type: none"> 5. Unlock steering column or remove the anti-rotation pin from lower end of steering column center shaft. 6. Install steering column lower shroud cover assembly. | <ol style="list-style-type: none"> 7. Install steering column lower trim cover if so equipped. 8. Check steering column for proper operation. |
|--|---|

Steering Shaft, Intermediate, E-350 Commercial Chassis**Removal**

1. Center front wheels to the straight-ahead position.
2. Set the parking brake.
3. Remove battery cable from the negative post.
4. Remove steering column lower trim cover if so equipped.

CAUTION: Be sure the steering column is in the locked position or pin the lower end of the steering column center shaft to prevent the steering wheel from being turned. Turning of the steering wheel with the intermediate shaft removed can cause damage to the clockspring contact assembly.

5. Remove the bolt retaining upper shaft assembly to lower shaft assembly.
6. Collapse lower shaft approximately two inches to allow separation of upper and lower shafts.
7. Remove bolt retaining upper shaft assembly U-joint to steering column center shaft.
8. Slide shaft off the end of steering column.
9. Remove the three screws retaining the dash panel seal to the dash panel.
10. Slide the seal assembly up and off the lower shaft assembly.
11. Remove the bolt retaining the lower shaft assembly U-joint to the steering gear input shaft.
12. Remove lower shaft assembly from steering gear.



E-350 COMMERCIAL CHASSIS

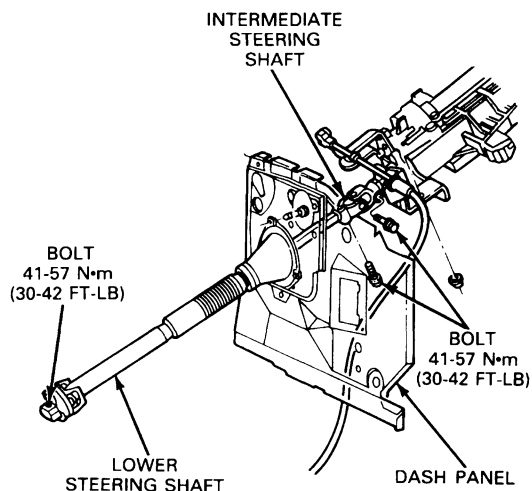
G7915-B

REMOVAL AND INSTALLATION (Continued)

Installation

1. Position the steering gear and front wheels in the straight-ahead position.
2. Align flat on U-joint of lower shaft assembly with flat on steering gear input shaft and install shaft on steering gear. Install retaining bolt and torque to 41-57 N·m (31-42 ft-lb).
3. Swing lower shaft through hole in dash panel.
4. Slide dash panel seal down over lower shaft assembly and install three retaining screws and torque to 16-20 N·m (12-15 ft-lb).
5. Align upper shaft assembly to steering column center shaft and slide into position. Install retaining bolt and torque to 41-57 N·m (31-42 ft-lb).
6. Align upper and lower shaft assemblies.
7. Extend end of lower shaft assembly up and into the upper shaft assembly. Install retaining bolt and torque to 41-57 N·m (31-42 ft-lb).
8. Install steering column trim cover if so equipped.
9. Check steering column for proper operation.

Steering Shaft, F-150-250-350 and Bronco



G7659-B

E-150-250-350 Vehicles Equipped with an Air Bag

Removal

1. Remove bolt securing lower intermediate shaft to upper. Collapse lower intermediate shaft.
2. Remove bolt retaining intermediate lower shaft assembly to steering gear input shaft.

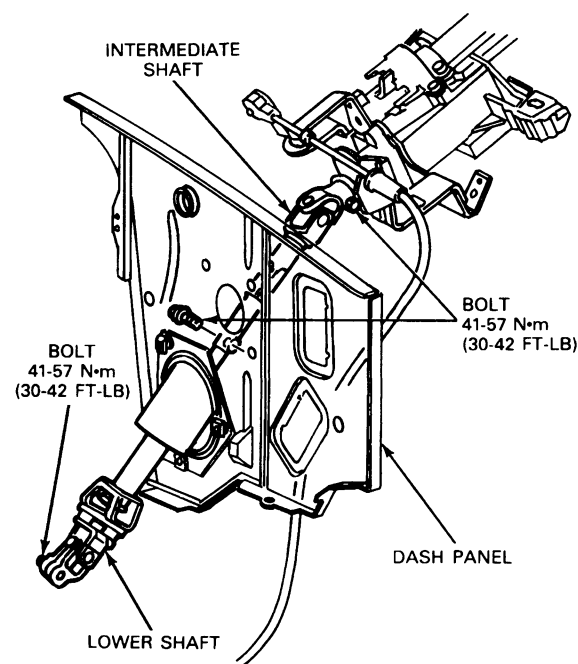
CAUTION: Be sure the steering column is in the locked position. The lower end of the steering column may be wired in such a way as to prevent the steering wheel from being turned as air bag clockspring assembly will be damaged.

3. From inside of engine compartment, remove lower intermediate shaft.

Installation

1. From inside engine compartment, install intermediate shaft through boot and to steering gear input shaft. Tighten bolt 41-57 N·m (30-42 ft-lb).
2. Extend lower shaft and insert into upper shaft assembly. Tighten bolt to 41-57 N·m (30-42 ft-lb).
3. Check steering column for proper operation.

E-150-250-350 Steering Shaft



G7661-B

Gearshift Lever and Cover

Column Shift

Removal

1. Remove tilt lever by unscrewing from the column.
2. Turn ignition switch to RUN position. Using a 1/8-inch drift, depress lock cylinder retaining pin through access hole and remove lock cylinder.
3. Remove lower instrument panel cover retaining screws and remove cover.
4. Remove four retaining screws from lower shroud. Remove upper and lower shroud assemblies.

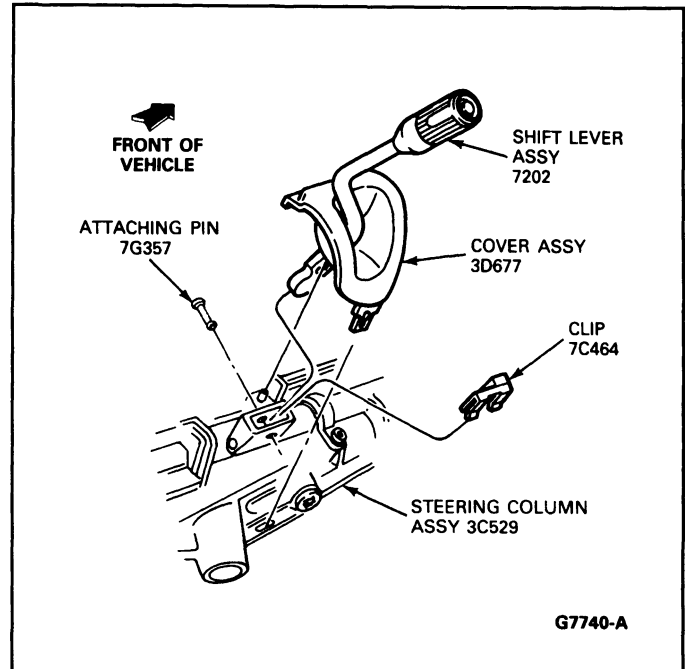
NOTE: For F-Series and Bronco vehicles with an E4OD transmission, a protective cover (such as rag) must be placed between the shift lever and shroud opening during shroud removal. This will prevent damage to the shift lever shrink wrap.

REMOVAL AND INSTALLATION (Continued)

5. Using a small screwdriver, pry rubber shift lever cover upper attachment from pedestal on lock cylinder housing. Slide cover toward shift lever handle to expose lever retaining pin.
6. On vehicles equipped with an E4OD transmission, disconnect overdrive lockout button electrical connector.
7. Using a small drift, tap lever retaining pin from bottom for removal. Discard lever retaining pin. Remove shift lever from shifter housing assembly.

Installation

1. Insert shift lever through hole in rubber cover. Position cover on shift lever.
2. Verify that the shift lever anti-rattle clip is correctly positioned in the shift tube shift lever socket. Replace if required.
3. Insert shift lever into opening in shifter housing assembly.
4. Install a new pin into position and tap in place until the head seats against shifter housing assembly.
5. On vehicles equipped with an E4OD automatic transmission, connect overdrive lockout button electrical connector.
6. Position shift lever cover on the lock cylinder housing. Insert lower attachment into the slot on side of housing.
7. Position upper attachment on mounting pin.
8. Install upper and lower shroud with four screws.
NOTE: For F-Series and Bronco vehicles with an E4OD transmission, a protective cover (such as rag) must be placed between the shift lever and shroud opening during shroud removal. This will prevent damage to the shift lever shrink wrap.
9. Install lower instrument panel cover and retaining screws.
10. Install lock cylinder into lock cylinder housing.
11. Install tilt lever onto column.
12. Check for proper start in PARK and NEUTRAL. Make sure start circuit cannot be actuated in DRIVE or REVERSE positions and the column is locked in the LOCK position.

**Key Lock Cylinder Components****Removal**

1. Disconnect battery ground cable.
2. Rotate ignition lock cylinder to RUN position. Using a 1/8-inch drift, depress lock cylinder retaining pin through access hole in lower steering column shroud and remove lock cylinder.
3. Remove blue plastic bearing retainer by inserting a screwdriver or similar tool, with a 90 degree bend on the tip, between bearing retainer and bearing and by prying upward.
Carefully note the position of the bearing retainer prior to removal.
4. Insert tip of a screwdriver into Double-D slot of bearing, then rotate 90 degrees. Remove bearing.
5. Remove lock drive gear. Carefully note relationship of lock drive gear to position of rack teeth.

Installation

1. Position lock drive gear in base of lock cylinder housing in the same position as that noted during removal procedure. The position of lock drive gear is correct if last tooth on drive gear is meshed with last tooth on rack.
2. Position bearing retainer in lock cylinder housing. Insert tip of a screwdriver into Double-D slot of bearing, then rotate 90 degrees.
3. Press blue plastic bearing retainer into lock cylinder housing. Make sure retainer is in its original position.
4. Line up flats of drive gear with flats of washer by pulling down on the column lock actuator.
5. Install lock cylinder assembly.

REMOVAL AND INSTALLATION (Continued)

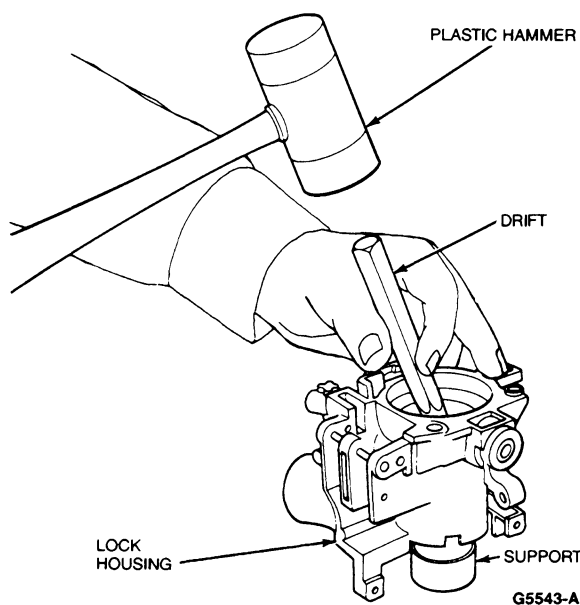
6. Connect battery ground cable.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

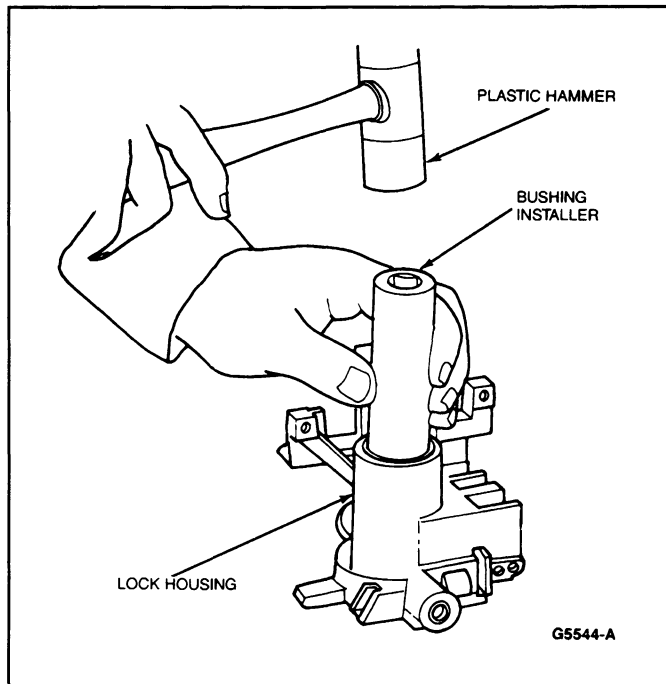
7. Check for proper start in PARK and NEUTRAL. Also, check to make sure start circuit cannot be actuated in DRIVE or REVERSE positions and the column is locked in LOCK position.

Shaft Bearing, Upper**Column Removed****Removal**

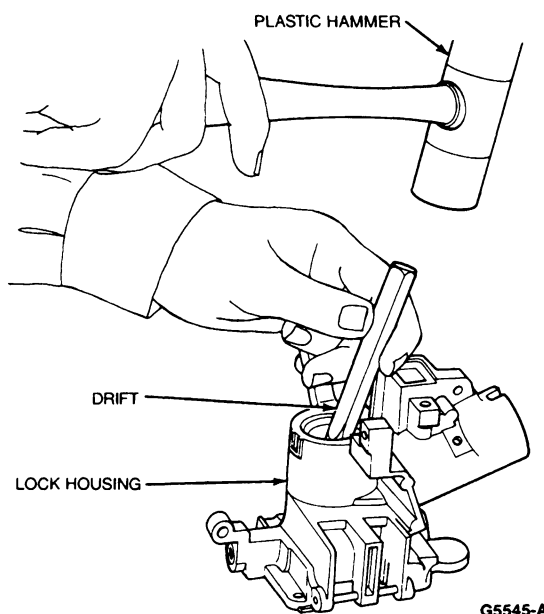
1. Remove lock housing from steering column assembly as outlined under Disassembly and Assembly.
2. Suitably support housing and tap out small bearing with an appropriate drift and a plastic hammer.

**Installation**

1. Suitably support housing. Position small bearing so the opening between races is "up." Tap into place with a plastic hammer and a bushing driver installer or socket the same size as outer race of bearing.
2. Install housing on steering column as outlined.

**Shaft Bearing, Intermediate****Column Removed****Removal**

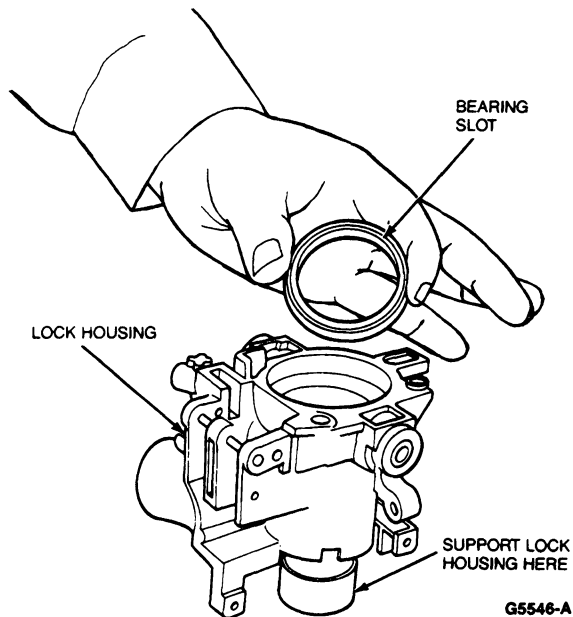
1. Remove lock housing as outlined.
2. Set housing flat on workbench and tap large bearing loose with suitable drift and a plastic hammer.

**Installation**

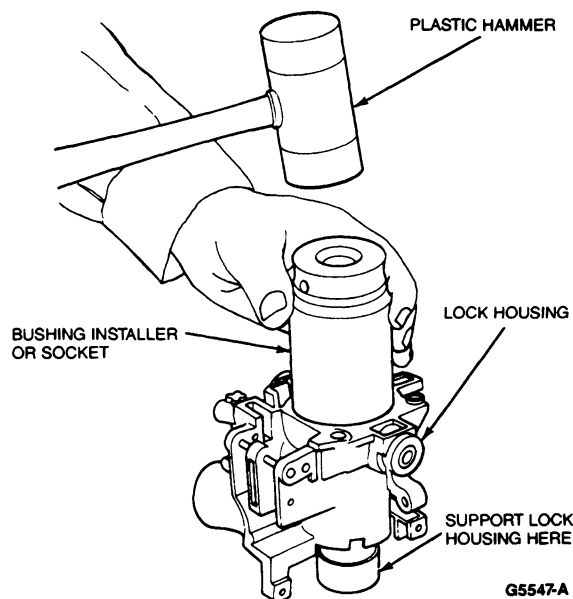
1. Support lock housing on workbench.

REMOVAL AND INSTALLATION (Continued)

2. Position bearing so the opening between races will face up, or out from housing, when installed.



3. Using a socket or bushing driver the same size as outer race of bearing, tap bearing into housing with a plastic hammer until fully seated.

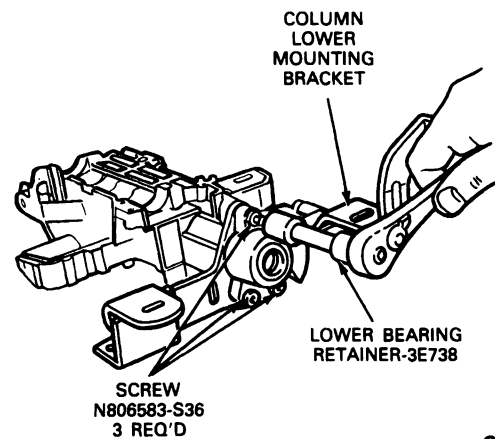
**Tilt Lock Lever****Removal and Installation**

1. To remove tilt lock lever, rotate lever counterclockwise.

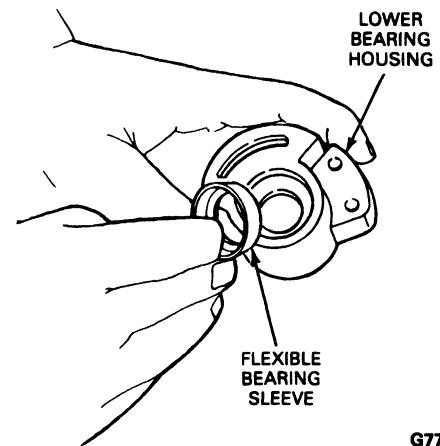
2. To install, position lever and rotate clockwise until tight.

Shaft Bearing, Lower**Column Removed****Removal**

1. Remove lower steering shaft bearing and housing assembly as outlined.
2. Suitably support housing and tap out bearing with a hammer and a drift.

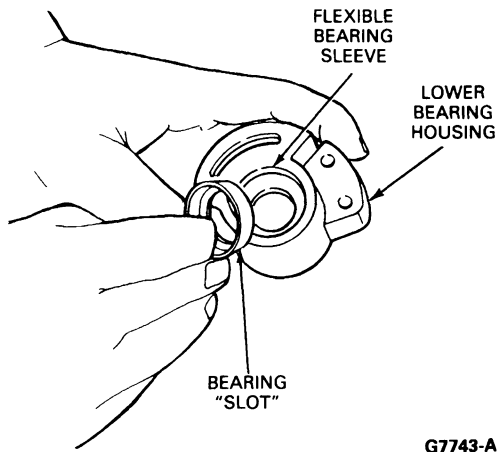
**Installation**

1. Inspect flexible bearing sleeve. Replace if damaged.



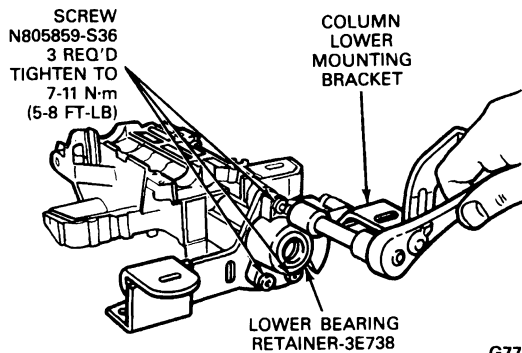
REMOVAL AND INSTALLATION (Continued)

2. Position bearing sleeve in housing.



G7743-A

3. Press in the new bearing with thumb pressure until seated. Slot between inner and outer races should face down when installed in the vehicle.
4. Install bearing housing on steering column as outlined.



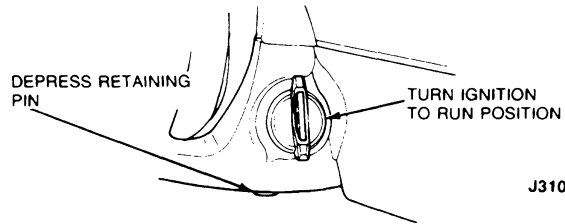
G7744-B

Key Lock Cylinder Assembly

NOTE: The following procedure applies to vehicle that have functional lock cylinders. Lock cylinder keys are available for these vehicles, or the lock cylinder key numbers are known and the proper key can be made.

Removal

1. Disconnect battery ground cable.
2. Turn lock cylinder key to RUN position.
3. Place a 3.17mm (1/8-inch) diameter wire pin or small drift punch in hole in trim shroud under lock cylinder. Depress retaining pin while pulling out on lock cylinder to remove it from column housing.



J3104-A

Installation

1. Install lock cylinder by turning it to RUN position and depressing retaining pin. Insert lock cylinder into lock cylinder housing. Make sure cylinder is fully seated and aligned in interlocking washer before turning key to OFF position. This will permit cylinder retaining pin to extend into cylinder housing hole.

2. Rotate lock cylinder, using lock cylinder key, to make sure of correct mechanical operation in all positions.

3. Connect battery ground cable.

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

NOTE: The following procedure applies to vehicles in which the ignition lock is inoperative and the lock cylinder cannot be rotated due to a lost or broken lock cylinder key, unknown key number, or a lock cylinder cap that has been damaged and / or broken to the extent that the lock cylinder cannot be rotated.

Removal

1. Disconnect battery ground cable.
2. Remove steering wheel as outlined.
3. Using channel lock pliers or vise grip pliers, twist lock cylinder cap until it separates from the lock cylinder.
4. Using a 3/8-inch diameter drill, drill down middle of ignition lock key slot approximately 44mm (1-3/4 inch) until lock cylinder breaks loose from breakaway base of lock cylinder. Remove lock cylinder and drill shavings from lock cylinder housing.
5. Remove retainer, washer, ignition switch and actuator. Thoroughly clean all drill shavings and other foreign materials from casting.
6. Carefully inspect lock cylinder housing for damage from the above operation. If damage is apparent, housing must be replaced.

Installation

1. Replace lock cylinder housing, if damaged.
2. Install actuator and ignition switch as outlined.
3. Install trim and electrical parts.
4. Install new ignition lock cylinder as outlined.
5. Install steering wheel as outlined.

REMOVAL AND INSTALLATION (Continued)

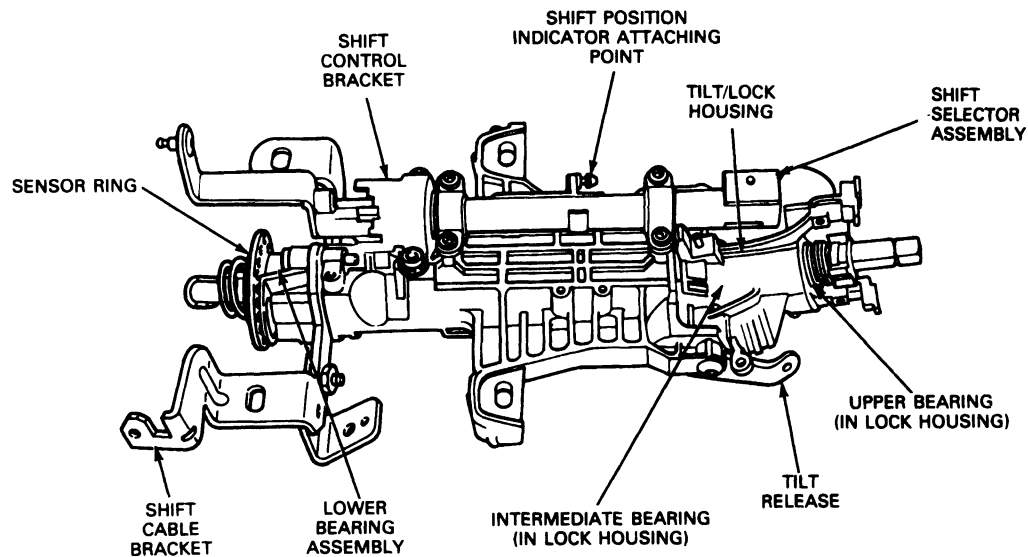
6. Connect battery ground cable.

7. Check lock cylinder operation.

DISASSEMBLY AND ASSEMBLY**Steering Column****Disassembly**

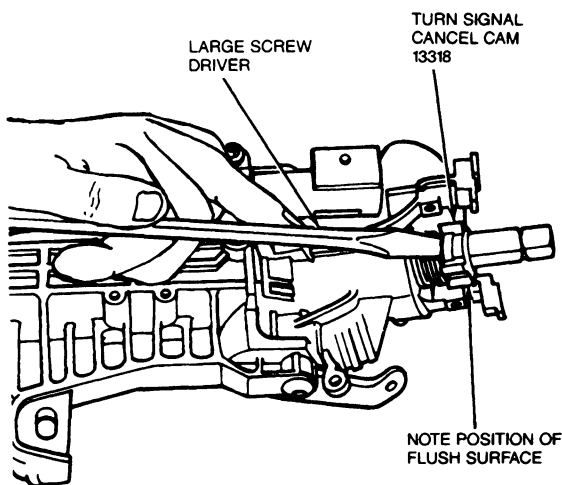
1. Disconnect battery ground cable and air bag backup power supply (if so equipped). Refer to Section 01-20B.

2. Remove steering wheel assembly as outlined.
3. Remove steering column from vehicle as outlined.
4. Remove lower U-joint, spring, sensor ring and bushing.

Column Shift Only

G7745-A

5. Remove turn signal cancelling cam by pushing up with flat-bladed screwdriver. Note direction of flush surface.



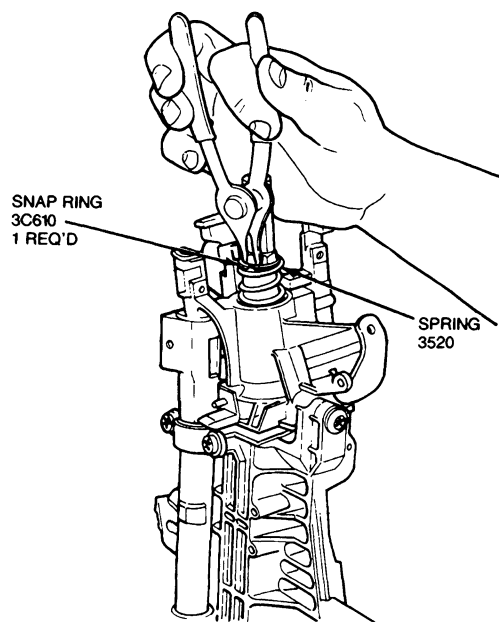
G5450-A

DISASSEMBLY AND ASSEMBLY (Continued)

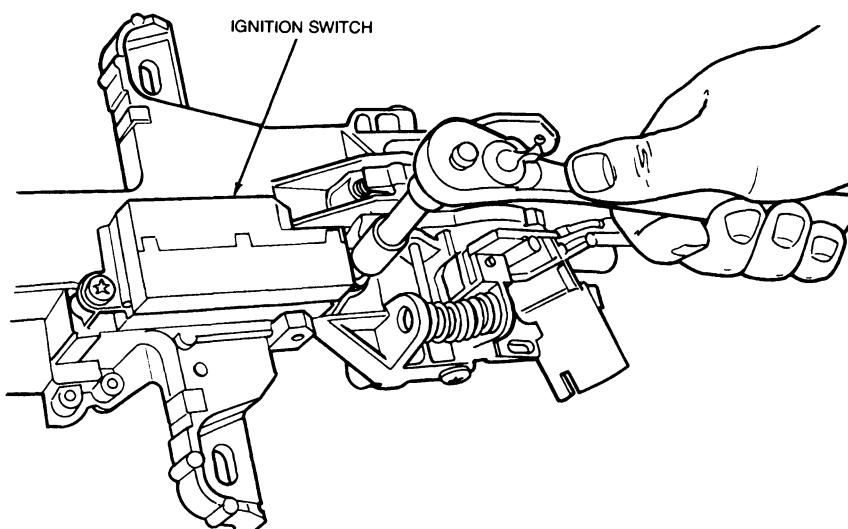
6. Remove upper snap ring and coil spring.

7. Remove steel sleeve and ring.

8. Remove ignition switch assembly.



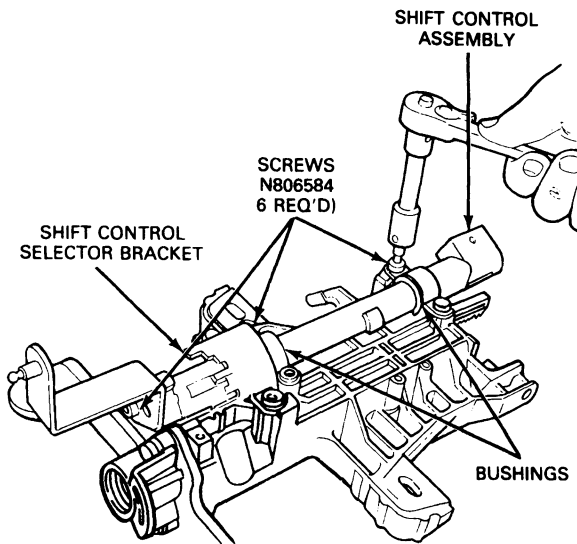
G5531-A

Ignition Switch Assembly

G5538-A

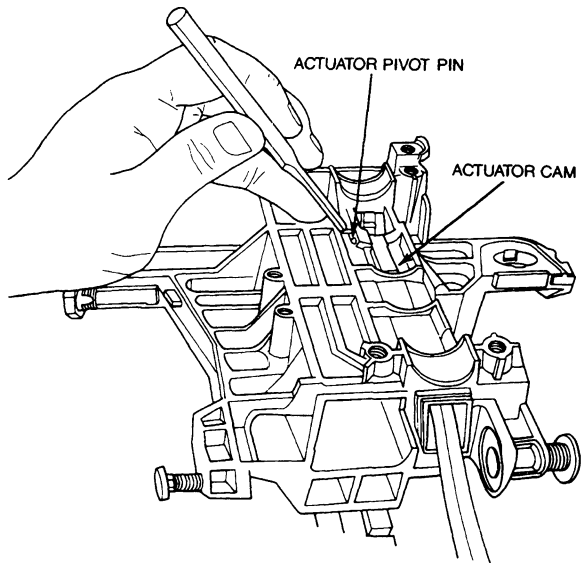
DISASSEMBLY AND ASSEMBLY (Continued)

9. Remove shift control assembly and shift control bracket (column shift only).



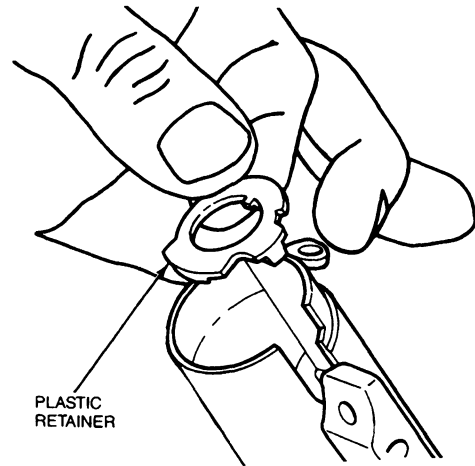
G7746-A

10. Using a drift, tap lock actuator cam pivot pin loose. Remove with diagonal pliers.



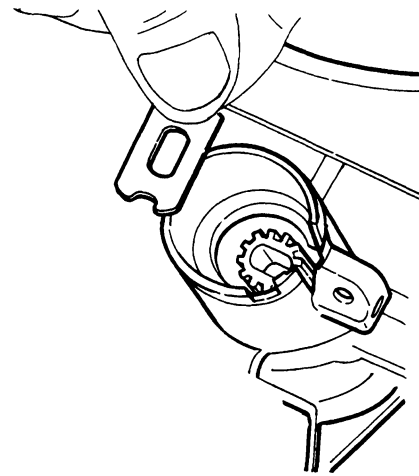
G5561-A

11. Remove plastic bearing retainer from lock cylinder bore.



G5447-A

12. Remove metal bearing from lock cylinder bore.

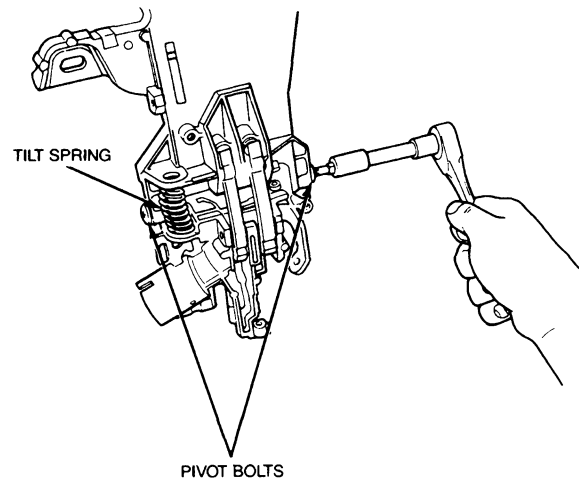


G5448-A

13. Remove ignition lock gear.

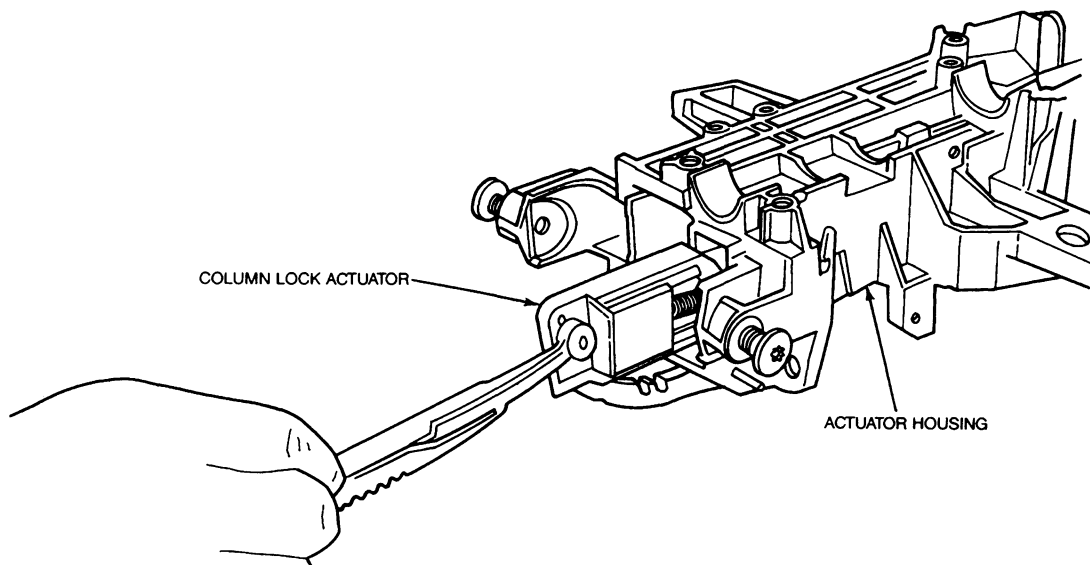
DISASSEMBLY AND ASSEMBLY (Continued)

14. Remove two pivot bolts. Use caution as tilt spring will release when bolts are removed. Remove lock cylinder housing.



G5539-A

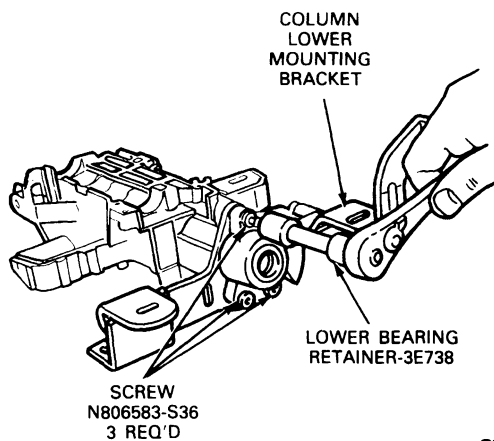
15. Remove steering shaft from column assembly.
16. Remove column lock actuator.

Column Lock Actuator

G5562-A

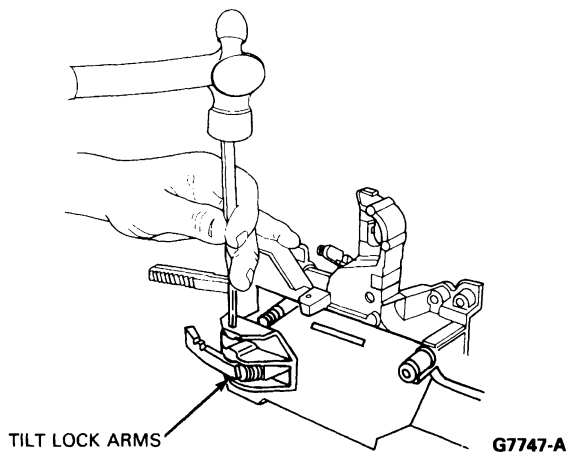
DISASSEMBLY AND ASSEMBLY (Continued)

17. Remove lower bearing retainer and mounting bracket.



G7741-A

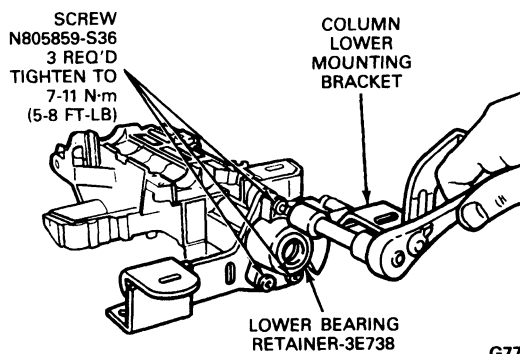
18. Remove tilt position lever arm pivot pin using a drift. Remove lever lock arm and spring.



G7747-A

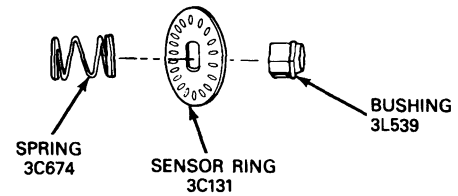
Assembly

1. Install steering shaft into housing.
2. Install lower bearing retainer and column mounting bracket. Tighten screws to 7-11 N-m (5-8 ft-lb).



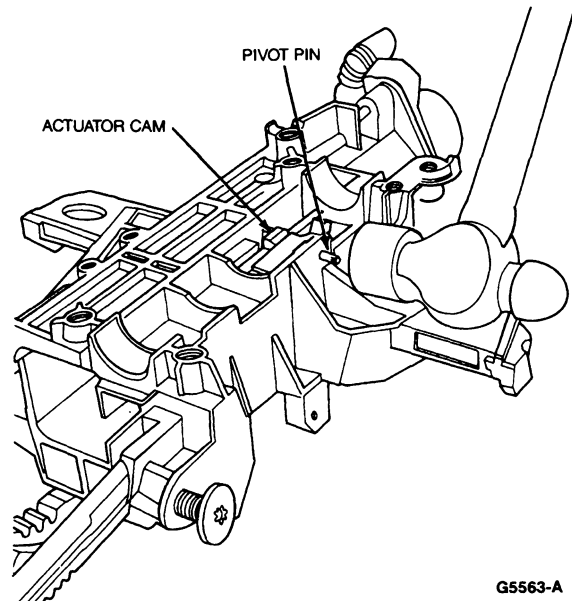
G7744-B

3. Install sensor ring, bushing, spring and flex coupling (if separated from intermediate steering shafts) to steering shaft.



G7748-A

4. Lubricate lock actuator assembly with ESA-M1C232-A grease or equivalent, prior to installation. Position lock actuator assembly in housing.
5. Position actuator cam in lock housing and install cam pivot pin with small hammer. Tap pin in until flush with housing.

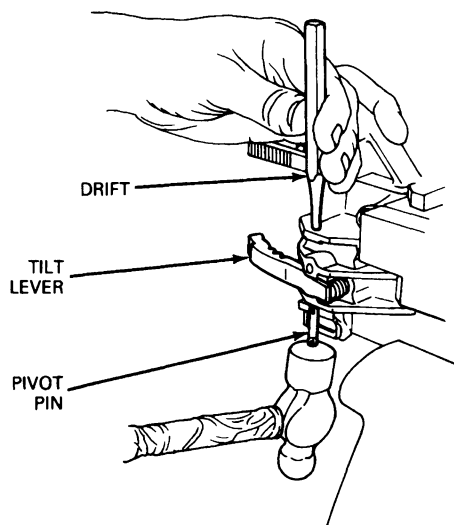


G5563-A

6. Install tilt lever spring and arm into housing using a drift to hold in place.

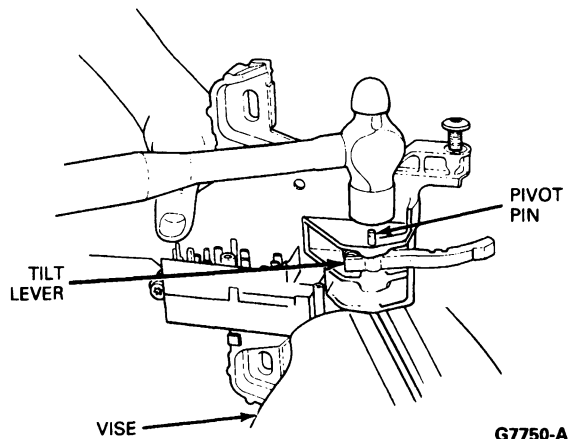
DISASSEMBLY AND ASSEMBLY (Continued)

7. Tap pin into place while driving out drift.



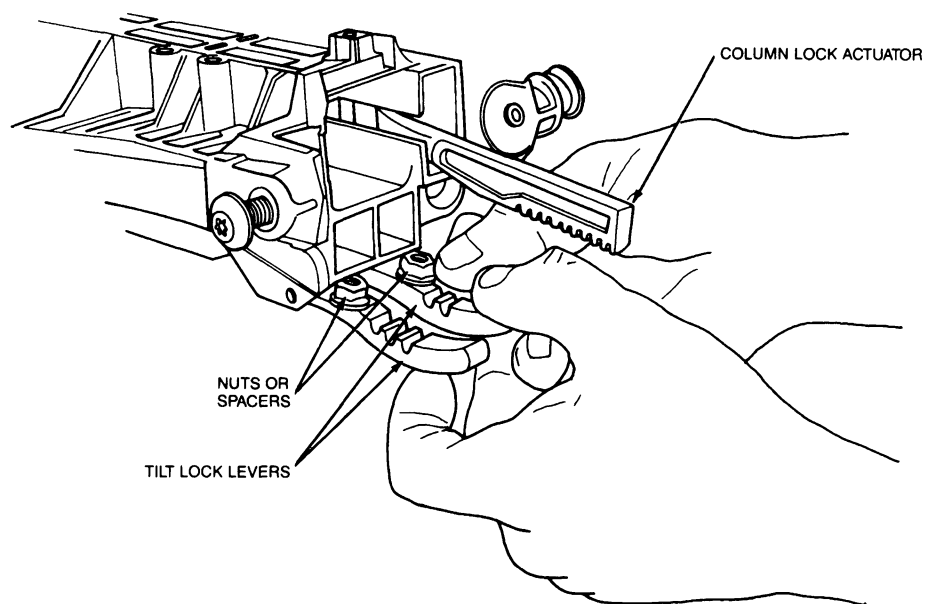
G7749-A

8. Support housing in a vise and drive pin flush with housing.



G7750-A

9. Place two nuts or spacers to hold tilt lock arms away from housing.

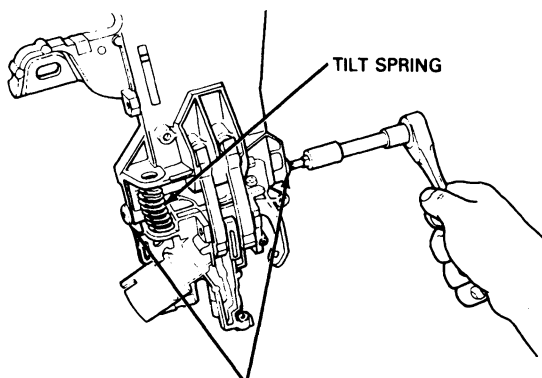
Lock Arm from Housing

G5566-B

DISASSEMBLY AND ASSEMBLY (Continued)

10. Position tilt spring on lock housing. With assistant, install lock housing and pivot bolts. Tighten to 18-26 N·m (14-19 ft-lb).

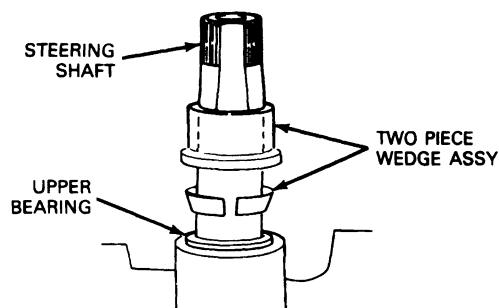
NOTE: Lube pivot bolts with ESA-M1C232-A grease or equivalent before installing.



PIVOT BOLTS
N806582-S36 (2 REQ'D)
TIGHTEN TO 18-26 N·m (14-19 LB-FT)
LUBRICATE SHOULDER WITH
ESA-M1C-232-A GREASE OR
EQUIVALENT

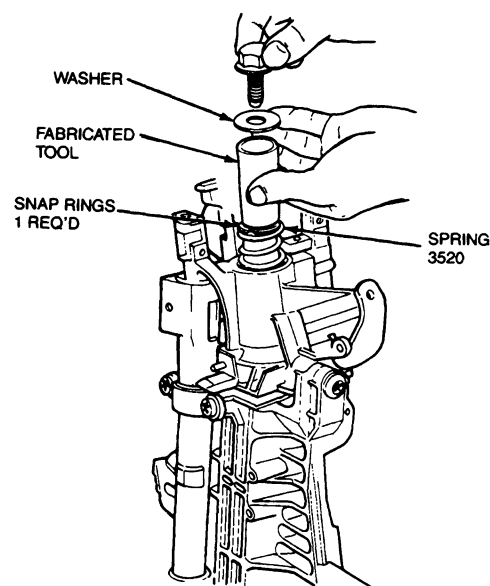
G7876-A

11. Install steel sleeve and ring over steering shaft to upper bearing.



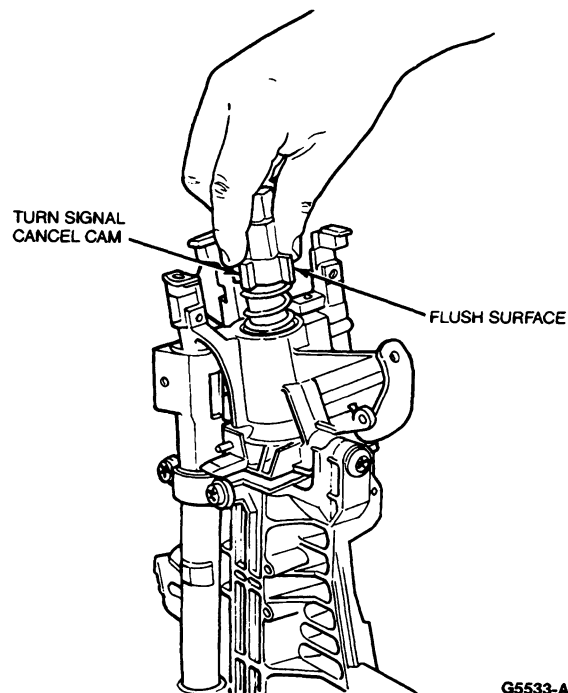
G7877-A

12. Install spring and new snap ring on top side of spring using a 3/4-inch by 2-1/4 inch PVC pipe.



G5567-A

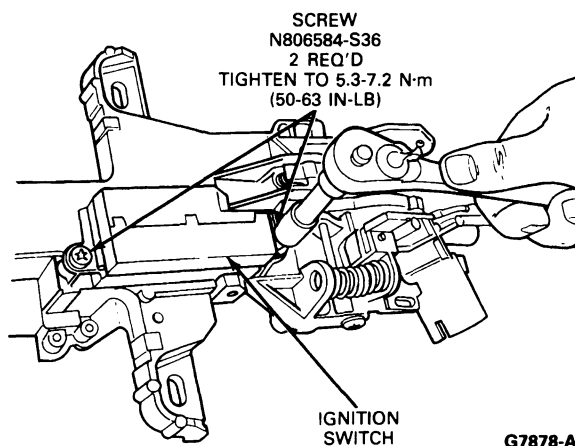
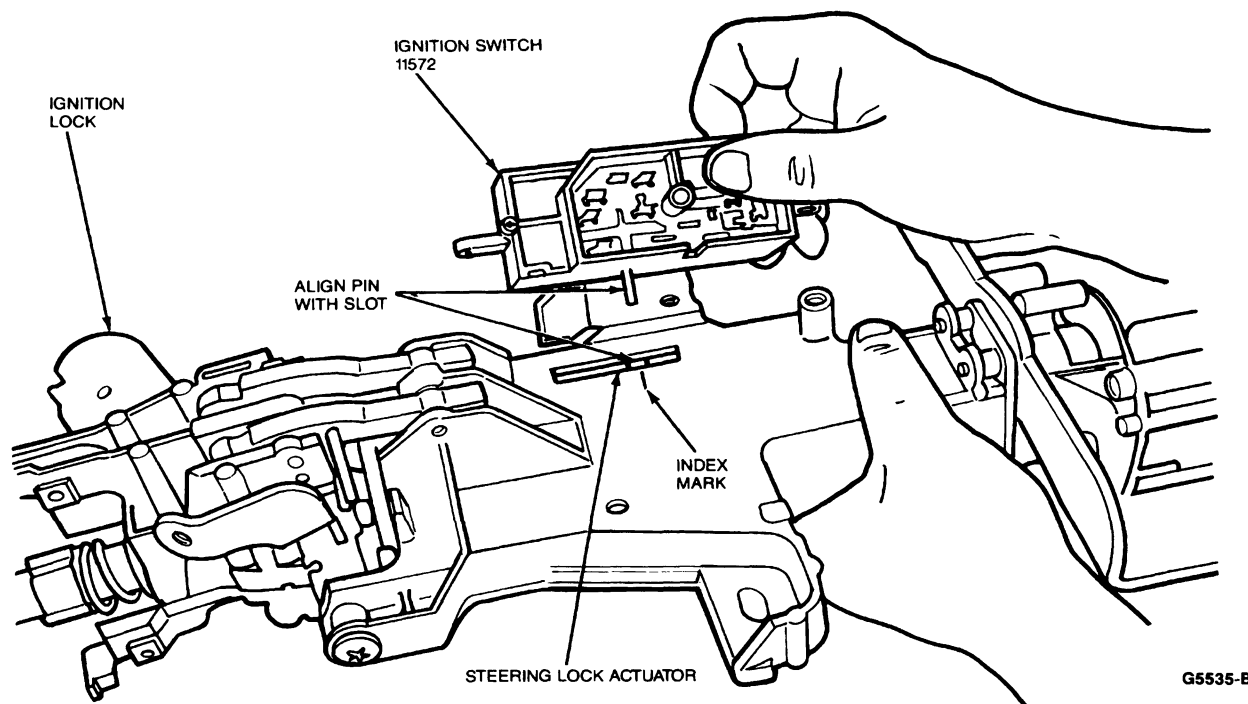
13. Install turn signal cancel cam, flush surface "up".



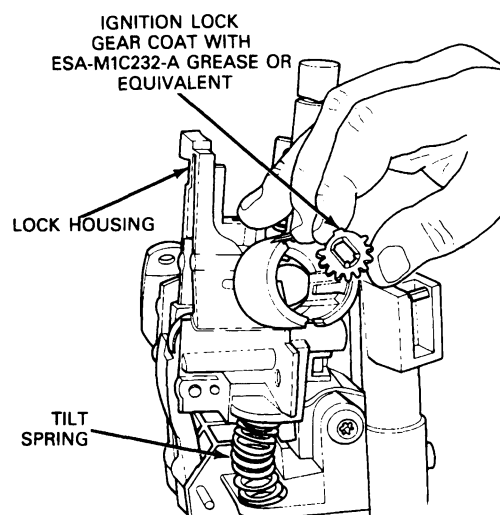
G5533-A

DISASSEMBLY AND ASSEMBLY (Continued)

14. Install ignition switch. Align pin from switch with slot in lock / column assembly. Position slot in lock / column assembly with index mark on casting. Ignition switch should be in RUN position. Tighten two retaining screws to 5-7 N·m (4-6 ft-lb).

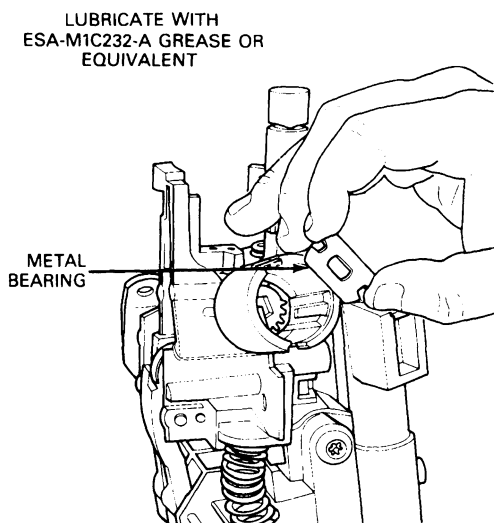


15. Install ignition lock gear. Coat gear with ESA-M1C232-A grease or equivalent.



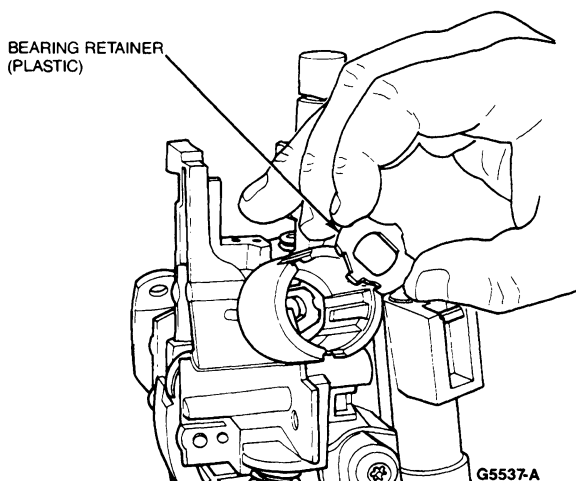
DISASSEMBLY AND ASSEMBLY (Continued)

16. Install metal bearing. Lubricate with ESA-M1C232-A grease or equivalent.

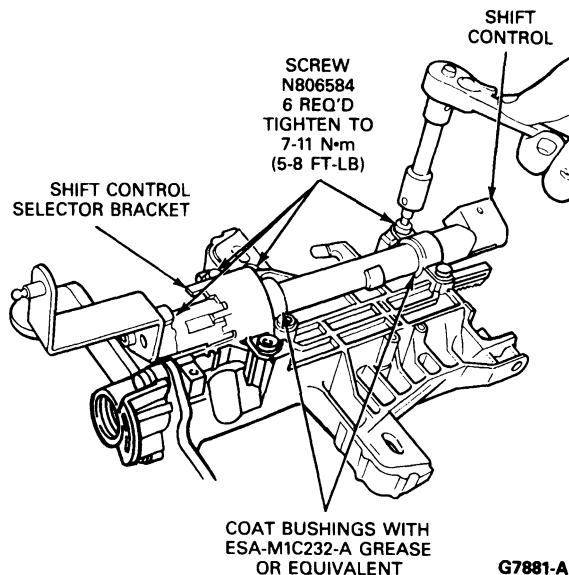


G7880-A

17. Install plastic bearing retainer.



18. Install shift control tube assembly (column shift only). Coat bushings with ESA-M1C232-A grease or equivalent. Tighten screws to 7-11 N·m (5-8 ft-lb).

Column Shift

19. Install shift cable bracket on lower column bearing assembly with two bolts (column shift only).
20. Install column in vehicle as outlined.
21. Install air bag clockspring contact, if so equipped, as outlined.
22. Install steering wheel as outlined.
23. Install air bag module, if so equipped, as outlined.
24. Connect battery ground strap and air bag backup power supply, if so equipped.
25. Verify air bag warning indicator, if so equipped.

ADJUSTMENTS**Steering Column Alignment**

There is no alignment adjustment of the steering column and coupling shaft. Alignment is maintained by the slip-joint coupling shaft attaching the steering column to the steering gear. If misalignment exists, check for indications of damage, such as bent or displaced components. For proper installation follow procedure described in this section.


Automatic Transmission Selector Indicator

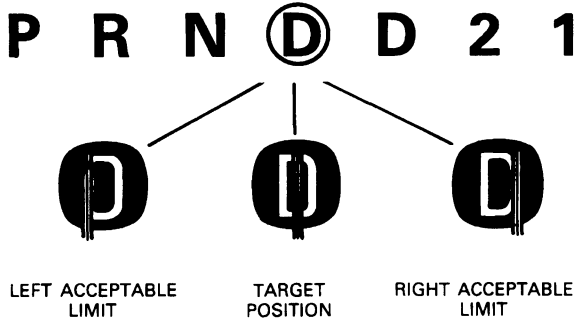
Use the following procedure to adjust the automatic transmission indicator flag:

NOTE: The steering column lower shroud must be removed.

1. Rotate column shift lever clockwise until it bottoms out in first gear.
2. Rotate column shift lever counterclockwise three detents (overdrive position).
3. Hang a three pound weight on the shift lever.

ADJUSTMENTS (Continued)

4. Center pointer in the middle of D if equipped with C6 transmission, or  if equipped with E4OD or AOD transmission, by rotating the thumbwheel.



G7647-A

Ignition Switch Adjustment

Refer to Step 14 under Steering Column in the Disassembly and Assembly portion of this section.


SPECIFICATIONS

Description	N-m	Lb-Ft
Steering Wheel Retaining Bolt	31-44	23-32
Clockspring Contact Assembly Screw (Air Bag Equipped Vehicles Only)	2-3	18-26 (Lb-In)
Steering Column Mounting Nut	20.3-33.9	15-25

(Continued)

Description	N-m	Lb-Ft
Steering Shaft Flex Coupling Bolt	40-56	26-41
Column Lower Mounting Bracket Bolt	7-11	5-8
Lock Housing Pivot Bolt	20-28	14-20
Ignition Switch Screw	7-11	5-8
Shift Control Tube Screw — Column Shift Only	7-11	5-8
Air Bag Module Nuts	4-5.6	36-50 (Lb-In)
Intermediate Shaft to Steering Gear Bolt	19-27	14-20
Intermediate Shaft to Steering Column Bolt	41-57	30-42
Steering Boot Nut	5-7	44-61 (Lb-In)
Lower Column Bearing Bolt	7-11	5-8

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number/ Description	Illustration
T671-3600A Steering Wheel Puller	 T671-3600-A

ROTUNDA EQUIPMENT

Tool Number	Description
105-00008	Air Bag Simulator Tool

SECTION 11-04B Steering Column, Motorhome and Commercial Chassis

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Ignition Switch Adjustment	11-04B-16	Installation	11-04B-12
Steering Column Alignment, F-Super Duty		Key Lock Cylinder Assembly.....	11-04B-13
Motorhome Chassis	11-04B-17	Key Lock Cylinder Components.....	11-04B-10
Switch Adjustments.....	11-04B-16	Shaft Bearing, Intermediate.....	11-04B-11
DESCRIPTION AND OPERATION		Shaft Bearing, Lower.....	11-04B-12
Steering Column, F-Super Duty Chassis	11-04B-1	Shaft Bearing, Upper.....	11-04B-11
DIAGNOSIS AND TESTING	11-04B-1	Steering Column Lower Bearing, F-Super Duty	
DISASSEMBLY AND ASSEMBLY		Motorhome Chassis	11-04B-5
Steering Column F-Super Duty	11-04B-14	Steering Column, F-Super Duty Commercial	
Steering Column Flange and Locking		Chassis Vehicles	11-04B-2
Mechanism Subassembly	11-04B-16	Steering Wheel, F-Super Duty	11-04B-1
REMOVAL AND INSTALLATION		Tilt Lock Lever.....	11-04B-12
Column Lock Actuator and Steering Wheel		Upper Shaft Bearing, Upper Flange and Shift	
Lock Pin.....	11-04B-8	Socket / Flange Extension	11-04B-7
Ignition Lock Cylinder Assembly	11-04B-9	SPECIAL SERVICE TOOLS	11-04B-17
Ignition Lock Drive Gear	11-04B-10	SPECIFICATIONS	11-04B-17
Installation	11-04B-11	VEHICLE APPLICATION	11-04B-1

VEHICLE APPLICATION

F-Super Duty Commercial Chassis and Motorhome Chassis Vehicles

DESCRIPTION AND OPERATION

Steering Column, F-Super Duty Chassis

Two types of columns are used: a manual transmission-type column and an automatic transmission-type column. The shifter unit is built into the automatic transmission column.

Features on the column include an emergency flasher switch and a turn signal indicating switch with lane change position.

DIAGNOSIS AND TESTING

Refer to Section 11-00, for diagnostic and testing procedures.

REMOVAL AND INSTALLATION

Steering Wheel, F-Super Duty

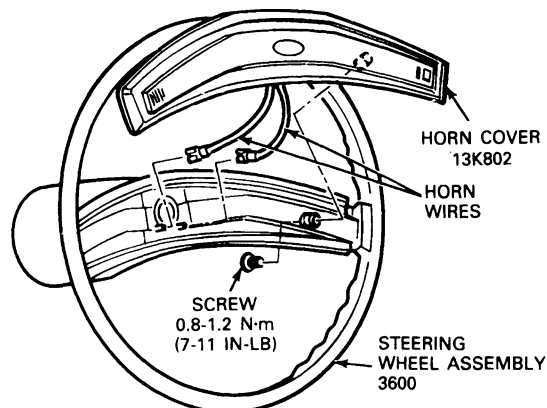
Removal

1. Park the vehicle with the front wheels in the straight-ahead position.

2. Mark the steering wheel in relationship to the steering column with chalk or two pieces of tape.
3. Disconnect the battery ground cable.

REMOVAL AND INSTALLATION (Continued)

4. Remove one screw from the underside of each steering wheel spoke, and lift the horn switch assembly (steering wheel pad) from the steering wheel.



F-SUPER DUTY COMMERCIAL CHASSIS STEERING WHEEL SHOWN — F-SUPER DUTY MOTORHOME CHASSIS SIMILAR

G6540-C

5. Disconnect the horn switch wires by pulling the spade terminal from the blade connectors.
6. Remove the horn switch assembly.
7. Remove steering wheel retaining nut.
8. Use Steering Wheel Puller T67L-3600-A and remove steering wheel from shaft.

CAUTION: Do not hammer on the steering wheel or center shaft or use a knock-off type steering wheel puller as either procedure will damage the steering column.

Installation

Place the steering wheel on the steering column upper shaft, so the mark or flat on the steering wheel is in line with the mark or flat on the steering column center shaft.

1. Install a steering wheel lock nut (389530-S2 or equivalent). Tighten the nut to 40-56 N·m (30-42 ft-lb).

2. Connect the horn wires.
3. Install the steering wheel horn cover pad. Tighten the screws to 0.8-1.2 N·m (7-11 in-lbs).
4. Connect the negative (-) battery cable to the terminal.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

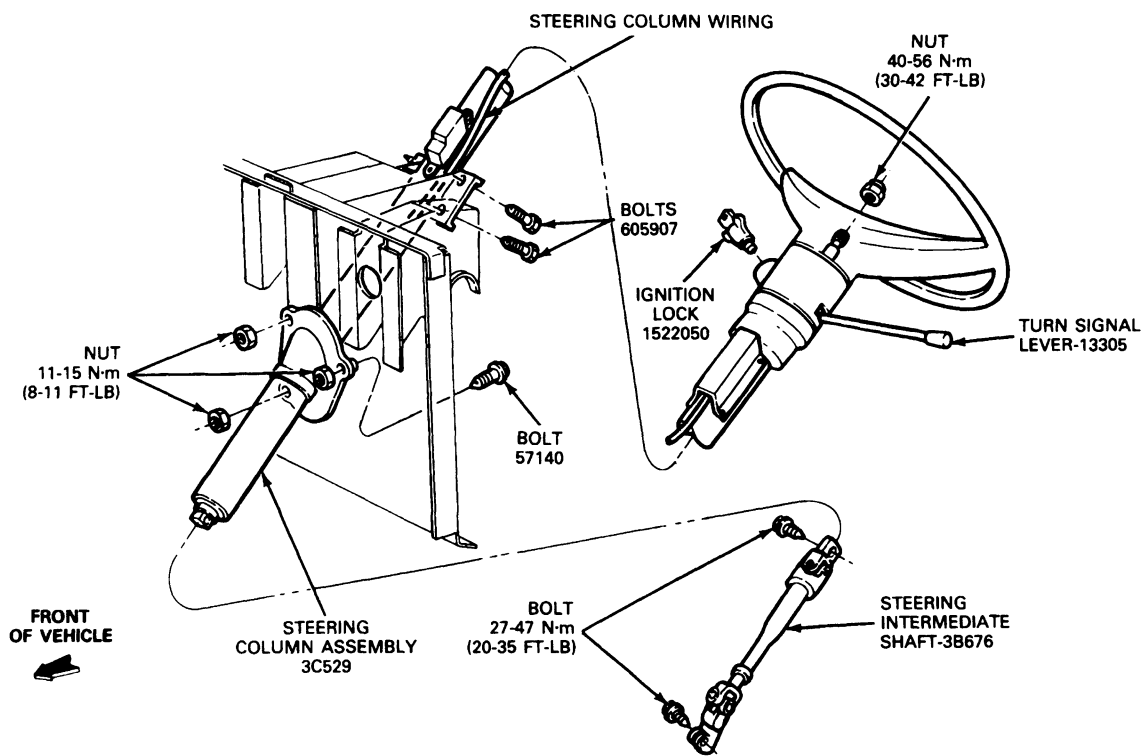
5. Test the steering column for proper operation.

Steering Column, F-Super Duty Commercial Chassis Vehicles**Removal**

1. Park the vehicle with front wheels in a straight-ahead position.
2. Disconnect the battery ground cable.
3. Remove the intermediate shaft-to-steering column shaft clamp bolt or disconnect the steering column from the steering gear by removing the clamp bolt.
4. Disconnect the transmission shift linkage rod from the column (vehicles with automatic transmission only).
5. Remove the steering wheel as described in this section.
6. Disconnect the turn signal, hazard warning, ignition switch and horn wiring harness from the column.
7. Remove the steering column-to-floor pan cover plate retaining bolts.
8. Remove the steering column to steering column support bracket retaining bolts and remove the steering column from the vehicle.

REMOVAL AND INSTALLATION (Continued)

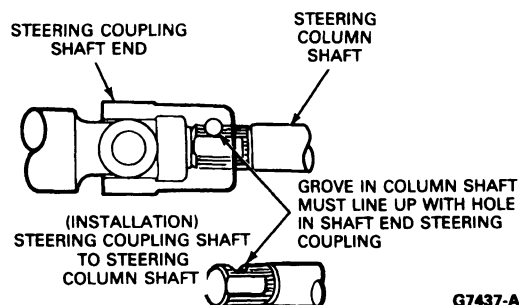
Steering Column Installation, F-Super Duty Commercial Chassis



G6541-D

Installation

1. Place the steering column in the vehicle.
2. Attach the turn signal, hazard warning, ignition switch and horn wiring harness to the column terminal.
3. Install steering column to support bracket.
4. Align two bolts in the shaft groove and tighten to 26-37 N·m (19-27 ft-lb).
5. If so equipped, attach intermediate shaft to column. Align and tighten clamp bolt to 27-47 N·m (20-35 ft-lb) in the shaft groove.



G7437-A

6. If so equipped, connect the steering column flange to the steering gear. Position the flange assembly and install the clamp bolt. Tighten to 27-47 N·m (20-35 ft-lb).
7. Attach lower seal and retainer assembly to dash panel with three bolts and tighten to 11-15 N·m (8-11 ft-lb).
8. Install the steering wheel back in original position. Install and tighten the steering wheel nut to 40-56 N·m (30-42 ft-lb).
9. Connect the horn switch wires, if present.

REMOVAL AND INSTALLATION (Continued)

10. Reinstall the shift linkage rod.
11. Reconnect the battery ground cable and test the steering column for proper operation.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Steering Column, F-Super Duty Motorhome Chassis Vehicles
Removal

1. Set the parking brake.
2. Remove the battery cable from the negative (-) post.
3. Remove the nut and bolt attaching the steering gear coupling shaft assembly to the steering column.
4. For vehicles equipped with automatic transmission, remove the shift linkage from the steering column.
5. Remove the steering wheel as outlined in this section.
6. Disconnect the turn signal / hazard and ignition switch wiring connectors from the steering column.
7. Remove the three bolts attaching the steering column toe plate to the dash panel.
8. Remove the two bolts attaching the upper portion of the steering column to the brake pedal support and shake braces.
9. Remove the steering column from the vehicle.
10. Remove the turn signal lever and the ignition switch key cylinder from the steering column.
11. For vehicles equipped with automatic transmission, remove the shift lever.

Installation

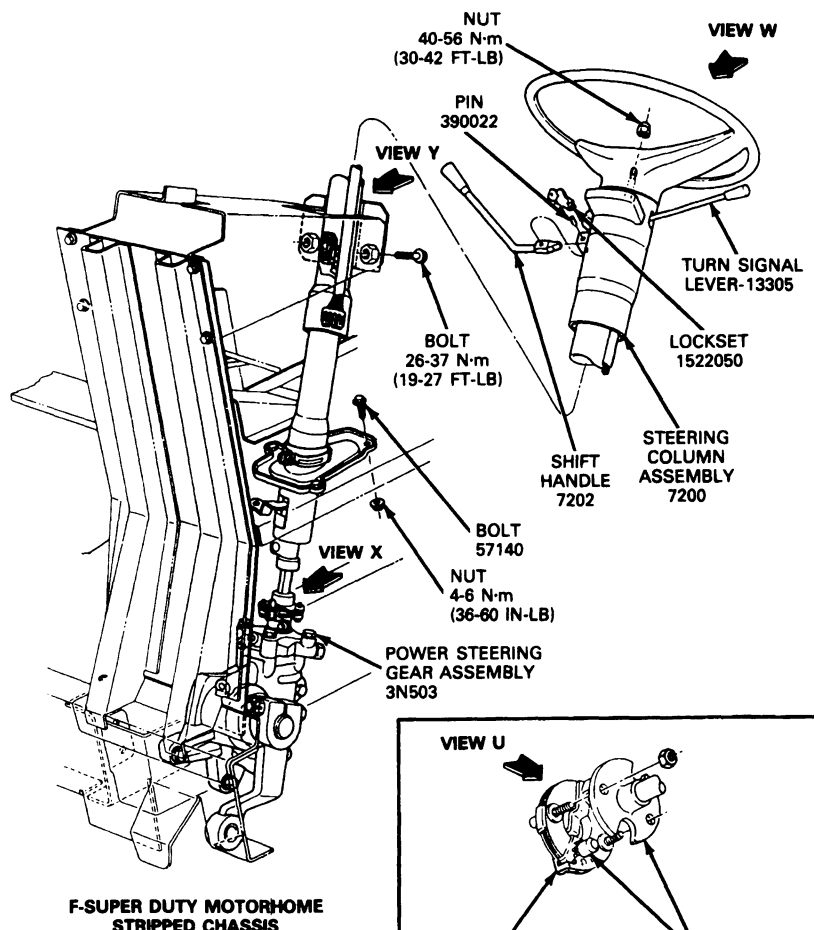
1. Install the turn signal lever (13305), ignition switch key cylinder (11A606).

2. Vehicles equipped with automatic transmission, install the shift lever (7202) into the steering column.
3. Position the steering column into the vehicle and loosely attach the top two attaching bolts (57142) connecting the upper portion of the steering column to the brake pedal support (2467) and shake braces (3678).
4. Attach steering gear coupling shaft assembly (3B676) to the end of the steering column.
5. Loosely attach three bolts (57140) through the steering column toe plate and into the dash panel.
6. Install the nut (34988) and bolt (387081) through the steering gear coupling shaft assembly (3B676) and tighten to 27-47 N·m (20-35 ft-lb).
7. Position steering column so coupling attached to the input shaft of the steering gear is flat and does not flex when the steering wheel is rotated through 360 degrees.
8. Tighten the two bolts (57142) attaching the upper portion of the steering column to the brake pedal support to 26-37 N·m (19-27 ft-lb).
9. Tighten the three bolts (57140) attaching the steering column toe plate to the dash panel to 4-6 N·m (36-60 in-lb).
10. Tighten the bolt attaching the steering column toe plate to the steering column to 25-34 N·m (18-25 ft-lb).
11. Install the steering wheel and horn pad as outlined in this section.
12. Connect the turn signal / hazard switch and ignition switch connectors to the steering column.
13. Connect the negative (-) cable to the battery post and release the parking brake.

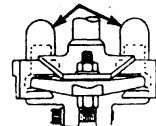
NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

REMOVAL AND INSTALLATION (Continued)

F-Super Duty Motorhome Chassis

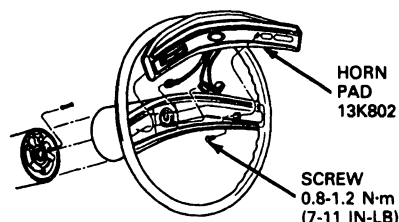


TO BE REMOVED AFTER COLUMN INSTALLATION IS COMPLETED AT THE ASSEMBLY PLANT

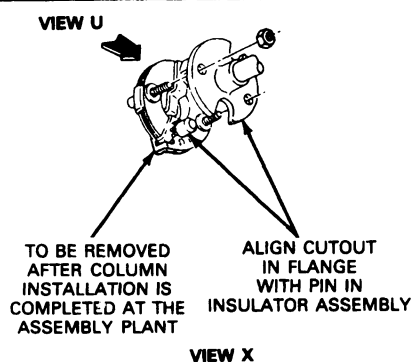


NOTE: AFTER FINAL ASSEMBLY AND REMOVAL OF SPACERS, FLEX COUPLING MUST BE FLAT TO .100 CONCAVE UPWARD IN FINAL POSITION

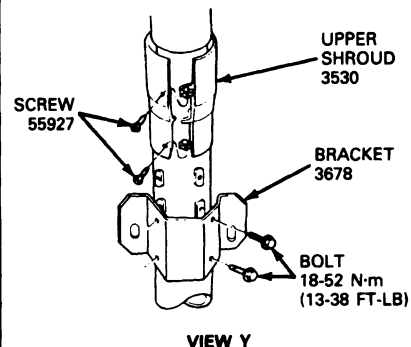
VIEW U



**FOR ALL MODELS WITH SPEED CONTROL OPTION ONLY
VIEW W**



VIEW X



VIEW Y

G6751-D

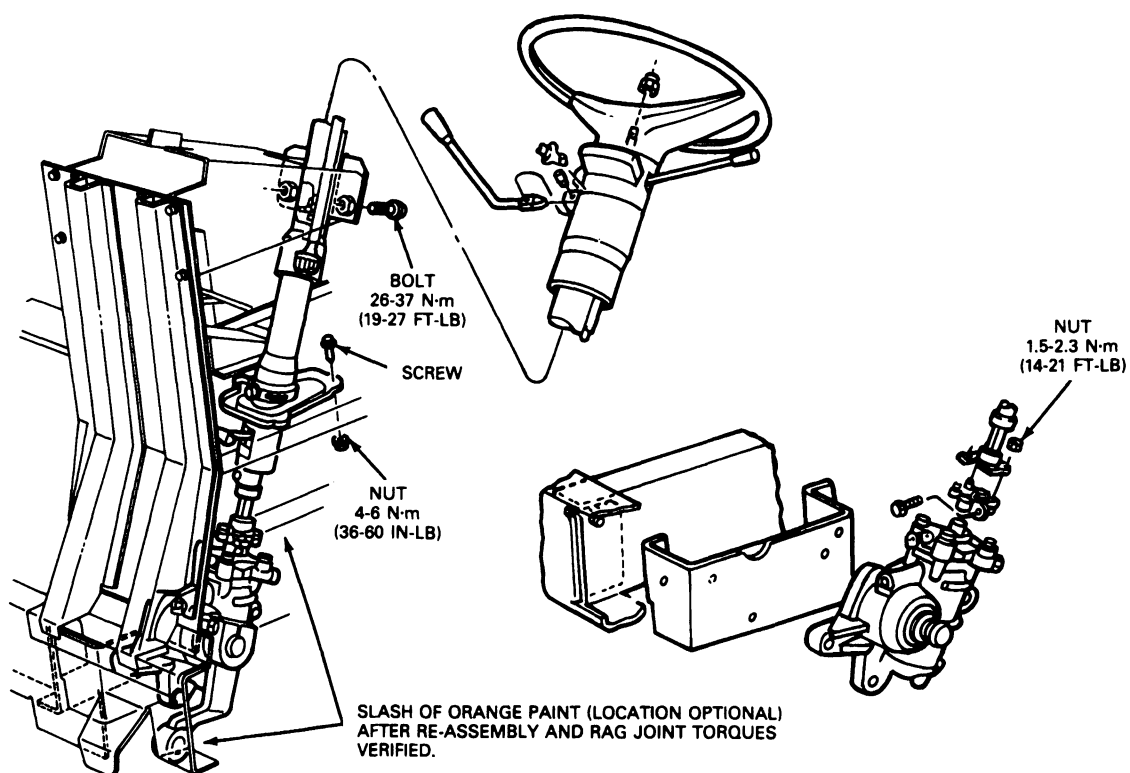
Steering Column Lower Bearing, F-Super Duty Motorhome Chassis

Removal

NOTE: If the steering column lower bearing has not been removed or a new steering column is being installed, then the lower bearing must be removed and **not** replaced.

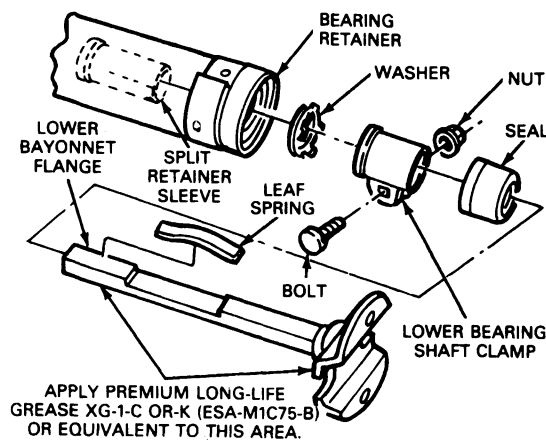
1. Remove the fasteners attaching the lower bayonet flange to the flange and insulator assembly (rag joint).
2. Remove the fasteners attaching the steering column to the steering column support.
3. Loosen the fasteners attaching the lower column seal to the floor pan.

4. Loosen the band-type clamp which secures the lower column seal to the column.
5. Gently lift the column off the rag joint and tilt upper end toward center of vehicle.
6. Loosen the lower shaft clamp.
7. Remove the following items from the column assembly:
 - a. Lower bayonet flange.
 - b. Leaf spring.
 - c. Lower shaft clamp and rubber stop.
 - d. Washer.
8. Remove the washer and bearing from the bearing retainer.

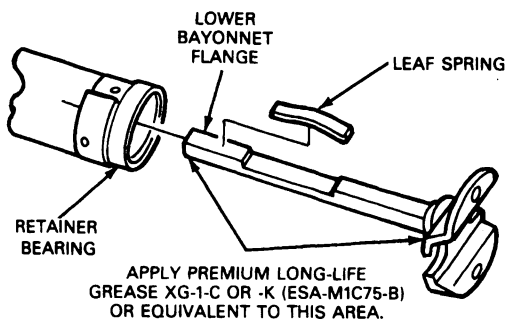
REMOVAL AND INSTALLATION (Continued)**Steering Column Lower Bearing**

G7439-B

REMOVAL AND INSTALLATION (Continued)



INSTALLATION BEFORE BEARING REMOVAL



INSTALLATION AFTER BEARING REMOVAL G7440-B

Installation

1. Position the leaf spring into the slot in the lower bayonet and slide it into the column shaft. Use a mallet to gently guide the bayonet into the shaft.
NOTE: The shaft should not retract into the column (shaft has a collapsing feature for crash protection).
2. Install column assembly into original position. Tighten the rag joint fasteners to 19-28 N·m (14-21 ft·lb).
3. Install the fasteners attaching the steering column to the steering column support and tighten to 26-36 N·m (19-27 ft·lb).
4. Position the lower end of the steering column tube so the inner shaft is centered within the tube.
5. Install lower seal fasteners finger-tight.
6. Tighten the lower seal band-type fastener to 7-9 N·m (5-7 ft·lb).
7. Verify the rag joint fastener tightening specifications and apply a slash of orange paint for identification purposes.

Upper Shaft Bearing, Upper Flange and Shift Socket/Flange Extension

These components can be serviced without removing the column from the vehicle.

Removal

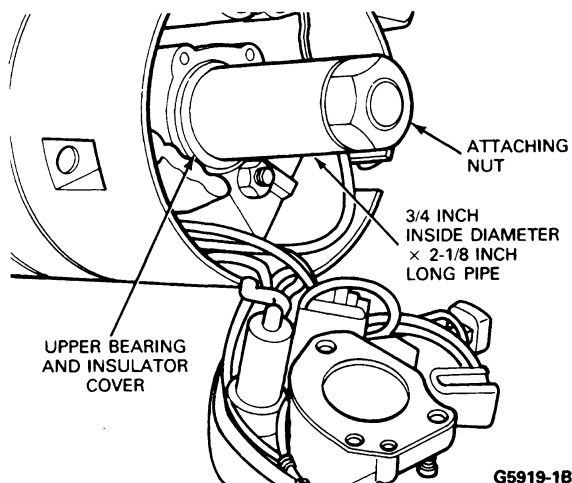
1. Set the parking brake.
2. Disconnect the battery cable from the negative terminal.
3. Remove the steering column shroud and instrument panel opening cover.
4. Disconnect the turn signal / hazard warning and ignition switch electrical connections.
5. Place the ignition switch in the LOCK position and remove the switch.
6. Remove the steering wheel as described in this section.
7. If the shift socket is to be removed, drive out the pivot pin and remove the lever.
8. Remove the turn signal lever.
9. Remove the automatic transmission hood and lens, if so equipped.
10. Remove the screws from the turn signal / hazard warning switch and slip the switch off the steering shaft.
11. Remove the snap ring from above the upper shaft bearing.
12. Loosen the nuts retaining the upper flange casting to the column until one or two threads on each remain engaged, pinching the nuts toward each other, withdraw the upper flange from the steering column. Some tapping on the steering shaft upper end with a light hammer may be required.
13. Remove the upper shaft bearing and insulator cover by driving out from the opposite side of the flange.
14. Remove the shift tube retaining screw at the bottom of the shift socket and withdraw the shift socket.
15. Remove the three flange extension retaining screws and remove the extension.

Installation

1. Install the shift socket / flange extension.
2. Place the flange on the steering column tube and tighten nuts to 6.8-8.5 N·m (60-75 in·lb).
3. Pick-punch the steering shaft serration diameter to obtain an interference fit to the inner face.
4. Place the bearing and insulator on the shaft, working them as far down the shaft as possible.
5. Place a piece of pipe 19.05mm (3/4 inch) inside diameter x 53.97mm (2-1/8 inch) long over the end of the shaft.
6. Install the steering wheel attaching nut. Tighten the nut until the bearing is seated in the flange.

REMOVAL AND INSTALLATION (Continued)

7. Remove the nut and pipe from the steering shaft.

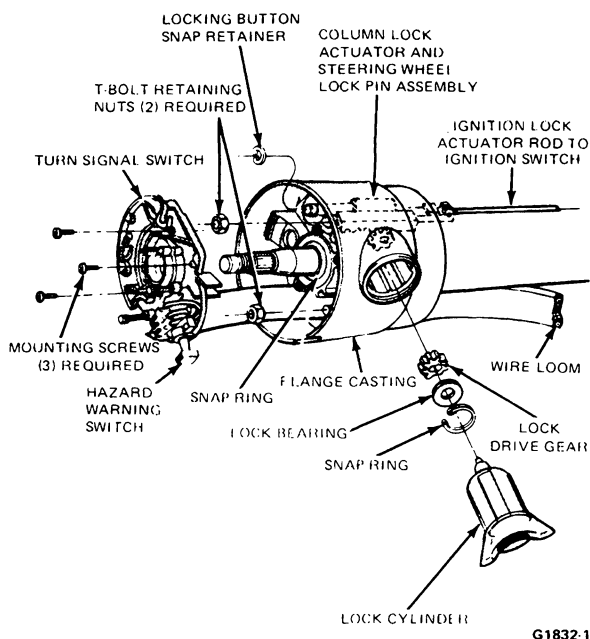


8. Install the snap ring in the groove on the steering shaft.
 9. Install the turn signal switch on the flange. Tighten the screws to 2.5-3.0 N·m (22-26 in-lbs).
 10. Install the automatic transmission hood and lens, if so equipped.
 11. Install the turn indicator lever.
 12. If the shift socket was removed, install the lever and pivot pin.
 13. Install the steering wheel as described in this section.
 14. Install the ignition switch.
 15. Connect the turn signal hazard warning and ignition switch electrical connections.
 16. Install the steering column shroud and instrument panel opening cover.
 17. Connect the negative battery cable to the terminal.
- NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
18. Test the steering column for proper operation.

Column Lock Actuator and Steering Wheel Lock Pin**Removal**

1. Remove the steering column shroud.
2. Remove the ignition lock drive gear as described in this section.
3. Loosen the ignition switch attaching nuts and remove the ignition rod from the switch end.

4. Remove the upper shaft bearing as described in this section.
5. Remove the ignition lock actuator rod and steering wheel lock pin assembly.
6. Remove and discard the retaining clip at the lower end of the steering wheel lock pin.
7. Remove the steering wheel lock pin and lock pin spring from ignition switch actuator. Do not lose the spring.

**Installation**

1. Install a new lock pin and clip, and the old-lock pin spring in the actuator casting.
2. Clean the grease from the column lock actuator and upper flange using parts cleaner (E6AZ-19579-BA) or equivalent. Apply silicone lubricant (COAZ-19553-AA) or equivalent to the lock actuator and upper flange where the actuator slides.
3. Place the column lock actuator and steering wheel lock pin in the steering column.
4. Engage actuator rod into ignition switch retaining nuts.
5. Install the lock drive gear, lock bearing and snap ring.
6. Install the lock cylinder with the key in the ON position. Install with the retaining pin flush with cylinder. Turn key to the OFF position.
7. Install the upper shaft bearing as outlined in this section.
8. Adjust the ignition switch as outlined in this section.
9. Install the steering column shroud.

REMOVAL AND INSTALLATION (Continued)**Ignition Lock Cylinder Assembly**

NOTE: The following procedure pertains to vehicles that have functional lock cylinders and ignition keys are available or the ignition key numbers are known and the proper key can be made.

Removal

1. Disconnect the battery ground cable.
2. Remove the horn button and the steering wheel as outlined earlier in this section.
3. Place the gear shift in neutral with automatic transmission or in any position with manual transmission.
4. Turn the lock cylinder with the ignition key to ON position.
5. Place 1/8-inch diameter wire pin or small drift punch in the hole located inside the column near the base of the lock cylinder housing.
6. Depress the retaining pin while pulling out on the lock cylinder to remove it from the column housing.

Installation

1. To install the lock cylinder, turn the lock cylinder to the ON position.
2. Depress the retaining pin, insert the lock cylinder into housing in the flange casting. Cylinder should be fully sealed and aligned into the interlocking washer before turning the key to the OFF position allowing cylinder retaining pin to extend into the cylinder cast housing hole.
3. Using the ignition key, rotate the lock cylinder to obtain correct mechanical operation in all positions.
4. Install the steering wheel and trim pads as outlined earlier in this section.
5. Connect the battery ground cable.
6. On vehicles equipped with automatic transmission, check for proper start in neutral.

NOTE: Check that the start circuit cannot be actuated in the drive and reverse positions and the engine will shut off in either drive, reverse or neutral. If the engine will not shut off the switch is not adjusted properly. Switch as described in Section 11-05.

Removal

NOTE: The following procedure applies to vehicles where the ignition lock is inoperative and the lock cylinder cannot be rotated due to a lost or broken ignition key and the key number not known or the lock cylinder cap is damaged and/or broken to the extent that the lock cylinder cannot be rotated.

1. Disconnect the battery ground cable.
2. Remove the horn button and steering wheel as outlined earlier in this section.
3. Remove the turn signal lever from the steering column.
4. Remove the steering column trim shrouds from the steering column.

5. Detach and lower the steering column assembly from the brake pedal support bracket as outlined earlier in this section.
6. Remove the ignition switch and pin it in the LOCK position.
7. Remove the turn signal switch from the column assembly as described in the Upper Shaft Bearing, Upper Flange and Shift Socket / Flange Extension in the Removal and Installation portion of this section.
8. Remove the upper bearing snap ring.
9. Remove two T-bolt retaining nuts that secure the flange casting to the outer tube.
10. Remove the entire flange casting assembly, upper shaft bearing, lock cylinder assembly, ignition switch actuator and ignition switch actuator rod by pulling the assembly over the end of the steering column shaft.

Installation

1. Replace the above assembly with a new assembly consisting of:
 - (1) 3511 Flange
 - (1) 11582 Lock Cylinder Assembly
 - (1) 3E717 Lock Gear, Steering Column Lock
 - (1) 3E700 Bearing, Steering Column Lock
 - (1) 3C610 Retainer, Steering Column Upper Bearing
 - (1) 3E723 Actuator Assembly, Steering Column Lock

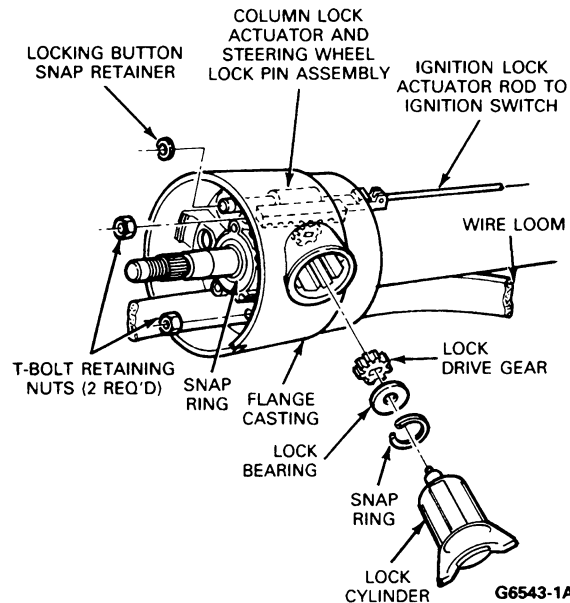
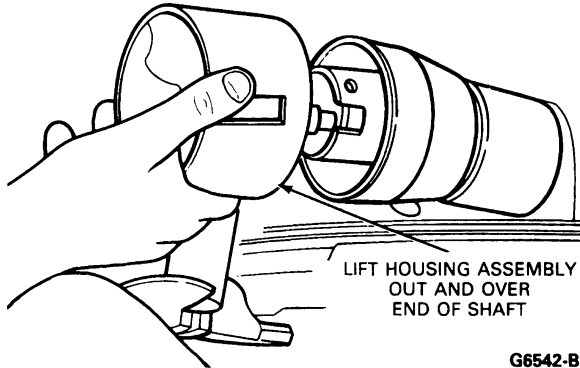
NOTE: Retain the ignition switch actuating rod from the removed casting assembly and use it with the new flange casting assembly.

2. Reassemble the above parts, installing a new upper shaft bearing(3517).
3. Set the actuator to drive gear as described earlier in this section.
4. Install the turn signal switch as outlined earlier in this section.
5. Install the ignition switch, check and/or adjust for proper function as specified in this section.
6. Install the steering column trim shrouds, steering wheel and pad assembly as specified earlier in this section.
7. Install the turn signal lever.
8. Using the ignition key, rotate the lock cylinder to obtain correct mechanical operation in all positions.
9. Install the horn button and steering wheel as outlined earlier in this section.
10. Connect the battery ground cable.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

REMOVAL AND INSTALLATION (Continued)

NOTE: Check for proper start in neutral. Also check to make certain that the start circuit cannot be actuated in the drive and reverse positions and engine will shut-off in either drive, reverse or neutral. If the engine will not shut off in the above positions, the switch is not adjusted properly. Readjust switch as described in Section 11-05.

**Ignition Lock Drive Gear****Removal**

1. Remove the lock cylinder assembly as outlined in this section.
2. Insert a flat bladed screwdriver in the recess of the drive gear at the bottom of the lock cylinder housing.
3. Turn the lock drive gear counterclockwise three notches.
4. Remove the snap ring, washer and lock drive gear from the lock cylinder housing. Note the position of the drive gear to the rack teeth.

Installation

1. Install the lock drive gear in the housing in the same position as noted during removal. Installation is correct if the last tooth on the drive gear is meshed with the last tooth on the rack.
2. Install the washer and snap ring.
3. Using the screwdriver blade, turn the drive gear clockwise three notches.
4. Install the lock cylinder assembly as outlined in this section.

Key Lock Cylinder Components**Removal**

1. Disconnect battery ground cable.
2. Rotate ignition lock cylinder to RUN position. Using a 1/8-inch drift, depress lock cylinder retaining pin through access hole in lower steering column shroud, and remove lock cylinder.
3. Remove blue plastic bearing retainer by inserting a screwdriver or similar tool, with a 90 degree bend on the tip, between bearing retainer and bearing and by prying upward.
NOTE: Carefully note the position of the bearing retainer prior to removal.
4. Insert tip of a screwdriver into Double-D slot of bearing, then rotate 90 degrees. Remove bearing.
5. Remove lock drive gear. Carefully note relationship of lock drive to position of rack teeth.

Installation

1. Position lock drive gear in base of lock cylinder housing. The position of lock drive gear is correct if last tooth on drive gear is meshed with last tooth on rack.
2. Position bearing retainer in lock cylinder housing. Insert tip of a screwdriver into Double-D slot of bearing, then rotate 90 degrees.
3. Press blue plastic bearing retainer into lock cylinder housing. Make sure retainer is in its original position.
4. Line up flats of drive gear with flats of washer by pulling down on the column lock actuator.
5. Install lock cylinder assembly.
6. Connect battery ground cable.

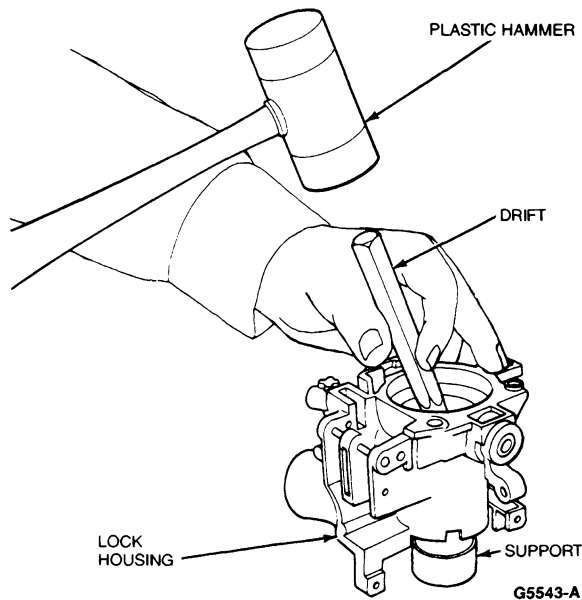
REMOVAL AND INSTALLATION (Continued)

7. Check for proper start in PARK and NEUTRAL. Also, check to make sure start circuit cannot be actuated in DRIVE or REVERSE positions and the column is locked in LOCK position.

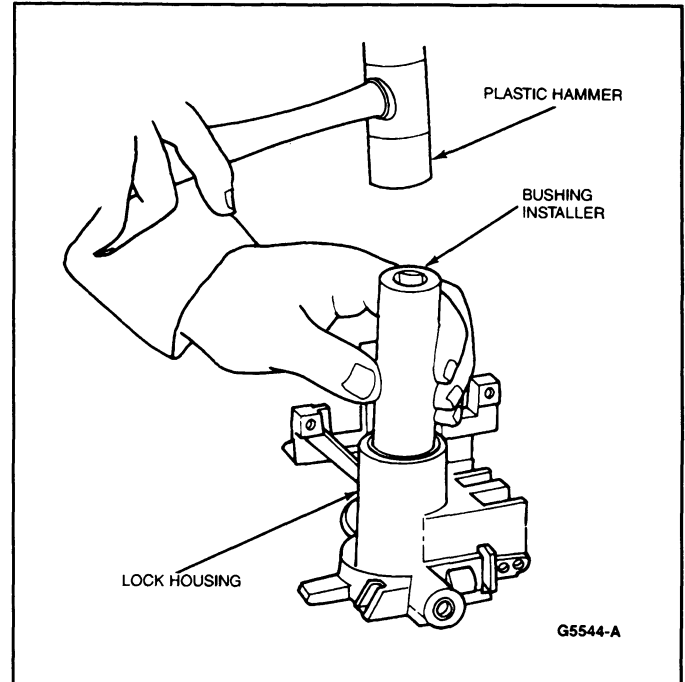
NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to learn the strategy.

Shaft Bearing, Upper**Column Removed****Removal**

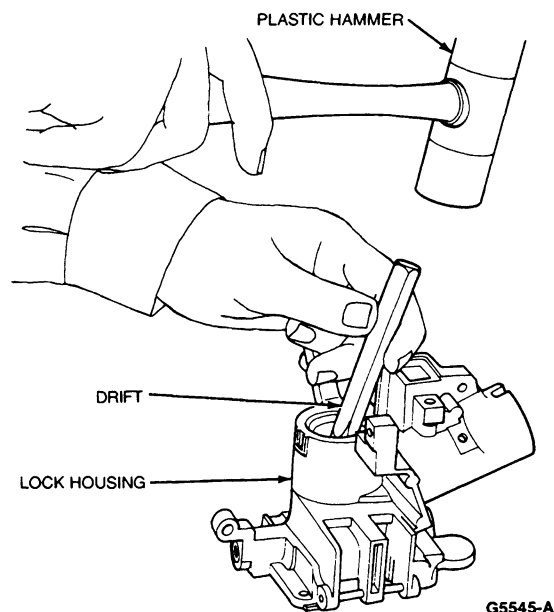
1. Remove lock housing from steering column assembly as outlined under Disassembly and Assembly.
2. Suitably support housing and tap out small bearing with an appropriate drift and a plastic hammer.

**Installation**

1. Suitably support housing. Position small bearing so the opening between races is "up." Tap into place with a plastic hammer and a bushing driver installer or socket the same size as outer race of bearing.
2. Install housing on steering column as outlined.

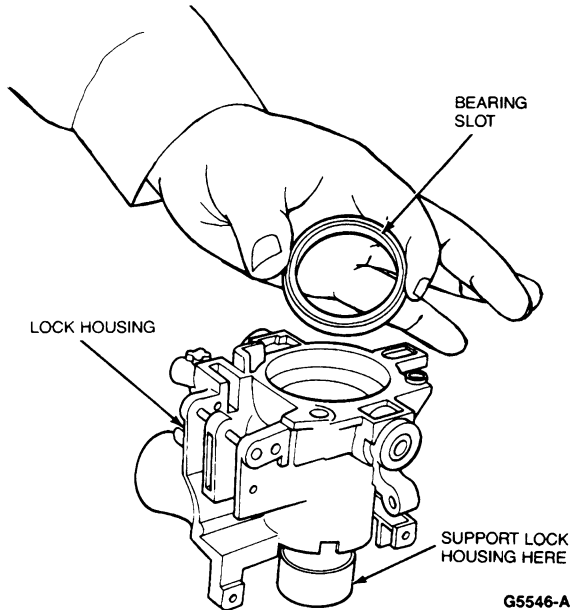
**Shaft Bearing, Intermediate****Column Removed****Removal**

1. Remove lock housing as outlined in this section.
2. Set housing flat on workbench and tap large bearing loose with suitable drift and a plastic hammer.

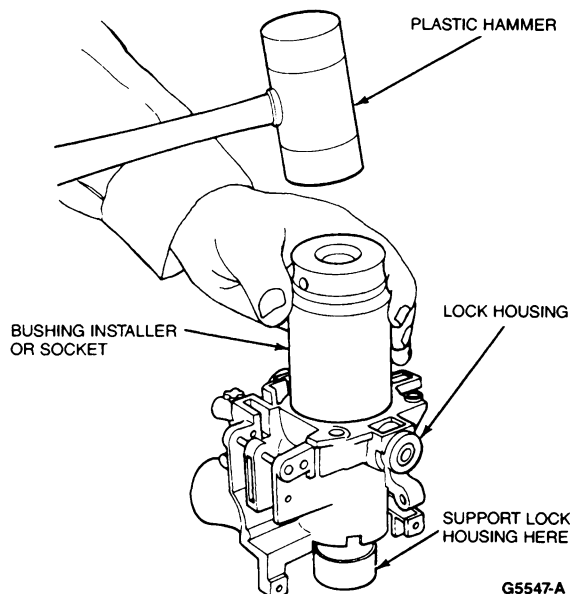


REMOVAL AND INSTALLATION (Continued)**Installation**

1. Support lock housing on workbench.
2. Position bearing that the opening between race will face up, or out from housing, when installed.



3. Using a socket or bushing driver the same size as outer race of bearing, tap bearing into housing with a plastic hammer until fully seated.

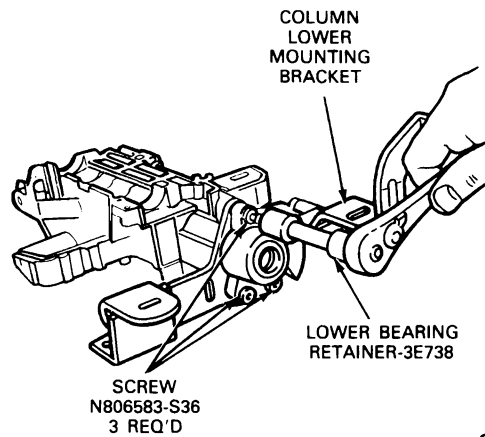
**Tilt Lock Lever****Removal and Installation**

1. To remove tilt lock lever, rotate lever counterclockwise.

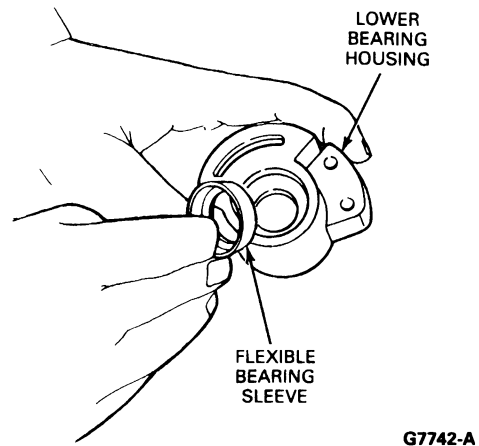
2. To install, position lever and rotate clockwise until tight.

Shaft Bearing, Lower**Column Removed****Removal**

1. Remove lower steering shaft and housing assembly as outlined.
2. Suitably support housing and tap out bearing with a hammer and a drift.

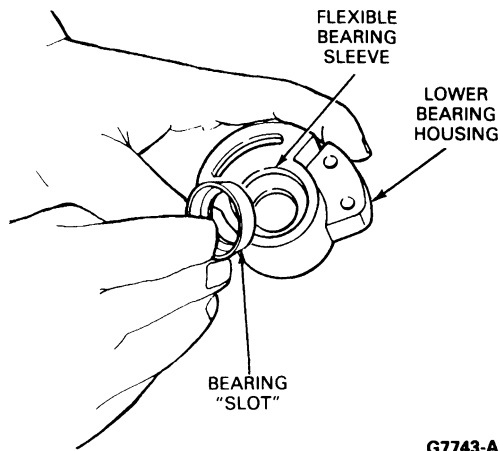
**Installation**

1. Inspect flexible bearing sleeve. Replace if damaged.



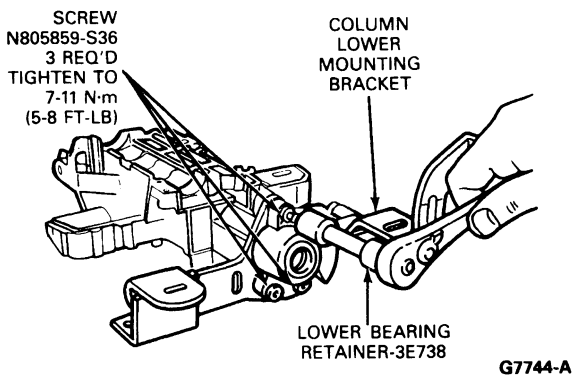
REMOVAL AND INSTALLATION (Continued)

2. Position bearing sleeve in housing.



G7743-A

3. Press in the new bearing with thumb pressure until seated. Slot between inner and outer races should face down when installed in the vehicle.
4. Install bearing housing on steering column as outlined.



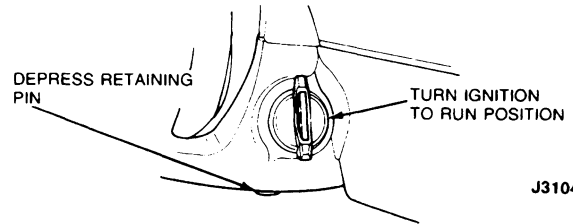
G7744-A

Key Lock Cylinder Assembly

NOTE: The following procedure applies to vehicles that have functional lock cylinder. Lock cylinder keys are available for these vehicles, or the lock cylinder key numbers are known and the proper key can be made.

Removal

1. Disconnect battery ground cable.
2. Turn lock cylinder key to RUN position.
3. Place a 3.17mm (1/8-inch) diameter wire pin or small drift punch in hole in trim shroud under lock cylinder. Depress retaining pin with pulling out on lock cylinder to remove it from column housing.



J3104-A

Installation

1. Install lock cylinder by turning to RUN position and depressing retaining pin. Insert lock cylinder into lock cylinder housing. Fully seat and align cylinder in interlocking washer before turning key to OFF position. This extends the cylinder retaining pin into cylinder housing hole.
2. Rotate lock cylinder, using cylinder key, to make sure correct mechanical operation in all positions.
3. Connect battery ground cable.

NOTE: The following procedure applies to vehicles in which the ignition lock is inoperative and the lock cylinder cannot be rotated due to a lost or broken lock cylinder key, unknown key number, or a lock cylinder cap that has been damaged and/or broken to the extent that the lock cylinder cannot be rotated.

Removal

1. Disconnect battery ground cable.
2. Remove steering wheel as outlined.
3. Using channel lock pliers or vise grip pliers, twist lock cylinder cap until it separates from the lock cylinder.
4. Using a 3/8-inch diameter drill, drill down middle of ignition lock key slot approximately 44mm (1-3/4 inch) until lock cylinder breaks loose from breakaway base of lock cylinder.
5. Remove lock cylinder and drill shaving from lock cylinder housing.
6. Remove retainer, washer, ignition switch and actuator.
7. Thoroughly clean all drill shavings and other foreign materials from casting.
8. Carefully inspect lock cylinder housing for damage from the above operation. If damaged, housing must be replaced.

Installation

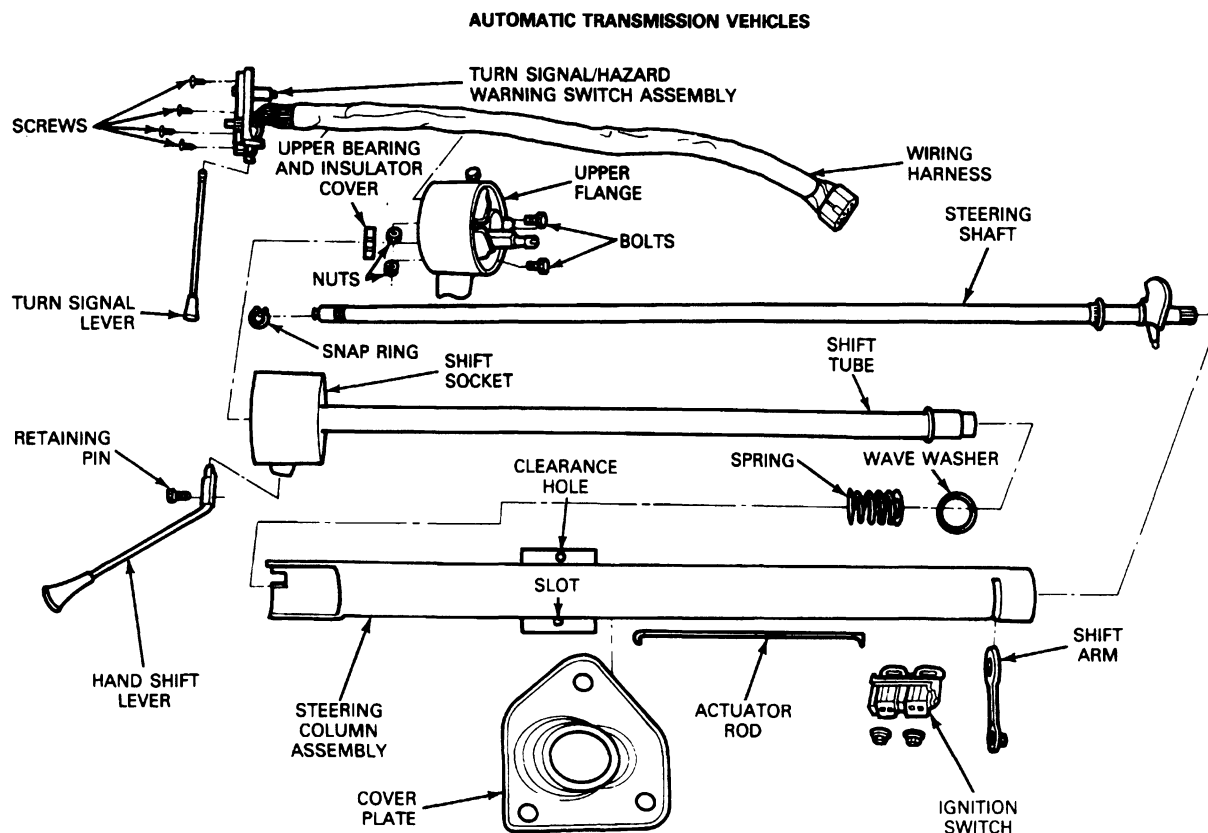
1. Replace lock cylinder housing, if damaged.
2. Install actuator and ignition switch as outlined.
3. Install trim and electrical parts.
4. Install new ignition lock cylinder as outlined.
5. Install steering wheel as outlined.
6. Check lock cylinder operation.

DISASSEMBLY AND ASSEMBLY

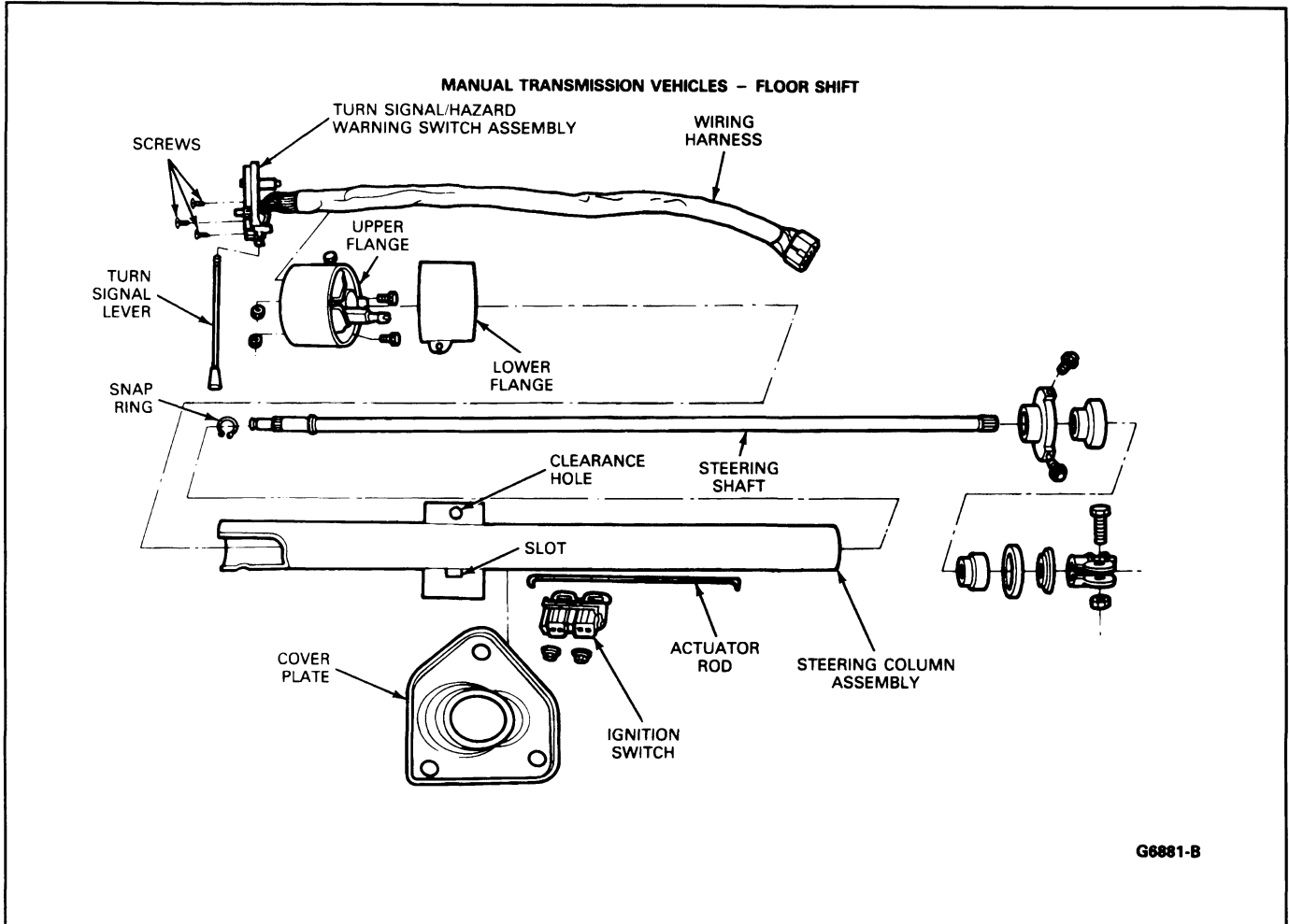
Steering Column F-Super Duty

Disassembly

1. Remove the steering column as outlined in this section.
2. Unscrew the turn signal lever.
3. Drive out hand shift lever pivot pin and remove hand shift lever.
4. Remove turn signal / hazard warning switch retaining screws and partially withdraw switch from upper flange.
5. Remove snap ring from steering shaft above the upper shaft bearing.
6. With a light hammer, tap the steering shaft out the bottom of the steering column.
7. Clip the ignition switch in LOCK position and remove ignition switch and actuator rod.
8. Remove the automatic transmission hood and lens assembly, if so equipped.
9. Loosen the upper flange retaining nuts until one or two threads remain engaged, pinch the nuts toward each other, and pull flange off outer tube.
10. Remove shift tube retaining bolt from the bottom of the shift socket.
11. Remove the shift socket / flange extension.
12. Remove the lower bearing retainer, if so equipped.
13. Withdraw shift tube from top or bottom of the steering column.
14. Withdraw lower shift arms and spacer from column outer tube.
15. Remove lamp from flange and separate turn signal-hazard warning switch from flange.
16. Remove upper shaft bearing and insulator cover from upper flange by tapping with light hammer from opposite side of flange.
17. Disassemble the upper flange and locking mechanism as outlined in this section.
18. Remove the floor opening cover plate from the outer tube.



G6192-2C

DISASSEMBLY AND ASSEMBLY (Continued)

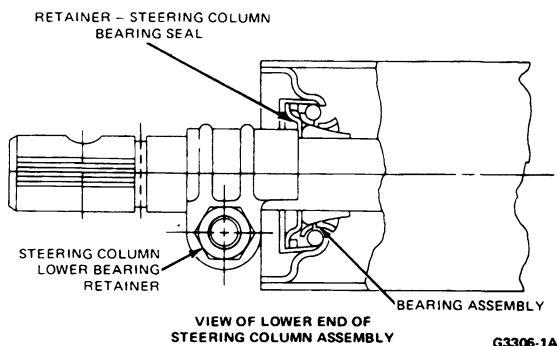
G6881-B

Assembly

1. Place bushing in socket retainer in outer tube.
2. Place bushing on upper hub and wave washer on lower hub of shift socket.
3. Insert lower shift arms and spacer in outer tube.
4. Insert shift tube assembly from top or bottom of column.
5. Install shift socket onto shift tube in outer tube or flange extension onto outer tube 1.7-2.3 N-m (15-20 in-lbs).
6. Install shift tube retaining screw in the bottom of the shift socket.
7. Place turn signal-hazard warning switch wiring harness through flange.
8. Press lamp and wire into flange.
9. Feed turn signal harness through shift socket. Pinching the flange casting subassembly retaining nuts toward each other, install flange.
10. Install ignition switch actuation rod, ignition switch and hand start the washer-nuts retaining the switch.
11. Adjust the ignition switch as outlined in this section.
12. Install the steering shaft from the column bottom.
13. Install the lower bearing retainer.
14. Install the upper shaft bearing and insulator cover as outlined in this section.
15. Install the snap ring on the shaft above the upper bearing.
16. Loosen the lower bearing retainer so it is free to slide on the steering shaft.
17. Seat the upper bearing by tapping on the upper end of the shaft with a rubber mallet.

DISASSEMBLY AND ASSEMBLY (Continued)

18. For F-Super Duty Commercial Chassis, preload the lower bearing by sliding the bearing retainer against the bearing with your thumb and forefinger while holding the steering shaft. Tighten the retainer nut to 14-18 N·m (10-14 ft-lb) while holding the bearing retainer.



19. Install the turn signal-hazard warning switch and tighten the three retaining screws.
20. Install the automatic transmission hood and lens, if so equipped.
21. Install the hand shift lever and pivot pin.
22. Install the turn signal lever.
23. Install the steering column as described in this section.

Steering Column Flange and Locking Mechanism Subassembly

1. Install lock actuator insert in rear of flange and tighten screw 1.7-2.8 N·m (15-25 in-lbs).
2. Insert lock actuator assembly through opening in front of flange until it bottoms against insert.
3. Install lock drive gear through lock cylinder opening. Actuator is fully rearward, if last gear tooth aligns with the last tooth on the actuator assembly.
4. Install the lock bearing.
5. Install the snap ring.
6. With the lock cylinder in the ON position and the retaining pin depressed, insert the lock cylinder into the flange.
7. Attach PRND21 insert to front of flange.
8. Position spring on lock release lever assembly and position lever assembly through hole in front of flange torque spring until lever assembly is allowed to drop into place.
9. Install snap ring on lock release lever assembly.
10. Install flange retaining bolts through holes in flange and hand start nuts one to two threads on rear side.

ADJUSTMENTS**Ignition Switch Adjustment****Correct Ignition Switch Operation**

The ignition switch is actuated by a rod through the lock actuator rack and pinion driven by the key cylinder. Rotating the key clockwise from the full counterclockwise stop, the positions are: ACCESSORY, LOCK, OFF, ON, and START, if the switch is properly adjusted.

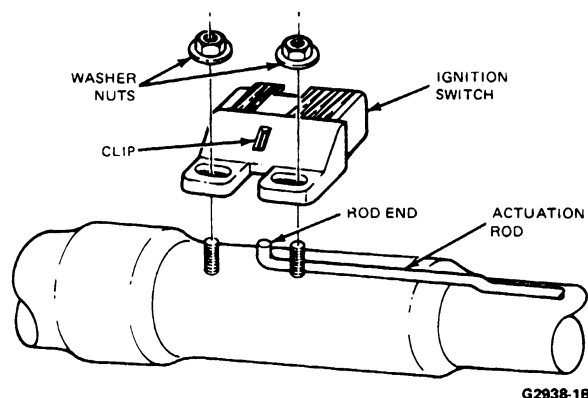
1. In ACCESSORY, the accessory circuits are operative.
2. In LOCK, all ignition switch electrical circuits are inoperative and the steering wheel and gearshift lever are locked.
3. In OFF, all ignition switch electrical circuits are inoperative and the steering wheel is unlocked for all gearshift lever positions.
4. In ON, all ignition switch circuits are operative except the starter circuit, and the steering wheel is unlocked.
5. In START, the engine ignition and starter circuits only are operative and the steering wheel is unlocked.

The above functions are attainable regardless of direction of actuation.

If the above operations are not acquired, adjust according to procedures below.

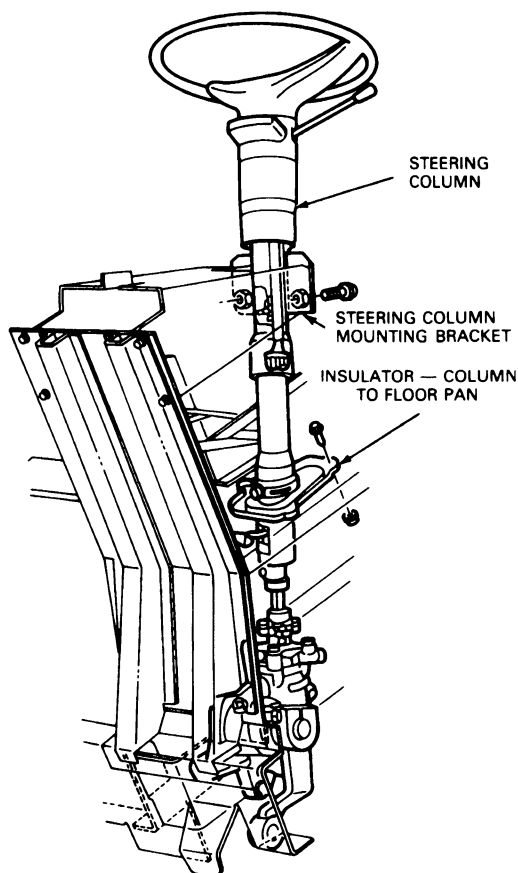
Switch Adjustments

1. Place the key in the ignition switch and rotate to LOCK position.
2. Loosen the washer-nuts retaining the ignition switch to the steering column.
3. Align the clip hole in the ignition switch with the actuation rod end.
4. Center the switch on the actuation rod.
5. Tighten the washer nuts to 4.5-7.3 N·m (40-65 in-lbs) and remove the clip.
6. Check for correct ignition switch operation.



ADJUSTMENTS (Continued)**Steering Column Alignment, F-Super Duty Motorhome Chassis**

1. Remove the fasteners attaching the steering column seal to floor pan, steering column upper bracket to brake and column support bracket.
2. Loosen the band-type clamp fastener which attaches the lower floor pan seal to steering column.
3. Gently pull upward on the steering wheel (along the axis of the column) until the rag joint is flat.
4. Attach steering column mounting bracket to the brake and pedal support and tighten to 26-36 N·m (19-27 ft·lb).
5. Slide the steering column-to-floor insulator down the axis of the column to the floor and install fasteners.
6. Tighten the band-type steering column-to-floor pan fastener to 20-27 N·m (15-20 ft·lb).
7. Tighten the column-to-floor insulator fasteners progressively and alternately to 11-15 N·m (8-11 ft·lb). This will prevent side forces from acting on the column.



G7435-A

Ignition Switch Adjustment

Refer to Step 14 under Steering Column in the Assembly portion of this section.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	Lb·Ft
Steering Wheel Retaining Bolt	31-44	23-32
Contact Assembly Screw	2-3	18-28 (lb-in)
Steering Column Mounting Nut	20.3-33.9	15-25
Steering Shaft Flex Coupling Bolt	7-11	5-8
Column Lower Mounting Bracket Bolt	7-11	5-8
Lock Housing Pivot Bolt	20-28	14-20
Ignition Switch Screw	7-11	5-8
Shift Control Tube Screw — Column Shift Only	7-11	5-8
Air Bag Module Nuts	4-6	3-4
Intermediate Shaft to Steering Gear Bolt	19-27	14-20
Intermediate Shaft to Steering Column Bolt	41-57	30-42
Steering Boot Nut	5-7	44-61 (lb-in)
Lower Column Bearing Bolt	7-11	5-8

SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
T67L-3600-A Steering Wheel Puller	<p>T67L-3600-A</p>

SECTION 11-05 Steering Column Switches

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DIAGNOSIS AND TESTING (Cont'd.)	
Ignition Switch.....	11-05-21	Multi-Function Switch	11-05-4
DESCRIPTION AND OPERATION		Switch Continuity	11-05-4
Ignition Switch.....	11-05-1	REMOVAL AND INSTALLATION	
Multi-Function Switch	11-05-1	Ignition Switch.....	11-05-21
Overdrive Lock-Out Button, E4OD Automatic		Multi-Function Switch	11-05-19
Transmission-Equipped Vehicles Only	11-05-3	Overdrive Lock-Out Button, E4OD Automatic	
DIAGNOSIS AND TESTING		Transmission-Equipped Vehicles Only	11-05-21
Ignition Switch.....	11-05-14	SPECIAL SERVICE TOOLS/EQUIPMENT	11-05-21
Ignition Switch, F-Series and Bronco.....	11-05-17	VEHICLE APPLICATION	11-05-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and Bronco Vehicles

DESCRIPTION AND OPERATION

Multi-Function Switch

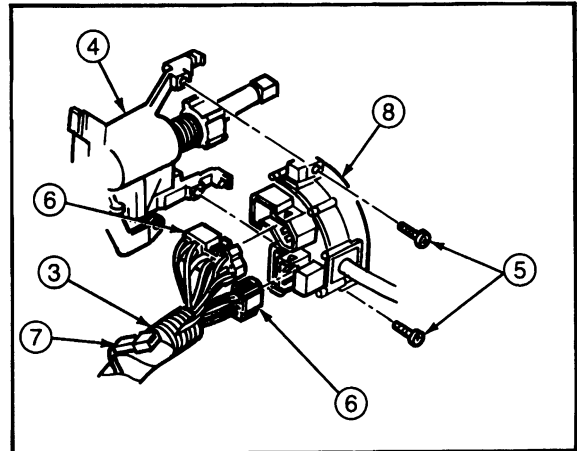
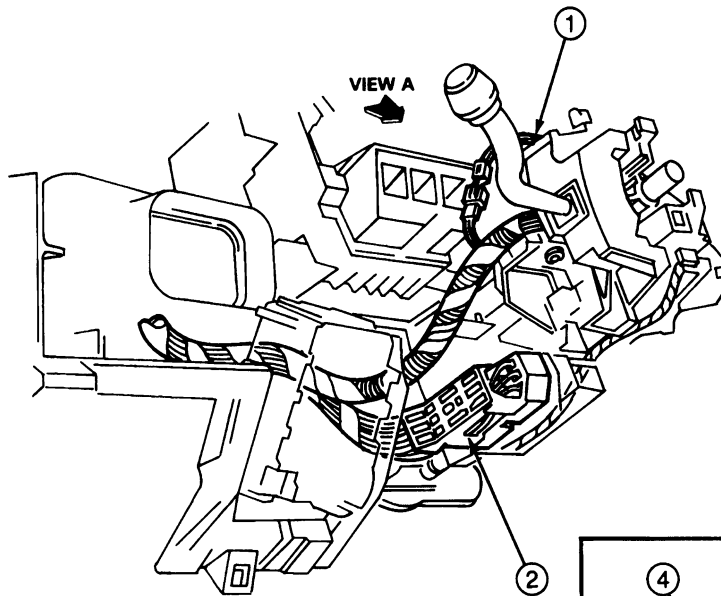
The multi-function switch provides electrical switching for the turn signal, headlamp dimmer, headlamp flash-to-pass, hazard warning, windshield washer and windshield wiper. The integrated switch assembly is mounted to the steering column.

Ignition Switch

The switch has blade-type terminals that engage with one multiple connector. The multiple connector is secured to the switch by integral locking fingers.

DESCRIPTION AND OPERATION (Continued)

Multi-Function and Ignition Switches, F-Series/Bronco



K17045-A

Item	Part Number	Description
1	—	Pigtail Wiring (E4OD Transmission)
2	11572	Ignition Switch
3	14401	Wiring Harness
4	—	Steering Column

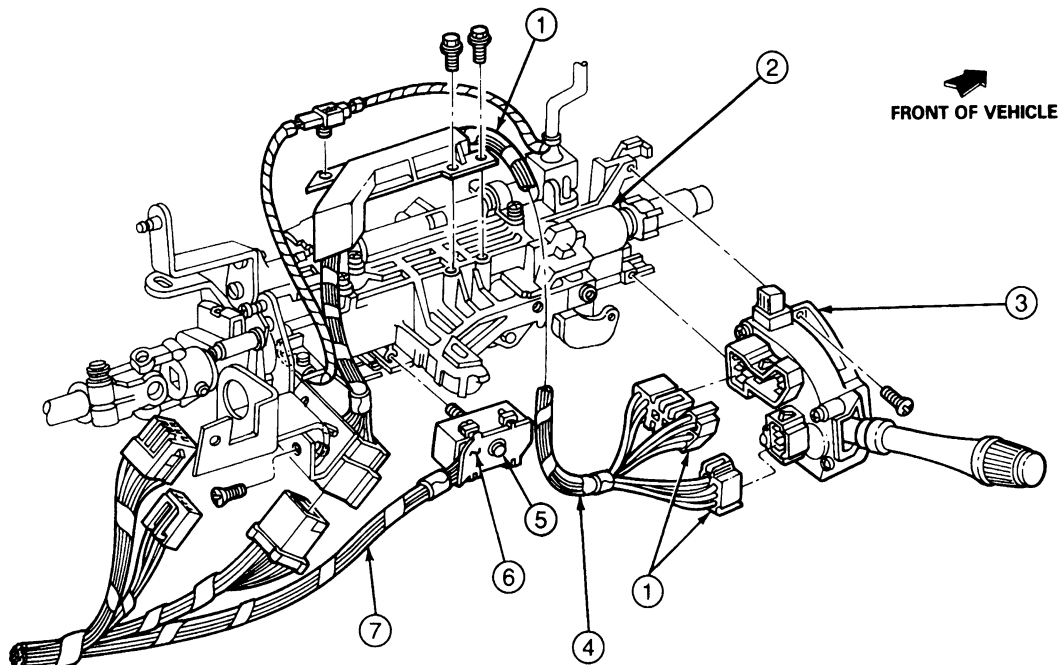
(Continued)

Item	Part Number	Description
5	390345-S36	Screw 2-3 N-m
6	—	Wiring to Multi-Function Switch
7	—	Pigtail Wiring (E4OD Transmission)
8	13K359	Multi-Function Switch

TK17045A

DESCRIPTION AND OPERATION (Continued)

Multi-Function and Ignition Switches, Econoline



K17047-B

Item	Part Number	Description
1	14A320	Wiring Assembly
2	3C529	Steering Column
3	13K359	Multi-Function Switch
4	14A320	Wiring Assembly, Headlamp Switch Jumper

(Continued)

Item	Part Number	Description
5	—	Captive Bolt, 6-8 N·m (53-71 In-Lb)
6	11572	Ignition Switch
7	14A200	Wiring to Ignition System

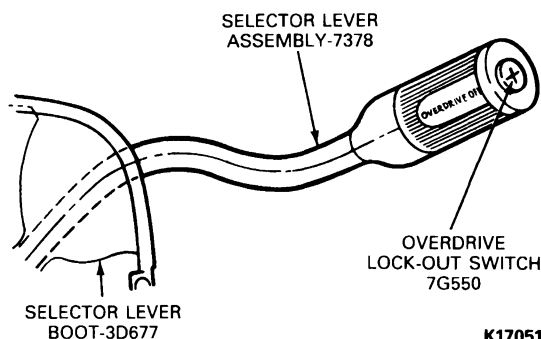
TK17047A

Overdrive Lock-Out Button, E4OD Automatic Transmission-Equipped Vehicles Only

The overdrive lock-out button is located on the end of the transmission selector lever. It locks out the overdrive operation of the transmission and enables full automatic operation through the first three gears.

When the button is pushed, the OFF indicator light on the selector lever will illuminate and overdrive operation will be disabled. If the button is pushed again, overdrive operation will be restored and the indicator light will be off.

Overdrive Lock-Out Button



K17051-B

DIAGNOSIS AND TESTING

Multi-Function Switch

The multi-function switch is a combination turn signal, hazard, dimmer switch which has a number of on-off switches packaged as a single unit. Testing for electrical malfunctions can be accomplished with a continuity tester. Malfunctions can be determined by checking continuity between the feed and function terminals of the switch.

Prior to testing, make sure hazard knob is pushed in fully to the OFF position. If the suspect circuit is satisfactory, the problem is elsewhere in the system.

Switch Continuity

Testing for electrical malfunctions can be accomplished using a continuity tester and ohmmeter, such as Rotunda Digital Volt-Ohmmeter 007-00001, or equivalent.

Diagnosis Guides, Multi-Function Switch

MECHANICAL MULTI-FUNCTION SWITCH DIAGNOSIS GUIDES

CONDITION	POSSIBLE SOURCE	ACTION
Hazard warning switch will not turn on warning lamps.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> Verify that the shroud does not restrict knob movement. With hazard warning switch in the OFF position, fully depress the knob and release. If the knob does not pop up to the ON position, the switch is damaged or worn. Replace the switch, refer to multi-function switch removal and installation procedures in this section.
Hazard warning switch will not turn off warning lamps.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> Verify that the shroud does not restrict knob movement. With hazard warning switch in the ON position, fully depress the knob and release. If the knob does not pop up to the OFF position, the switch is damaged or worn. Replace the switch, refer to multi-function switch removal and installation procedures in this section.
Turn signal lever will not stay in the left or right turn position.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> With the steering wheel locked in the straight-ahead position, move the lever to the right and left turn positions. If the lever does not stay in either turn position, the switch is worn or damaged. Replace the switch, refer to multi-function switch removal and installation procedures in this section. If the lever stays in either turn position, but requires an effort to manually move the switch from the turn position back to the neutral position, the switch is damaged. Replace the switch, refer to multi-function switch removal and installation procedures in this section.

DIAGNOSIS AND TESTING (Continued)

MECHANICAL MULTI-FUNCTION SWITCH DIAGNOSIS GUIDES (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Turn signal lever cancels before steering wheel returns from the desired turn position.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> Road test the vehicle. <p>NOTE: A slight movement of the steering wheel in the return direction causes the switch to cancel.</p> <p>If the lever cancels before the steering wheel returns, the switch is worn or damaged. Replace the switch, refer to multi-function switch removal and installation procedures in this section.</p>
Turn signal lever will not cancel when steering wheel returns from the desired turn position.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> Road test the vehicle. Verify that the switch is mounted properly to the casting. Verify that the cancel cam on the steering column is in the correct location. If the lever does not cancel, the switch is worn or damaged. Replace the switch, refer to multi-function switch removal and installation procedures in this section.
Headlamp dimmer switch does not stop in LOWBEAM position after the flash-to-pass function is operated.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> Gently pull the turn signal lever to the FLASH-TO-PASS position and release. If the lever stops in the LOWBEAM position, the switch is good. If the lever travels beyond the LOWBEAM position, the switch is worn or damaged. Replace the switch, refer to multi-function switch removal and installation procedures in this section.
Headlamp dimmer switch does return to LOWBEAM position after the flash-to-pass function is operated.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> Gently pull the turn signal lever to the FLASH-TO-PASS position and release. If the lever does not return to the LOWBEAM position, the switch is worn or damaged. Replace the switch, refer to multi-function switch removal and installation procedures in this section.
Turn signal lever is loose.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> Verify that the mounting screws are tight. Move the turn signal from LOWBEAM to HIGHBEAM and back to LOWBEAM. If looseness is felt in the lever, the switch is worn or damaged. Replace the switch, refer to multi-function switch removal and installation procedures in this section.
Windshield washer switch knob does not return from the WASH position.	<ul style="list-style-type: none"> Worn or damaged switch. 	<ul style="list-style-type: none"> With the ignition lock cylinder in the OFF position, push the washer switch knob to the ON position. If the washer knob does not return to the OFF position, the switch is worn or damaged. Replace the switch, refer to multi-function switch removal and installation procedures in this section.

TK 14467D

DIAGNOSIS AND TESTING (Continued)

Description	Test
Multi-function Switch, Bench Check (F-Series, Bronco)	Test A
Multi-function Switch, Bench Check (Econoline)	Test B
Ignition Switch Electrical Test	Test C
Ignition Switch Electrical Test (F/B) Econoline	Test D

MULTI-FUNCTION SWITCH, BENCH CHECK (F-SERIES, BRONCO) — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	CONTINUITY CHECK, SIGNAL LEVER IN NEUTRAL, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in neutral. Turn the hazard switch OFF. Check for continuity between Circuit 511 and Circuits 5 and 9. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A2. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A2	OPEN CIRCUIT CHECK, SIGNAL LEVER IN NEUTRAL, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in neutral. Turn the hazard switch OFF. Check for open circuit between Circuit 511 and Circuits 2 and 3. Check for open circuit between Circuit 44 and Circuits 2, 3, 5 and 9. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A3. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A3	CONTINUITY CHECK, SIGNAL LEVER IN LEFT TURN, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in left turn. Turn the hazard switch OFF. Check for continuity between Circuit 511 and Circuit 5. Check for continuity between Circuit 44 and Circuits 3 and 9. Check for continuity between Circuit 15 and Circuit 380. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A4. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A4	OPEN CIRCUIT CHECK, SIGNAL LEVER IN LEFT TURN, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in left turn. Turn the hazard switch OFF. Check for open circuit between Circuit 511 and Circuits 2, 3 and 9. Check for open circuit between Circuit 44 and Circuits 2 and 5. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A5. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A5	CONTINUITY CHECK, SIGNAL LEVER IN RIGHT TURN, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in right turn. Turn the hazard switch OFF. Check for continuity between Circuit 511 and Circuit 9. Check for continuity between Circuit 44 and Circuits 2 and 5. Check for continuity between Circuit 15 and Circuit 379. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A6. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.

DIAGNOSIS AND TESTING (Continued)

MULTI-FUNCTION SWITCH, BENCH CHECK (F-SERIES, BRONCO) — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A6	OPEN CIRCUIT CHECK, SIGNAL LEVER IN RIGHT TURN, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in right turn. Turn the hazard switch OFF. Check for open circuit between Circuit 511 and Circuits 2, 3 and 5. Check for open circuit between Circuit 44 and Circuits 3 and 9. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A7. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A7	CONTINUITY CHECK, HAZARD ON		
	<ul style="list-style-type: none"> Turn the hazard switch ON. Check for continuity between Circuit 385 and Circuits 2, 3, 5 and 9. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A8. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A8	OPEN CIRCUIT CHECK, HAZARD ON		
	<ul style="list-style-type: none"> Turn the hazard switch ON. Check for open circuit between Circuit 44 and Circuit 511. Check for open circuit between Circuit 385 and Circuits 44 and 511. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A9. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A9	CONTINUITY CHECK, HEADLAMP BEAM SWITCH, HIGH BEAMS		
	<ul style="list-style-type: none"> Place the lever on HIGH beams. Check for continuity between Circuit 15 and Circuit 12. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A10. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A10	OPEN CIRCUIT CHECK, HEADLAMP BEAM SWITCH, HIGH BEAMS		
	<ul style="list-style-type: none"> Place the lever on HIGH beams. Check for open circuit between Circuit 15 and Circuits 13 and 196. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A11. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A11	CONTINUITY CHECK, HEADLAMP BEAM SWITCH, LOW BEAMS		
	<ul style="list-style-type: none"> Place the lever on LOW beams. Check for continuity between Circuit 15 and Circuit 13. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A12. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A12	OPEN CIRCUIT CHECK, HEADLAMP BEAM SWITCH, LOW BEAMS		
	<ul style="list-style-type: none"> Place the lever on LOW beams. Check for open circuit between Circuits 15 and 12. Check for open circuit between Circuit 196 and Circuits 12 and 13. Do circuits check as indicated? 	Yes No	<ul style="list-style-type: none"> GO to A13. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.

DIAGNOSIS AND TESTING (Continued)**MULTI-FUNCTION SWITCH, BENCH CHECK (F-SERIES, BRONCO) — TEST A (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
A13	CONTINUITY CHECK, HEADLAMP BEAM SWITCH, FLASH-TO-PASS		
	<ul style="list-style-type: none"> Place the lever on flash-to-pass. Check for continuity between Circuit 15 and Circuit 13. Check for continuity between Circuit 196 and Circuit 12. Do circuits check as indicated? 	Yes No	GO to A14. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A14	OPEN CIRCUIT CHECK, HEADLAMP BEAM SWITCH, FLASH-TO-PASS		
	<ul style="list-style-type: none"> Place the lever on flash-to-pass. Check for open circuit between Circuit 15 and Circuit 12. Do circuits check as indicated? 	Yes No	GO to A15. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A15	OPEN CIRCUIT CHECK, WIPER / WASHER SWITCH, WASH OFF		
	<ul style="list-style-type: none"> Turn the washer OFF. Check for open circuit between Circuit 993 and Circuit 590. Do circuits check as indicated? 	Yes No	GO to A16. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A16	CONTINUITY CHECK, WIPER / WASHER SWITCH, WASH ON		
	<ul style="list-style-type: none"> Turn the washer on. Check for continuity between Circuit 993 and Circuit 590. Do circuits check as indicated? 	Yes No	GO to A17. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A17	OPEN CIRCUIT / RESISTANCE CHECK, WIPER / WASHER SWITCH, WIPER OFF, WASH OFF		
	<ul style="list-style-type: none"> Turn the wiper OFF. Turn the washer OFF. Check for open circuit between Circuit 589 and Circuit 590. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 103,300 ohms. Measure the resistance between Circuit 993 and 589. The correct resistance is approximately 47,600 ohms. Do circuits check as indicated? 	Yes No	GO to A18. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A18	OPEN CIRCUIT / RESISTANCE CHECK, WIPER / WASHER SWITCH, WIPER LOW, WASH OFF		
	<ul style="list-style-type: none"> Turn the wiper on LOW. Turn the washer OFF. Check for open circuit between Circuit 589 and Circuit 590. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 3,300 ohms. Measure the resistance between Circuit 993 and Circuit 589. The correct resistance is approximately 4,100 ohms. Do circuits check as indicated? 	Yes No	GO to A19. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.

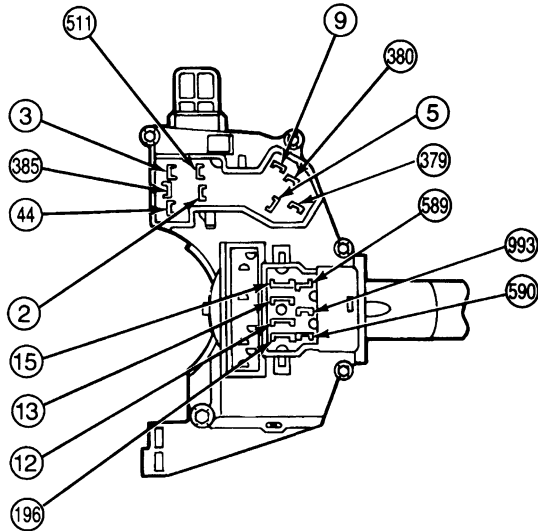
DIAGNOSIS AND TESTING (Continued)

MULTI-FUNCTION SWITCH, BENCH CHECK (F-SERIES, BRONCO) — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A19	CONTINUITY CHECK, WIPER / WASHER SWITCH, WIPER HIGH, WASH OFF		
	<ul style="list-style-type: none"> Turn the wiper on HIGH. Turn the washer OFF. Check for continuity between Circuit 993 and Circuit 589. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 3,300 ohms. Do circuits check as indicated? 	Yes No	GO to A20 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A20	OPEN CIRCUIT CHECK, WIPER / WASHER SWITCH, WIPER HIGH, WASH OFF		
	<ul style="list-style-type: none"> Turn the wiper on HIGH. Turn the washer OFF. Check for open circuit between Circuit 589 and Circuit 590. Do circuits check as indicated? 	Yes No	GO to A21 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A21	OPEN CIRCUIT/RESISTANCE CHECK, WIPER / WASHER SWITCH, INTERVAL AT MAXIMUM DELAY		
	<ul style="list-style-type: none"> Turn the wiper interval delay to the maximum setting. Check for open circuit between Circuit 589 and Circuit 590. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 103,300 ohms. Measure resistance between Circuit 993 and Circuit 589. The correct resistance is approximately 11,300 ohms. Do circuits check as indicated? 	Yes No	GO to A22 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
A22	OPEN CIRCUIT/RESISTANCE CHECK, WIPER / WASHER SWITCH, INTERVAL AT MINIMUM DELAY		
	<ul style="list-style-type: none"> Turn the wiper interval delay to the minimum setting. Check for open circuit between Circuit 589 and Circuit 590. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 3,300 ohms. Measure the resistance between Circuit 993 and Circuit 589. The correct resistance is approximately 11,300 ohms. Do circuits check as indicated? 	Yes No	The switch is OK. RETURN to service. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.

TK17740A

NOTE: Resistance values are accurate to within $\pm 15\%$.

DIAGNOSIS AND TESTING (Continued)**Multi-Function Switch, F-Series and Bronco****K17741-A**

Circuit No.	Description
2	Right Front Turn Signal Lamp
3	Left Front Turn Signal Lamp
5	Right Rear Turn Signal Lamp
9	Left Rear Turn Signal Lamp
44	Flasher Feed
44A	Internal Switch Connection
49	Flasher Feed
379	Right Cornering Lamp
380	Left Cornering Lamp
385	Hazard Feed
511	Brake Feed
511A	Internal Switch Connection
IGN	Ignition
BAT	Battery
12	Hi Beam
13	Lo Beam
15	Lighting Switch Feed
196	Flash to Pass Feed
W1(993)	
W2(590)	
W3(589)	

TK17741A

MULTI-FUNCTION SWITCH, BENCH CHECK (ECONOLINE) — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	CONTINUITY CHECK, SIGNAL LEVER IN NEUTRAL, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in neutral. Turn the hazard switch OFF. Check for continuity between Circuit 511 and Circuits 5 and 9. Check for continuity between Circuit 49 and Ignition (IGN). Do circuits check as indicated? 	Yes No	GO to B2 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B2	OPEN CIRCUIT CHECK, SIGNAL LEVER IN NEUTRAL, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in neutral. Turn the hazard switch OFF. Check for open circuit between Circuit 511 and Circuits 2 and 3. Check for open circuit between Circuit 44 and Circuits 2, 3, 5 and 9. Do circuits check as indicated? 	Yes No	GO to B3 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B3	CONTINUITY CHECK, SIGNAL LEVER IN LEFT TURN, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in left turn. Turn the hazard switch OFF. Check for continuity between Circuit 511 and Circuit 5. Check for continuity between Circuit 44 and Circuits 3 and 9. Check for continuity between Circuit 15 and Circuit 380. Check for continuity between Circuit 49 and IGN. Do circuits check as indicated? 	Yes No	GO to B4 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.

DIAGNOSIS AND TESTING (Continued)

MULTI-FUNCTION SWITCH, BENCH CHECK (ECONOLINE) — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B4	OPEN CIRCUIT CHECK, SIGNAL LEVER IN LEFT TURN, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in left turn. Turn the hazard switch OFF. Check for open circuit between Circuit 511 and Circuits 2, 3 and 9. Check for open circuit between Circuit 44 and Circuits 2 and 5. Do circuits check as indicated? 	Yes No	GO to B5 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B5	CONTINUITY CHECK, SIGNAL LEVER IN RIGHT TURN, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in right turn. Turn the hazard switch OFF. Check for continuity between Circuit 511 and Circuit 9. Check for continuity between Circuit 44 and Circuits 2 and 5. Check for continuity between Circuit 15 and Circuit 379. Check for continuity between Circuit 49 and IGN. Do circuits check as indicated? 	Yes No	GO to B6 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B6	OPEN CIRCUIT CHECK, SIGNAL LEVER IN RIGHT TURN, HAZARD OFF		
	<ul style="list-style-type: none"> Place the turn signal lever in right turn. Turn the hazard switch OFF. Check for open circuit between Circuit 511 and Circuits 2, 3 and 5. Check for open circuit between Circuit 44 and Circuits 3 and 9. Do circuits check as indicated? 	Yes No	GO to B7 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B7	CONTINUITY CHECK, HAZARD ON		
	<ul style="list-style-type: none"> Turn the hazard switch ON. Check for continuity between Circuit 44 and Circuits 2, 3, 5 and 9. Check continuity between Circuit 49 and battery. Do circuits check as indicated? 	Yes No	GO to B8 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B8	OPEN CIRCUIT CHECK, HAZARD ON		
	<ul style="list-style-type: none"> Turn the hazard switch ON. Check for open circuit between Circuit 44 and Circuit 511 and battery (B+). Check for open circuit between Circuit 49 and Circuit 3 and IGN. Do circuits check as indicated? 	Yes No	GO to B9 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B9	CONTINUITY CHECK, HEADLAMP BEAM SWITCH, HIGH BEAMS		
	<ul style="list-style-type: none"> Place the lever on HIGH beams. Check for continuity between Circuit 15 and Circuit 12. Do circuits check as indicated? 	Yes No	GO to B10 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B10	OPEN CIRCUIT CHECK, HEADLAMP BEAM SWITCH, HIGH BEAMS		
	<ul style="list-style-type: none"> Place the lever on HIGH beams. Check for open circuit between Circuit 15 and Circuits 13 and 196. Do circuits check as indicated? 	Yes No	GO to B11 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.

DIAGNOSIS AND TESTING (Continued)**MULTI-FUNCTION SWITCH, BENCH CHECK (ECONOLINE) — TEST B (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
B11	CONTINUITY CHECK, HEADLAMP BEAM SWITCH, LOW BEAMS		
	<ul style="list-style-type: none"> Place the lever on LOW beams. Check for continuity between Circuit 15 and Circuit 13. Do circuits check as indicated? 	Yes No	GO to B12 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B12	OPEN CIRCUIT CHECK, HEADLAMP BEAM SWITCH, LOW BEAMS		
	<ul style="list-style-type: none"> Place the lever on LOW beams. Check for open circuit between Circuit 15 and Circuit 12. Check for open circuit between Circuit 196 and Circuits 12 and 13. Do circuits check as indicated? 	Yes No	GO to B13 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B13	CONTINUITY CHECK, HEADLAMP BEAM SWITCH, FLASH-TO-PASS		
	<ul style="list-style-type: none"> Place the lever on flash-to-pass. Check for continuity between Circuit 15 and Circuit 13. Check for continuity between Circuit 196 and Circuit 12. Do circuits check as indicated? 	Yes No	GO to B14 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B14	OPEN CIRCUIT CHECK, HEADLAMP BEAM SWITCH, FLASH-TO-PASS		
	<ul style="list-style-type: none"> Place the lever on flash-to-pass. Check for open circuit between Circuit 15 and Circuit 12. Do circuits check as indicated? 	Yes No	GO to B15 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B15	OPEN CIRCUIT CHECK, WIPER / WASHER SWITCH, WASH OFF		
	<ul style="list-style-type: none"> Turn the washer OFF. Check for open circuit between Circuit 993 and Circuit 590. Do circuits check as indicated? 	Yes No	GO to B16 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B16	CONTINUITY CHECK, WIPER / WASHER SWITCH, WASH ON		
	<ul style="list-style-type: none"> Turn the washer on. Check for continuity between Circuit 993 and Circuit 590. Do circuits check as indicated? 	Yes No	GO to B17 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B17	OPEN CIRCUIT/RESISTANCE CHECK, WIPER / WASHER SWITCH, WIPER OFF, WASH OFF		
	<ul style="list-style-type: none"> Turn the wiper OFF. Turn the washer OFF. Check for open circuit between Circuit 589 and Circuit 590. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 103,300 ohms. Measure the resistance between Circuit 993 and Circuit 589. The correct resistance is approximately 47,600 ohms. Do circuits check as indicated? 	Yes No	GO to B18 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.

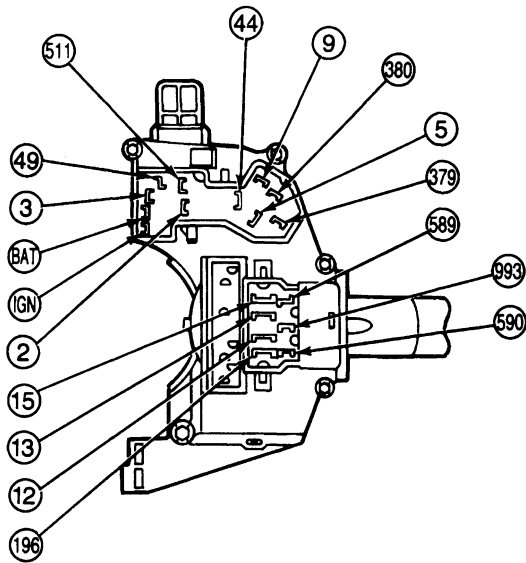
DIAGNOSIS AND TESTING (Continued)

MULTI-FUNCTION SWITCH, BENCH CHECK (ECONOLINE) — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B18	OPEN CIRCUIT/RESISTANCE CHECK, WIPER/WASHER SWITCH, WIPER LOW, WASH OFF		
	<ul style="list-style-type: none"> Turn the wiper on LOW. Turn the washer OFF. Check for open circuit between Circuit 589 and Circuit 590. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 3,300 ohms. Measure the resistance between Circuit 993 and Circuit 589. The correct resistance is approximately 4,100 ohms. Do circuits check as indicated? 	Yes No	GO to B19 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B19	CONTINUITY CHECK, WIPER/WASHER SWITCH, WIPER HIGH, WASH OFF		
	<ul style="list-style-type: none"> Turn the wiper on HIGH. Turn the washer OFF. Check for continuity between Circuit 993 and Circuit 589. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 3,300 ohms. Do circuits check as indicated? 	Yes No	GO to B20 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B20	OPEN CIRCUIT CHECK, WIPER/WASHER SWITCH, WIPER HIGH, WASH OFF		
	<ul style="list-style-type: none"> Turn the wiper on HIGH. Turn the washer OFF. Check for open circuit between Circuit 589 and Circuit 590. Do circuits check as indicated? 	Yes No	GO to B21 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B21	OPEN CIRCUIT/RESISTANCE CHECK, WIPER/WASHER SWITCH, INTERVAL AT MAXIMUM DELAY		
	<ul style="list-style-type: none"> Turn the wiper interval delay to the maximum setting. Check for open circuit between Circuit 589 and Circuit 590. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 103,300 ohms. Measure resistance between Circuit 993 and Circuit 589. The correct resistance is approximately 11,300 ohms. Do circuits check as indicated? 	Yes No	GO to B22 . REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.
B22	OPEN CIRCUIT/RESISTANCE CHECK, WIPER/WASHER SWITCH, INTERVAL AT MINIMUM DELAY		
	<ul style="list-style-type: none"> Turn the wiper interval delay to the minimum setting. Check for open circuit between Circuit 589 and Circuit 590. Measure resistance between Circuit 993 and Circuit 590. The correct resistance is approximately 3,300 ohms. Measure the resistance between Circuit 993 and Circuit 589. The correct resistance is approximately 11,300 ohms. Do circuits check as indicated? 	Yes No	The switch is OK. RETURN to service. REPLACE switch. REFER to multi-function switch removal and installation procedures in this section.

TK17743A

NOTE: Resistance values are accurate to within $\pm 15\%$.

DIAGNOSIS AND TESTING (Continued)**Multi-Function Switch, F-Series and Bronco**

K17744-A

Circuit No.	Description
2	Right Front Turn Signal Lamp
3	Left Front Turn Signal Lamp
5	Right Rear Turn Signal Lamp
9	Left Rear Turn Signal Lamp
44	Flasher Feed
44A	Internal Switch Connection
49	Flasher Feed
379	Right Cornering Lamp
380	Left Cornering Lamp
385	Hazard Feed
511	Brake Feed
511A	Internal Switch Connection
IGN	Ignition
BAT	Battery
12	Hi Beam
13	Lo Beam
15	Lighting Switch Feed
196	Flash to Pass Feed
W1(993)	
W2(590)	
W3(589)	

TK17744A

Ignition Switch

NOTE: For an "engine-won't crank" condition with an automatic transmission, determine if the condition exists with the shift lever in both PARK and NEUTRAL positions before performing ignition switch continuity tests. For an "engine-won't crank" condition with a manual transmission, verify that the clutch/starter interlock switches operate properly. If the "no-crank" problem occurs in one shift lever position but not the other, a more probable cause is the neutral start switch located on the transmission.

IGNITION SWITCH ELECTRICAL TEST — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	CONTINUITY CHECK, IGNITION SWITCH IN ACCESSORY POSITION		
<ul style="list-style-type: none"> Disconnect the multiple connector. (Spread apart locking fingers on each side of the connector while pulling to disengage connector from ignition switch.) Ignition in ACCESSORY position. Check for continuity between Circuit 37 and Circuit 297. Do circuits check as indicated? 		Yes	GO to C2. REPLACE switch. REFER to ignition switch removal and installation procedures in this section.
		No	

DIAGNOSIS AND TESTING (Continued)

IGNITION SWITCH ELECTRICAL TEST — TEST C (Continued)

TEST STEP		RESULT	ACTION TO TAKE
C2	OPEN CIRCUIT CHECK, IGNITION SWITCH IN ACCESSORY POSITION		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in ACCESSORY position. Check for open circuit between Circuit 16 and Circuits 32, 41, 262, 687, 977 and chassis ground. Check for open circuit between Circuit 32 and Circuits 41, 262, 687, 977 and chassis ground. Check for open circuit between Circuit 262 and Circuits 687, 977 and chassis ground. Check for open circuit between Circuit 687 and Circuit 977 and chassis ground. Check for open circuit between Circuit 977 and chassis ground. Do circuits check as indicated? 	Yes No	GO to C3 . REPLACE switch. REFER to ignition switch removal and installation procedures in this section.
C3	OPEN CIRCUIT CHECK, IGNITION SWITCH IN ACCESSORY POSITION, CIRCUITS 16 AND 37		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in ACCESSORY position. Check for open circuit between Circuit 16 and Circuit 37. Do circuits check as indicated? 	Yes No	GO to C4 . REPLACE switch. REFER to ignition switch removal and installation procedures in this section.
C4	OPEN CIRCUIT CHECK, IGNITION SWITCH IN LOCK POSITION		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in LOCK position. Check for open circuit between Circuit 16 and Circuits 32, 37, 41, 262, 297, 687, 977 and chassis ground. Check for open circuit between Circuit 32 and Circuits 37, 41, 262, 297, 687, 977 and chassis ground. Check for open circuit between Circuit 41 and Circuits 262, 297, 687, 977 and chassis ground. Check for open circuit between Circuit 262 and Circuits 297, 687, 977 and chassis ground. Check for open circuit between Circuit 297 and Circuits 687, 977 and chassis ground. Check for open circuit between Circuit 687 and Circuit 977 and chassis ground. Check for open circuit between Circuit 977 and chassis ground. Do circuits check as indicated? 	Yes No	GO to C5 . REPLACE switch. REFER to ignition switch removal and installation procedures in this section.
C5	OPEN CIRCUIT CHECK, IGNITION SWITCH IN OFF POSITION		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in LOCK position. Check for open circuit between Circuit 16 and Circuits 32, 37, 41, 262, 297, 687, 977 and chassis ground. Check for open circuit between Circuit 32 and Circuits 37, 41, 262, 297, 687, 977 and chassis ground. Check for open circuit between Circuit 41 and Circuits 262, 297, 687, 977 and chassis ground. Check for open circuit between Circuit 262 and Circuits 297, 687, 977 and chassis ground. Check for open circuit between Circuit 297 and Circuits 687, 977 and chassis ground. Check for open circuit between Circuit 687 and Circuit 977 and chassis ground. Check for open circuit between Circuit 977 and chassis ground. Do circuits check as indicated? 	Yes No	GO to C6 . REPLACE switch. REFER to ignition switch removal and installation procedures in this section.

DIAGNOSIS AND TESTING (Continued)

IGNITION SWITCH ELECTRICAL TEST — TEST C (Continued)			
TEST STEP		RESULT	ACTION TO TAKE
C6	CONTINUITY CHECK, IGNITION SWITCH IN RUN POSITION		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in RUN position. Check for continuity between Circuit 16 and Circuits 37, 297 and 687. Check for continuity between Circuit 37 and Circuits 297 and 687. Check for continuity between Circuit 297 and Circuit 687. Do circuits check as indicated? 	Yes No	GO to C7. REPLACE switch. REFER to ignition switch removal and installation procedures in this section.
C7	OPEN CIRCUIT CHECK, IGNITION SWITCH IN RUN POSITION		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in RUN position. Check for open circuit between Circuit 16 and chassis ground. Check for open circuit between Circuit 32 and Circuits 41, 262, 977 and chassis ground. Check for open circuit between Circuit 41 and Circuits 262, 977 and chassis ground. Check for open circuit between Circuit 262 and Circuit 977 and chassis ground. Check for open circuit between Circuit 977 and chassis ground. Do circuits check as indicated? 	Yes No	GO to C8. REPLACE switch. REFER to ignition switch removal and installation procedures in this section.
C8	OPEN CIRCUIT CHECK, IGNITION SWITCH IN RUN POSITION, CIRCUITS 16 AND 32		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in RUN position. Check for open circuit between Circuit 16 and Circuit 32. Do circuits check as indicated? 	Yes No	GO to C9. REPLACE switch. REFER to ignition switch removal and installation procedures in this section.
C9	CONTINUITY CHECK, IGNITION SWITCH IN START POSITION		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in START position. Check for continuity between Circuit 41 and Circuit 977 and chassis ground. Check for continuity between Circuit 977 and chassis ground. Check for continuity between Circuit 16 and Circuits 32, 37 and 262. Check for continuity between Circuit 32 and Circuits 37 and 262. Check for continuity between Circuit 37 and Circuit 262. Do circuits check as indicated? 	Yes No	GO to C10. REPLACE switch. REFER to ignition switch removal and installation procedures in this section.
C10	OPEN CIRCUIT CHECK, IGNITION SWITCH IN START POSITION		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in START position. Check for open circuit between Circuit 32 and chassis ground. Check for open circuit between Circuit 32 and Circuit 41. Check for open circuit between Circuit 297 and Circuit 687 and chassis ground. Check for open circuit between Circuit 687 and chassis ground. Do circuits check as indicated? 	Yes No	GO to C11. REPLACE switch. REFER to ignition switch removal and installation procedures in this section.

DIAGNOSIS AND TESTING (Continued)

IGNITION SWITCH ELECTRICAL TEST — TEST C (Continued)

TEST STEP		RESULT	ACTION TO TAKE
C11	OPEN CIRCUIT CHECK, IGNITION SWITCH IN START POSITION, CIRCUITS 32 AND 297		
	<ul style="list-style-type: none"> Multiple connector disconnected. Ignition switch in START position. Check for open circuit between Circuit 32 and Circuit 297. Do circuits check as indicated? 	<p>Yes</p> <p>No</p>	<p>The switch is OK. RETURN to service.</p> <p>REPLACE switch. REFER to ignition switch removal and installation procedures in this section.</p>

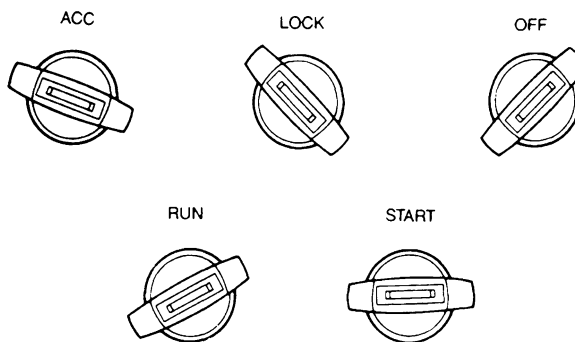
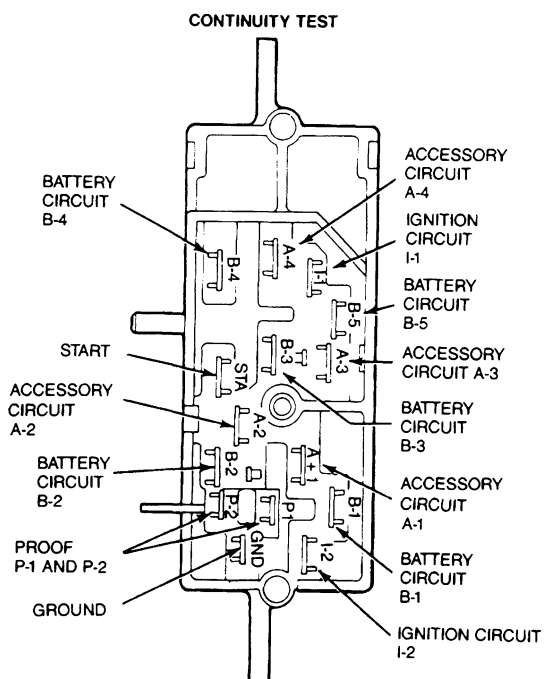
TK18117A

Ignition Switch, F-Series and Bronco

Continuity Test

Disconnect multiple connector from the ignition switch. Test the switch continuity as described in the following illustration. Connect a self-powered test lamp or ohmmeter between the blade terminals indicated on the chart. No continuity between any blade and chassis ground should exist in any switch position except the proof Circuits 41 and 977 in the START position only.

For an "engine won't crank" condition, determine if the condition exists with the shift lever in both PARK and NEUTRAL positions before performing the ignition switch continuity tests. If the "no-crank" condition occurs in one shift lever position but not the other, a more probable cause is the neutral start switch located in the transmission.



SWITCH POSITION	CONTINUITY SHOULD EXIST ONLY BETWEEN
ACC	A-1 THROUGH B-5
LOCK	NO CONTINUITY
OFF	NO CONTINUITY
RUN	A-1 AND B-1, A-2 AND B-2, A-3 AND B-3, A4 AND B4, I1 AND B5
START	I-1 AND B-5, I-2 AND B-1, STA AND B-4, P-1 AND GRD, P-2 AND GRD.

K14670-B

DIAGNOSIS AND TESTING (Continued)**Mechanical Test**

Test the steering column ignition system mechanical operation by rotating the lock cylinder / key through all switch positions. The movement should feel smooth with no sticking or binding. The ignition system should return from the START position back to the RUN position without assistance (spring return). If sticking or binding is encountered, check for the following:

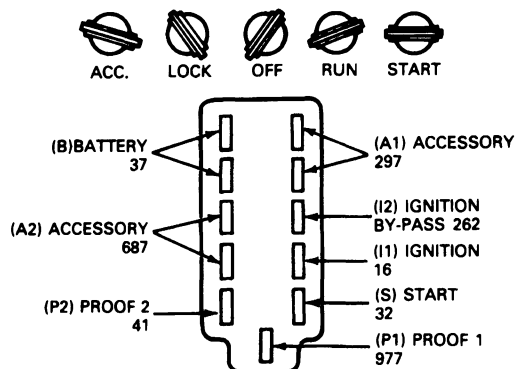
- Burrs on the lock cylinder key
- Binding lock cylinder
- Shroud rubbing against lock cylinder
- Burrs or foreign material around the rack-and-pinion actuator in the lock cylinder housing
- Insufficient lube on actuator
- Binding ignition switch

NOTE: Do not apply lubricant to the inside of the ignition switch.

IGNITION SWITCH MECHANICAL DIAGNOSIS

CONDITION	POSSIBLE SOURCE	ACTION
High Key Efforts	Damaged lock cylinder.	Lubricate cylinder and check for burrs on key. If effort is still excessive, replace lock cylinder.
	Shrouds mis-aligned. Casting / actuator binds, sticks, grabs, with key rotation.	Align shroud to fit properly. If improper fit between casting and actuator exists, replace parts. If burrs are found on actuator surfaces which contact the casting during key travel, gently file these surfaces until smooth. At no time attempt to file teeth of actuator. If serious burrs are found on casting surface which contact actuator during key travel, replace the casting. If actuator teeth show excessive wear or are burred, replace actuator. Assemble lock housing assembly taking care to thoroughly lube all internal components and check key efforts. If still high, replace lock housing assembly. Replace the ignition switch.
	Damaged ignition switch.	

NOTE: Accessories that fail to operate with the ignition switch in the RUN position, or that remain on when the ignition switch is turned off, may be the result of a misadjusted ignition switch rather than a malfunctioning ignition switch. Refer to Adjustments in this section.

DIAGNOSIS AND TESTING (Continued)**Blade-Type Connector Ignition Switch Continuity Test, Econoline**

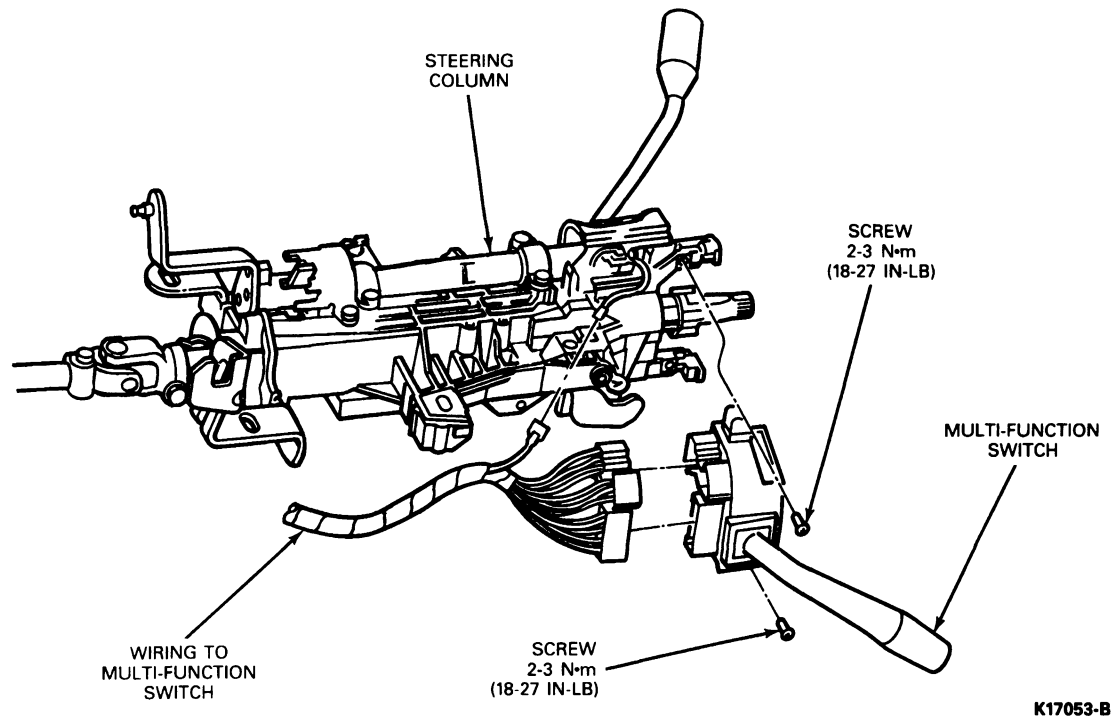
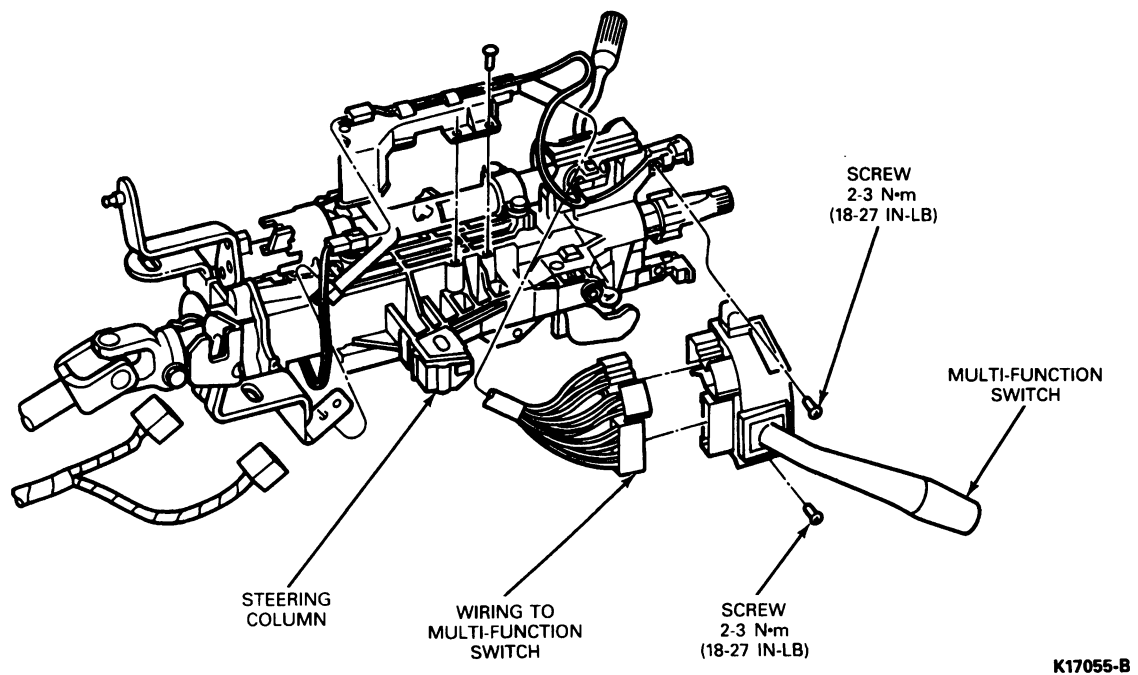
SWITCH POSITION:	CONTINUITY SHOULD EXIST ONLY BETWEEN:
ACCESSORY	37-297
LOCK	NO CONTINUITY BETWEEN ANY CIRCUITS
OFF	NO CONTINUITY BETWEEN ANY CIRCUITS
RUN	37-16-687-297
START	977-41-GROUND; 37-32-262 (POSSIBLY 16)

NOTE: THE FOLLOWING CIRCUITS ARE CONNECTED IN PAIRS INTERNALLY IN THE SWITCH:
37, 687, AND 297.

K9558-B

REMOVAL AND INSTALLATION**Multi-Function Switch****Removal**

1. Disconnect battery ground cable.
2. Remove the steering column shroud as outlined in the appropriate steering column section in Group 11.
3. Remove two self-tapping screws that attach the multi-function switch to the steering column casting. Disengage switch from casting.
4. Disconnect the two electrical connectors, using caution not to damage the locking tabs. Do not damage PRNDL cable.

REMOVAL AND INSTALLATION (Continued)**Multi-Function Switch, F-Series / Bronco****Multi-Function Switch, Econoline**

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Install the two switch electrical connectors to full engagement. The wiring for the switch is to be routed under the PRNDL cable.
2. Align the multi-function switch mounting holes with the holes in the steering column casting. Install two self-tapping screws making sure to start the screws in the previously tapped holes. Tighten to 2-3 N·m (18-27 in·lb).
3. For automatic transmission, verify that the PRNDL adjustment is correct.
4. Install the shroud as outlined in Section 11-04B.
5. Connect the battery ground cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the EEC processor relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

6. Check the steering column for proper operation.

2. Insert a thin-blade screwdriver into the slot on the switch and remove the switch by pulling switch out of the selector lever.

NOTE: The indicator light cover can be removed from the selector lever if it is damaged. Carefully insert a thin-blade screwdriver into the selector lever and using the ridge on the cover slide cover off of selector lever.

Installation

NOTE: If the indicator light cover was removed, install by positioning cover to selector lever and sliding into place. Make sure that the sides of the cover fit properly into the slots on the selector lever.

1. Position switch to selector lever making sure that the contract pins are properly oriented to the connector. Install switch by pushing into selector lever until bottom is felt.
2. Position switch cover to selector lever and snap into place.
3. Check switch for proper operation.

Ignition Switch

For ignition switch removal and installation procedures, refer to the appropriate steering column section Group 11.

ADJUSTMENTS**Ignition Switch**

For ignition switch adjustment, refer to the appropriate steering column section in Group 11.

Overdrive Lock-Out Button, E4OD Automatic Transmission-Equipped Vehicles Only**Removal**

1. Remove the switch cover by inserting a thin-blade screwdriver into the recess at the end of the selector lever and unsnapping the cover from the selector lever.

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
007-00001	Digital Volt-Ohmmeter

GROUP

CLIMATE CONTROL

12

(18000 & 19000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
AIR CONDITIONING, HEATER SYSTEM, F-SERIES AND BRONCO, MANUAL	12-03A-1	COMPRESSOR AND CLUTCH, FS-6	12-03F-1
AIR CONDITIONING GENERAL SERVICE	12-03-1	COMPRESSOR AND CLUTCH, FX-15	12-03C-1
AIR CONDITIONING, HEATER SYSTEM, SIDE MOUNTED AUXILIARY	12-03D-1	HEATER AND VENTILATION SYSTEM, F-SERIES AND BRONCO	12-02B-1
AIR CONDITIONING, HEATER SYSTEM, ECONOLINE	12-03B-1	HEATING SYSTEM GENERAL SERVICE	12-02-1
		HEATING SYSTEM, ECONOLINE	12-02A-1

SECTION 12-02 Heating System General Service

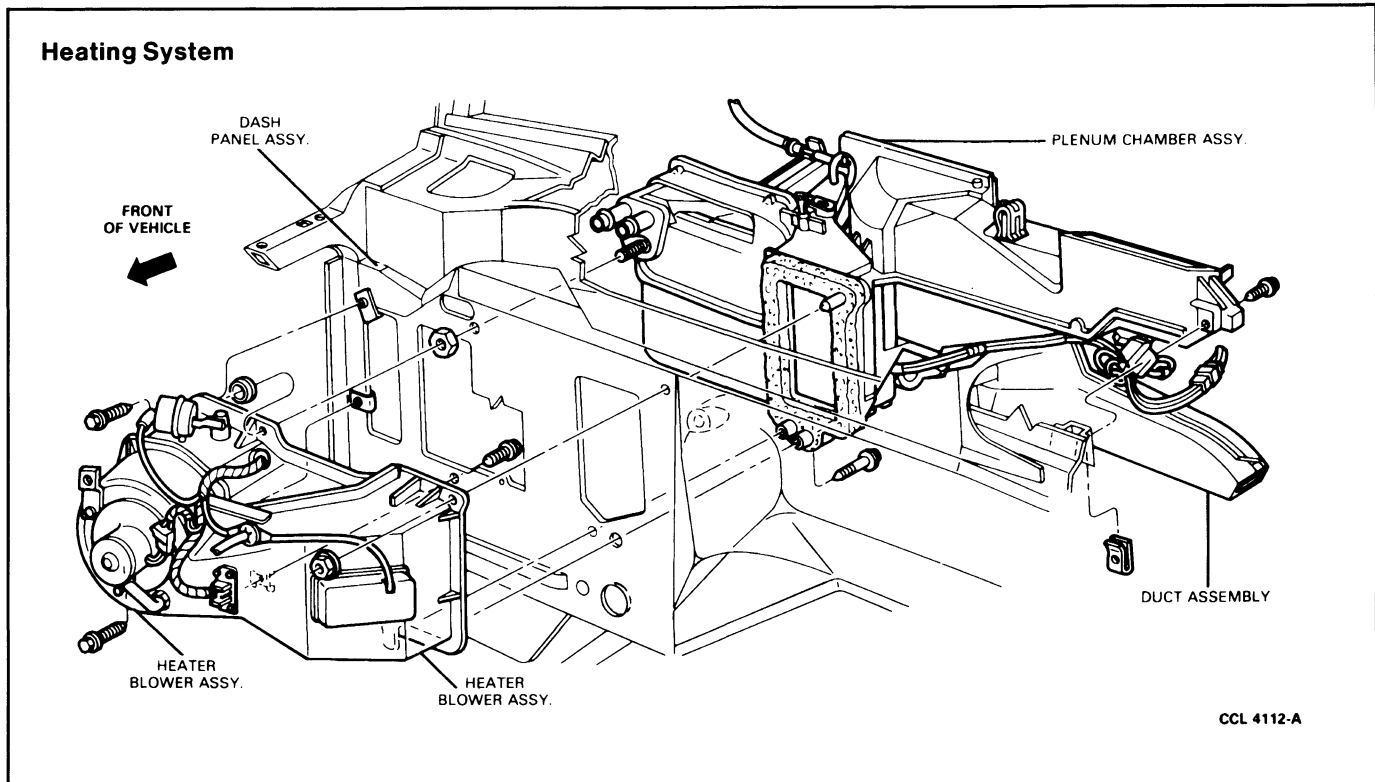
SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Blower Switch	12-02-2	Blower Switch Continuity Test	12-02-3
Heating System and Control Doors.....	12-02-2	Heater Core Leak Test	12-02-5
Safety Precautions	12-02-2	Loose Blower Wheel Test.....	12-02-3
DIAGNOSIS AND TESTING		Open Circuit Test.....	12-02-5
Bleeding Air From Heater Core.....	12-02-5	Visual Check of Blower	12-02-3
Blower Motor Current Draw Test (Heater System).....	12-02-3	SPECIAL SERVICE TOOLS/EQUIPMENT	12-02-9
Blower Motor Voltage Test (Heater System).....	12-02-3	VEHICLE APPLICATION	12-02-1

VEHICLE APPLICATION

E 150-350, F 150-350, F-Super Duty and Bronco Vehicles

DESCRIPTION AND OPERATION

Detailed information and illustrations regarding the heating and ventilation systems and their components are provided in Section 12-02B. The coverage in this section is an overview of the systems with coverage highlighting those diagnosis and testing procedures that are common to all light trucks. This section also provides a procedure for servicing a heater core. This following illustration illustrates the major components of a typical system.

DESCRIPTION AND OPERATION (Continued)**Heating System and Control Doors**

All heater plenum assemblies contain a blower and a heater core, through which coolant flows from the engine. The air (forced by blower or ram effect) passes through and / or around the heater core and discharges through various outlets.

Several doors determine the amount of air passing through the heater core and the particular outlet(s) through which it discharges. The number of doors used and the manner in which they are actuated differ according to the particular system function. Two control levers (function and temperature) determine the location of discharge air and temperature.

Blower Switch

Battery voltage is delivered directly to the blower motor whenever the ignition switch is on. Blower motor speed is controlled by the blower motor resistor through three separate circuits. Various positions of the blower motor switch energize these circuits.

When the blower switch is moved to the blower speed selected, a circuit is completed to ground. Current flow from the battery to the blower motor, blower motor resistor, and blower motor switch operates the blower motor. The different blower motor speeds result from the amount of resistance in each of the circuits. Greater circuit resistance results in slower motor speed.

When the blower switch is moved to the high speed position, a separate circuit is completed. The high speed circuit is completed directly from the blower motor, through the blower switch to ground. This circuit allows full battery voltage, producing maximum blower motor speed.

Safety Precautions

Whenever components in the engine compartment or instrument panel areas are being serviced, the battery ground cable must be disconnected to eliminate the possibility of electrical shorts, burned-up wiring, and fires. Extreme care must be exercised when performing electrical tests where the battery must be connected to operate the system.

Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with the vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gasses outside the closed area.

DIAGNOSIS AND TESTING

Various tests for checking heater system operation follow. In addition to testing, visual inspections should be made of components and their connections. Include inspections for air leaks in the body.

DIAGNOSIS AND TESTING (Continued)**Visual Check of Blower**

Check to see that all blower motor connections are correct including proper grounding of the system. Check the resistor connection at heater case and at the heater fuse. Also check the connection at the rear of the blower switch located on the control assembly.

Loose Blower Wheel Test

Place the blower switch in HIGH position. If air flow is not evident but the motor can be heard, the blower wheel may not be secured to the motor shaft. Do not replace the blower motor unless the unit fails the current draw test.

Blower Motor Voltage Test (Heater System)

1. Place temperature selector lever in mid-range position (halfway between COOL and WARM).
2. Place function control lever in PANEL position (air through registers).
3. Insert probes of Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent into connector at rear of blower motor and make contact with wire terminals. With engine running, measure voltage drop across motor.
4. With engine running (battery voltage approximately 14.2 volts), voltage reading should be within range specified for each blower motor lever position. (Refer to Specifications.)

Blower Motor Current Draw Test (Heater System)

1. Disconnect blower motor electrical wire harness.

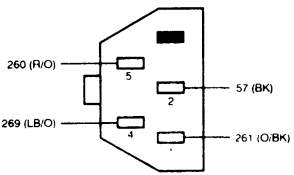
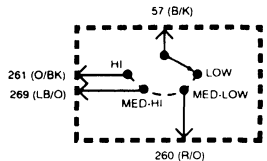
2. Connect Rotunda Digital Volt-Ohmmeter 007-0001 or equivalent between left (positive) terminal on motor and corresponding terminal of the wire harness connector. Set meter in the AMPS position. Connect a jumper wire between right (ground) terminal on motor and corresponding terminal wire harness connector.
3. Place system temperature control lever in the mid-range position (halfway between COOL and WARM) and function control lever in PANEL position (air through registers).
4. With battery fully charged, start engine and operate blower in all blower speeds. Record the current draw for each blower speed.
5. The current draw for each blower speed should be within limits shown in Specifications.
6. Disconnect Digital Volt-Ohmmeter and jumper wire. Connect the harness connector to blower motor.
7. Check blower system for proper operation.

Blower Switch Continuity Test

Check for continuity between connected terminals with a self-powered test light or an ohmmeter as shown on the schematic. Check terminal continuity at every lever position. The light should go on or ohmmeter should show an open or closed circuit. If the ohmmeter needle moves or the light illuminates, the circuit is closed. If needle movement is slight, there may be high resistance in the circuit.

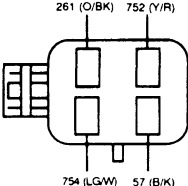
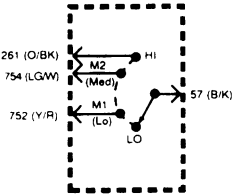
DIAGNOSIS AND TESTING (Continued)

Component Testing Procedure, Blower Switch, Econoline

TERMINAL LOCATIONS		ECONOLINE			
					
SCHEMATIC		COMPONENT TESTING PROCEDURE			
		TO TEST	Connect Self-Powered Test Lamp or Ohmmeter to Terminals	Move Control to These Positions	A Good Switch Will Indicate
		High Speed	57 (BK) and 261 (O/BK)	Low Medium Lo Medium Hi Hi	Open Circuit Open Circuit Open Circuit Closed Circuit
		Medium High Speed	57 (BK) and 269 (LB/O)	Lo Medium Lo Medium Hi Hi	Open Circuit Open Circuit Open Circuit Closed Circuit
		Medium Low Speed	57 (BK) and 260 (R/O)	Low Medium Lo Medium Hi Hi	Open Circuit Closed Circuit Open Circuit Open Circuit
		Low Speed	57 (BK) and Any other position	Lo Medium Lo Medium Hi Hi	Open Circuit Open Circuit Open Circuit Open Circuit

CCL 4389-A

Component Testing Procedure, F-Series and Bronco

TERMINAL LOCATIONS		F-SERIES/BRONCO			
					
SCHEMATIC		COMPONENT TESTING PROCEDURE			
		TO TEST	Connect Self-Powered Test Lamp or Ohmmeter to Terminals	Move Control to These Positions	A Good Switch Will Indicate
		Medium Low Speed	57 (BK) and 752 (Y/R)	Lo M1 M2 Hi	Open Circuit Closed Circuit Open Circuit Open Circuit
		Medium Speed	57 (BK) and 754 (LG/W9)	Lo M1 M2 Hi	Open Circuit Open Circuit Closed Circuit Open Circuit
		Hi Speed	57 (BK) and 261 (O/BK)	Lo M1 M2 Hi	Open Circuit Open Circuit Open Circuit Closed Circuit

CCL 4390-A

DIAGNOSIS AND TESTING (Continued)**Open Circuit Test**

On all electrical circuits, continuity must exist from the source of power (battery), to the unit where the power is used, and back up to the source of power (ground).

An ohmmeter or self-powered test light connected between any two points of a circuit will show whether the circuit is open or continuous.

If the meter does not move or the light does not go on, the circuit is open.

If the meter movement is slight, high resistance is indicated.

Bleeding Air From Heater Core

Remove the hose at the outlet connection of the heater core (hose leading to the water pump). Allow any trapped air to flow out. When a continuous flow of coolant is obtained, connect the hose to the core. Do not over-tighten heater hose clamps.

Heater Core Leak Test**Inspection**

1. Inspect for visible evidence of coolant leakage at the hose to heater core attachments. A coolant leak at the hose could follow the heater core tube to the core and appear as a leak in the heater core.
2. Check the system for loose heater hose clamps. The clamps should be tightened to 2-3 N·m (18-23 in-lbs).
3. If leakage is found and the hose clamps are tight, check the heater core tubes for distortion. Severe distortion of the tubes could cause leakage at the hose connection.

NOTE: All heater hoses that are installed in service as replacement parts should be made with EPDM or NOMEX as their component materials. Hoses made from other materials may not be suitable for their particular application.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Insufficient, erratic, or no heat or defrost.	<ul style="list-style-type: none"> ● Low radiator coolant level due to coolant leaks. ● Engine overheating. ● Loose fan belt. ● Thermostat. ● Plugged or partially plugged heater core. ● Loose or improperly adjusted control cables. ● Kinked, clogged, collapsed, soft, swollen, or decomposed engine cooling system or heater system hoses. ● Blocked air inlet. 	<ul style="list-style-type: none"> ● Check radiator cap pressure. Replace if below minimum pressure. ● Fill to specified coolant level. Pressure test for engine cooling system and heater system leaks. Service as required. ● Remove bugs, leaves, etc. from radiator or condenser fins. Check for: <ul style="list-style-type: none"> — Loose fan belt — Sticking thermostat — Incorrect ignition timing — Water pump impeller damage — Restricted cooling system ● Service as required. ● Replace if cracked or worn and / or adjust belt tension. ● Check coolant temperature at radiator filler neck. If under 76°C (170°F) replace thermostat. See Group 03 for complete testing. ● Clean and backflush engine cooling system and heater core. ● Adjust to specifications. ● Replace damaged hoses and backflush engine cooling system, then heater system, until all particles have been removed. ● Check cowl air inlet for leaves, foreign material, etc. Remove as required. ● Check internal blower inlet screen (on vehicles so equipped) for leaves and foreign material.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Blower does not operate properly. Check fuse.	<ul style="list-style-type: none"> ● Blower motor. ● Blower resistor. ● Blower wire harness. ● Blower switch(es). 	<ul style="list-style-type: none"> ● Connect a # 10 gauge (or larger diameter) jumper wire directly from the positive battery terminal to the positive lead (orange wire) of the blower motor. If the motor runs, the problem must be external to the motor. If the motor will not run, connect a # 10 gauge (or larger diameter) jumper wire from the motor black lead to a good ground. If the motor runs, the trouble is in the ground circuit. On vehicles with ground side switching, check the blower resistor, the blower switch and the harness connections. Service as required. If motor still will not run, the motor is inoperative and should be replaced. ● Check continuity of resistors for opens or shorts (self-powered test lamp). Service or replace as required. ● Check for proper installation of harness connector terminal connectors. ● Check wire-to-terminal continuity. ● Check continuity of wires in harness for shorts, opens, abrasions, etc. Service as required. ● Check blower switch(es) for proper contact. Replace switch(es) as required.
Vacuum motor system.	<ul style="list-style-type: none"> ● Vacuum leak. ● Loose or disconnected vacuum hose. ● Damaged vacuum motor. ● Misrouted vacuum connections. 	<ul style="list-style-type: none"> ● Repair or replace system components as required.

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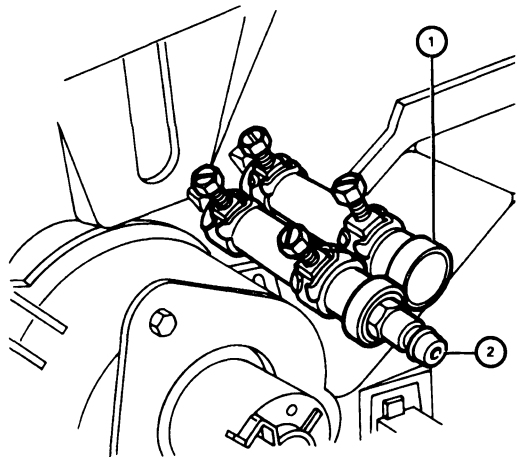
Pressure Test

1. Drain the cooling system.

2. Disconnect the heater hoses from the heater core tubes.

DIAGNOSIS AND TESTING (Continued)

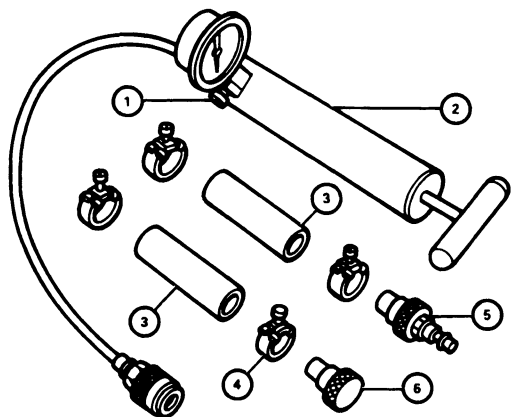
3. Install a short piece of heater hose (approximately 100mm or 4 inches long) onto each heater core tube.



CCL 4111-A

ITEM	DESCRIPTION
1.	PLUG - BT-7422-B
2.	ADAPTER - BT-7422-A

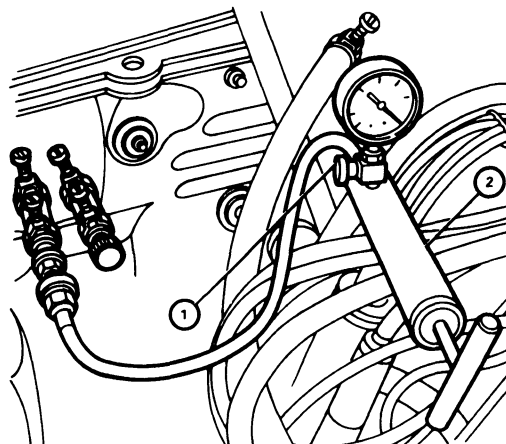
4. Fill the heater core and hoses with water and install Plug BT-7422-B and Adapter BT-7422-A from Radiator Pressure Tester 021-00012 or equivalent in the hose ends. Secure the hoses to the heater core, plug and adapter with hose clamps.



CCL 4108-A

ITEM	DESCRIPTION
1.	BLEED VALVE
2.	RADIATOR PRESSURE TESTER - 021-00012
3.	HEATER HOSE (4 INCHES LONG)
4.	HOSE CLAMP
5.	ADAPTER - BT-7422-A
6.	PLUG - BT-7422-B

5. Attach Radiator Pressure Tester 021-00012 or equivalent to the adapter. Close the bleed valve at the base of the gauge and pump 207 kPa (30 psi) of air pressure into the heater core.



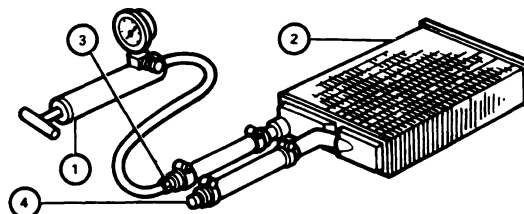
CCL 4109-A

ITEM	DESCRIPTION
1.	BLEED VALVE
2.	RADIATOR PRESSURE TESTER - 021-00012

6. Observe the pressure gauge for a minimum of three minutes. The pressure should not drop.
7. If the pressure does not drop, no leaks are indicated.
8. If the pressure drops, check the hose connections at the core tubes for leaks. If the hoses do not leak, remove the heater core from the vehicle and test the core as described in this section. Refer to Section 12-02A or 12-02B for heater core removal and installation procedures.

Bench Test

1. Drain all coolant from the heater core.
2. Connect the 100mm (4-inch) test hoses with plug and adapter to the core tubes. Then connect Radiator Pressure Tester 021-00012 or equivalent to the adapter.



CCL 4110-A

ITEM	DESCRIPTION
1.	RADIATOR PRESSURE TESTER - 021-00012
2.	HEATER CORE
3.	ADAPTER - BT-7422-A
4.	PLUG - BT-7422-B

3. Apply 207 kPa (30 psi) of air pressure to the heater core with Radiator Pressure Tester 021-00012 or equivalent, and submerge the core in water.
4. If a leak is observed, repair or replace the heater core as necessary.

DIAGNOSIS AND TESTING (Continued)**Heater Core Back-Flushing**

All engine cooling system flushing and back-flushing must include a separate back-flushing of the heater or air conditioning system heater core. Separate flushing or back-flushing of the engine cooling system and heater core prevent engine cooling system particles from clogging the heater core tubes and reducing (or eliminating) coolant flow through the heater core.

The heater core must be back-flushed separately from the engine cooling system for proper back-flush water flow direction through the heater core.

The correct heater core back-flushing procedure follows.

1. Disconnect the heater core outlet heater hose from the water pump fitting and install a female garden hose-end fitting adapter into the end of the outlet heater hose. Secure with a hose clamp.
2. Connect the female garden hose end of the outlet heater hose to the male end of a water supply garden hose.
3. Disconnect the heater core inlet heater hose from the engine block fitting. Place inlet hose into an approved container and drain fluid into container.

NOTE: Discard used fluid according to local and / or EPA regulations.

4. Turn the water supply valve on and off several times so that the surge action will help to dislodge larger stubborn particles from the heater core tubes. Allow full water pressure to flow for approximately five minutes.

5. Remove the hose clamp and female garden hose-end adapter from the end of the outlet heater hose. Install the outlet heater hose onto the water pump fitting. Secure with hose clamp.
6. Connect the inlet heater hose onto the engine block fitting. Secure with hose clamp.
7. Fill the cooling system, as described in Section 03-03 of the Engine Repair Manual, with the specified mixture of 50 / 50 water and Premium Cooling System Fluid E2FZ-19549-AA (ESE-M97B44-A) or equivalent.
8. Test the system for proper heater performance under the specified engine cooling system conditions.

SPECIAL SERVICE TOOLS / EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
021-00012	Radiator Pressure Tester
BT-7422-A	Adapter
BT-7422-B	Plug

SECTION 12-02A Heating System, Econoline

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Auxiliary Heater System.....	12-02A-6	Heater Assembly	12-02A-22
Blower Motor Resistor	12-02A-5	Heater Core	12-02A-11
Control Assembly	12-02A-4	Heater Hose Installations.....	12-02A-23
Heater and Ventilation System.....	12-02A-1	Instrument Panel	12-02A-13
Temperature Selector Lever	12-02A-5	Outside-Recirculation Air Door Vacuum	
DIAGNOSIS AND TESTING		Motor	12-02A-16
Blower Motor Current Draw Test	12-02A-6	Plenum Chamber	12-02A-14
Blower Motor Voltage Test.....	12-02A-6	Quick Connect/Disconnect Hose	
Test Procedure.....	12-02A-6	Couplings	12-02A-28
Vacuum System Tests.....	12-02A-7	Register Ducts.....	12-02A-14
REMOVAL AND INSTALLATION		Right, Center and Left Register Louver	
Blower Motor and Wheel Assembly	12-02A-12	Assembly	12-02A-18
Blower Motor Resistor	12-02A-13	Vacuum Selector Valve	12-02A-10
Blower Switch	12-02A-10	SPECIAL SERVICE TOOLS/EQUIPMENT	12-02A-29
Control Assembly	12-02A-8	SPECIFICATIONS.....	12-02A-29
Defroster Nozzle	12-02A-17	VEHICLE APPLICATION	12-02A-1

VEHICLE APPLICATION

E-150-250-350 Vehicles

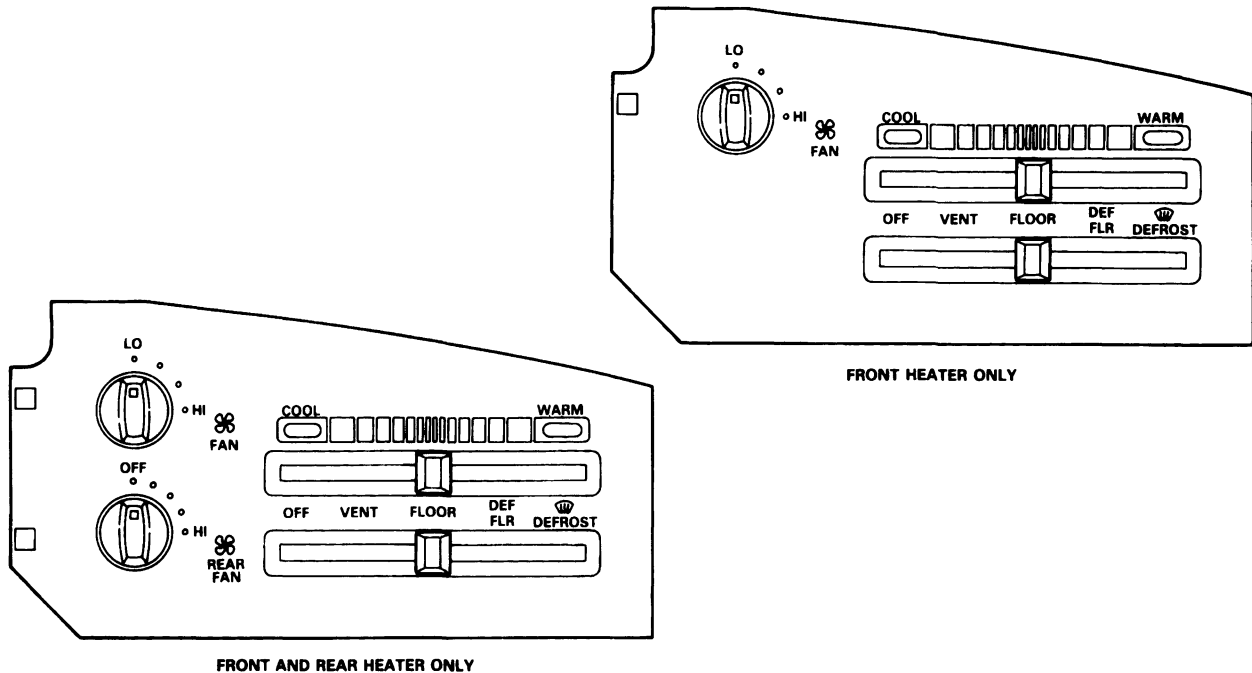
DESCRIPTION AND OPERATION

Heater and Ventilation System

The heater is a blend air type which receives its outside air supply from the cowl inlet. The heater control assembly is located in the instrument panel to the right of the steering column. It includes a blower switch which provides four operating speeds. The control assembly also includes two levers. One is provided to allow temperature selection between the extremes of COOL and WARM; the other provides for functional selection between OFF, VENT, HEAT, MIX, and DEFROST. Vacuum motors actuate the function doors to direct air flow within the system. The temperature blend door is operated by cable.

DESCRIPTION AND OPERATION (Continued)

Heater Control Assemblies



CCL 4215-A

Air Flow

Two air flow diagrams follow which illustrate the path air flow takes in response to each functional setting of the control lever.

Ventilation is delivered through the instrument panel registers when the function lever in the control assembly is set in the VENT position. In the VENT position, the outside/recirc door is open to the outside with no vacuum being applied to the door vacuum motor. The air coming in through the cowl is discharged through the panel registers. A small amount of this input is diverted to the floor area.

In the FLOOR position, the outside/recirc. door is open to the outside air flow with no vacuum being applied to the door's motor. Air is discharged through the floor outlets with a small amount going to the defroster nozzles.

In the MIX position, outside air is discharged through the defroster nozzles and the floor outlets.

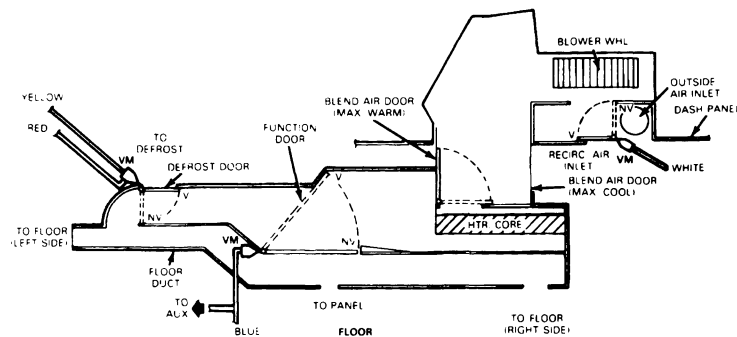
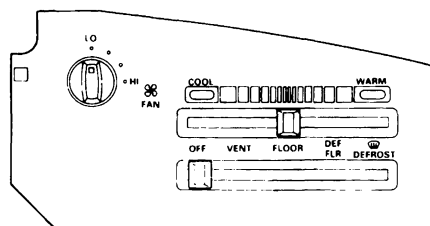
In the DEFROST position, outside air is discharged through the defrosters with a small amount going to the floor outlets.

In the OFF position, all doors are in the vacuum-applied position with the exception of the PANEL/DEFROST door.

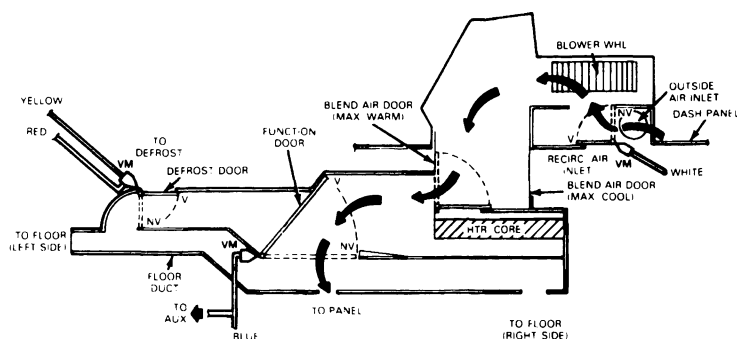
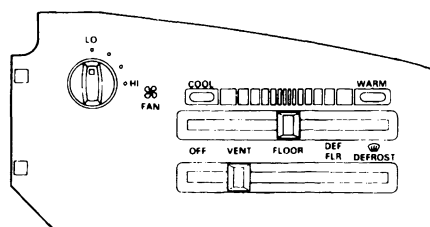
When the temperature control lever in the control assembly is moved between the COOL and WARM positions, a temperature control cable moves the temperature blend door, which directs a portion of the total air input through the heater core. As the percentage of air exposed to the core increases, the air temperature at the outlets to the passenger compartment also increases.

DESCRIPTION AND OPERATION (Continued)

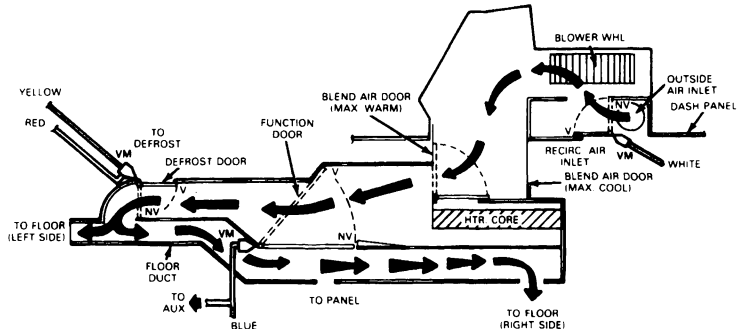
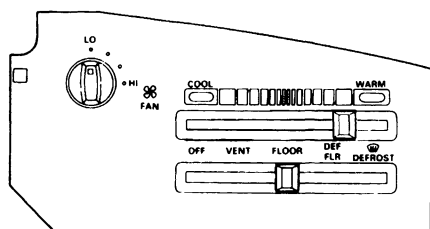
Heater System Air Flow



OFF POSITION



VENT POSITION

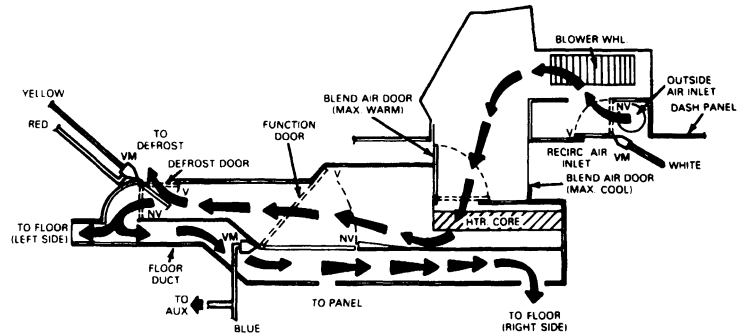
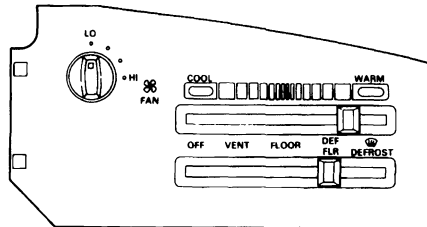


FLOOR POSITION

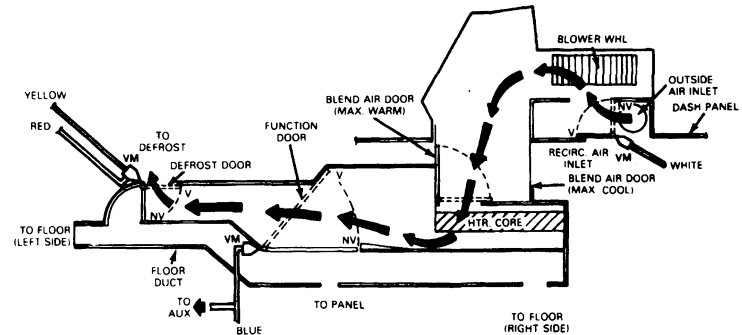
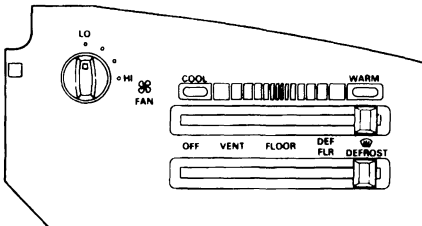
CCL 4248-A

DESCRIPTION AND OPERATION (Continued)

Heater System Air Flow



DEFROST/FLOOR POSITION



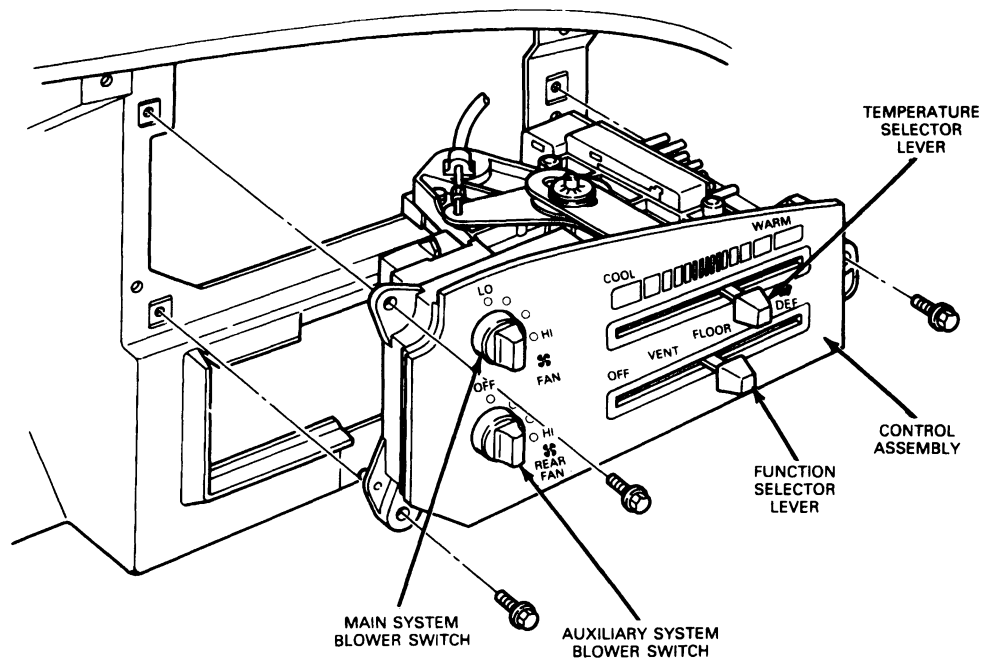
DEFROST POSITION

CCL 4249-A

Control Assembly

When the function selector lever is moved to any of its five positions, the appropriate ports in an eight-port vacuum selector valve are actuated. This valve controls the distribution of vacuum to the motors which operate the following doors:

- Outside / Recirc
- Floor / Defrost
- Panel / Defrost

DESCRIPTION AND OPERATION (Continued)**Heater Control Assembly Installation**

CCL 4217-A

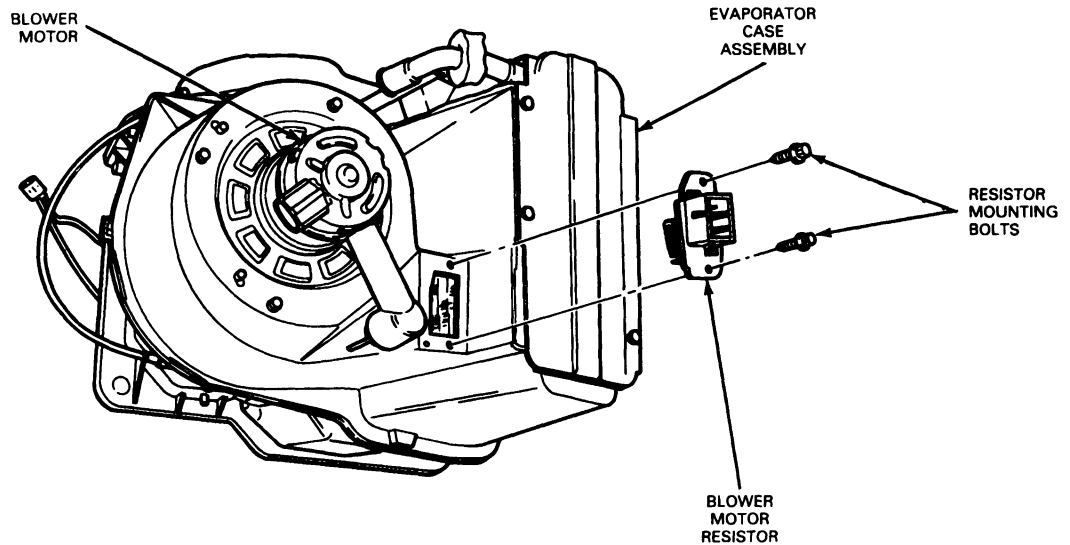
The function selector lever also controls blower operation. When the lever is in the OFF position, the four-speed blower switch will not operate.

Temperature Selector Lever

The temperature selector lever actuates a control cable which operates the temperature blend door. The blower motor will operate at low, medium low, medium high, or high speed, depending upon selection. The function selector lever must be in the OFF position if no blower operation is desired. (If the vehicle is equipped with auxiliary heat, the blower control knob for the rear unit has an OFF position).

Blower Motor Resistor

A resistor with a thermal limiter is mounted in the heater / blower assembly. The resistor is used in conjunction with the blower motor switch to obtain the desired fan speed. The thermal limiter in the switch assembly serves as a temperature sensitive fuse.

DESCRIPTION AND OPERATION (Continued)**Blower Motor Resistor Installation**

CCL 4238-B

Auxiliary Heater System

Refer to Section 12-03D for all service procedures.

DIAGNOSIS AND TESTING**Blower Motor Voltage Test**

The heater system blower motor electrical circuit uses ground side switching. When performing blower motor voltage tests on systems with ground side switching, the voltage reading must be taken across the motor wires.

Test Procedure

1. Place the temperature selector lever in WARM position.
2. Place function selector lever in the FLOOR position.
3. Insert probes of a voltmeter into wire holes of the motor's two hardshell connectors and make contact with wire terminals. Measure voltage drop across motor.

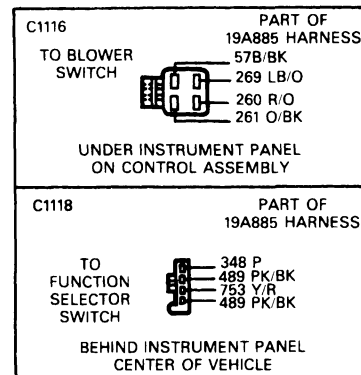
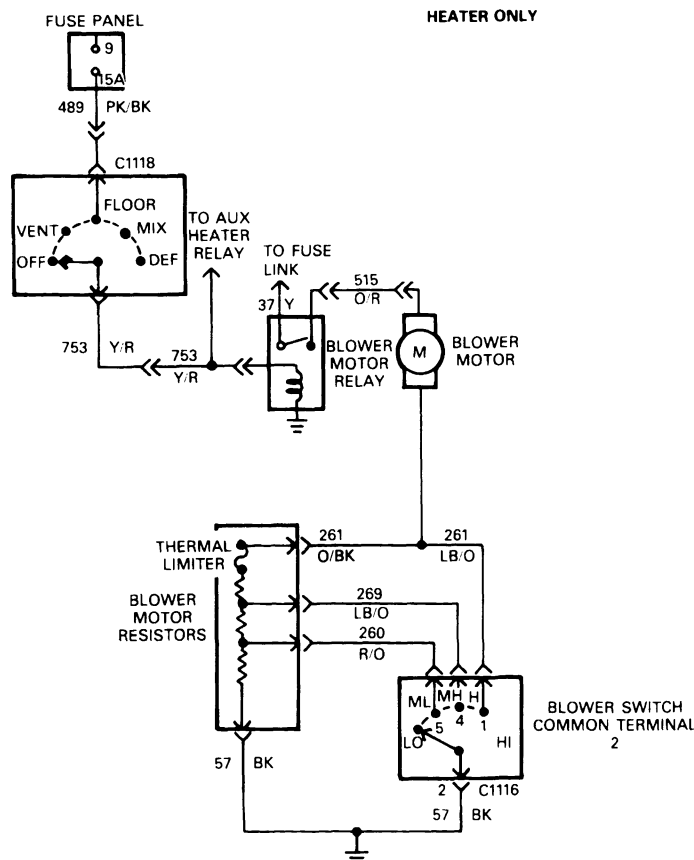
4. With engine running (battery voltage approximately 14.2 volts), the voltage reading should be within the specified range for each blower switch position. Refer to the Electrical Specifications Chart, in the Specifications portion of this section, for specifications.

Blower Motor Current Draw Test

1. Separate blower motor ground (black) wire at blower motor resistor.
2. Connect positive (+) ammeter lead to female spade connector and negative (-) ammeter lead to resistor terminal.
3. Place temperature selector lever in mid-position and the function selector lever in the HEAT position to turn blower on.
4. Turn ignition switch to ON position.
5. With a fully charged battery, blower motor current draw (amps) should be approximately as indicated for each blower speed in blower switch chart of the electrical wiring diagram.

DIAGNOSIS AND TESTING (Continued)

Heater Electrical System Schematic



CCL 4220-A

Vacuum System Tests

To test the air conditioning-heater control system, start the engine and move the function selector lever slowly from one position to another. A momentary hiss should be heard as the function selector lever is moved from one position to another indicating that vacuum is available at the control assembly. A continuous hiss at the control assembly indicates a major leak somewhere in the system. It does not necessarily indicate that the leak is at the control assembly.

If a momentary hiss cannot be heard when the function selector lever is moved from one position to another, check for a kinked, pinched, or disconnected vacuum source hose. Also inspect the check valve between the intake manifold and the vacuum reservoir to be sure it is working properly.

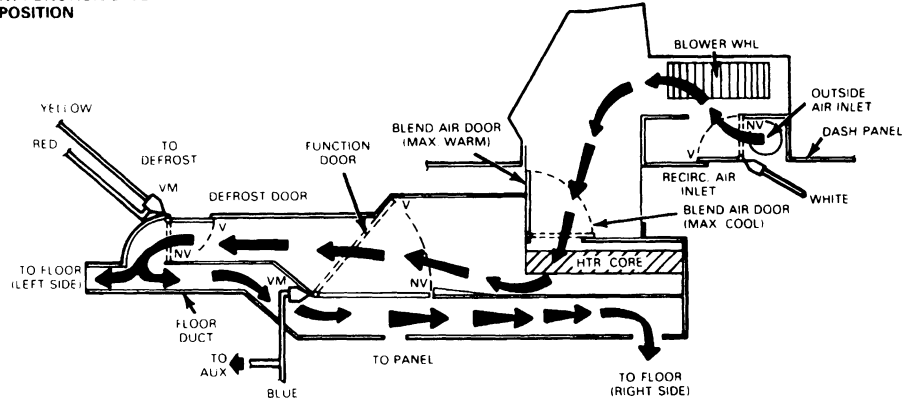
If a momentary hiss can be heard when the function selector lever is moved from one position to another, vacuum is available at the control assembly. Then, cycle the function selector through each position with the blower on HI and check the location(s) from which air is being discharged.

The air flow schematic indicates whether vacuum or no vacuum is being applied and shows the physical position of a door in response to the existing vacuum conditions. The vacuum diagram traces the vacuum lines from the selector switch to the motor each operates. If a vacuum motor fails to operate, the faulty one can be identified easily because air flow will not follow its intended course.

DIAGNOSIS AND TESTING (Continued)

Heater Vacuum Logic

AIRFLOW SHOWN WITH FUNCTION LEVER
IN FLOOR POSITION



HEATER VACUUM LOGIC

PORT	FUNCTION	MODE LEVER POSITION						HOSE COLOR
		OFF	VENT	HEAT	DEFOG	DEFROST		
1	RECIRC - OUTSIDE AIR	V	NV	NV	NV	NV		WHITE
2	FULL FLOOR	V	V	V	NV	NV		RED
3	FULL PANEL	NV	V	NV	NV	NV		BLUE
4	PARTIAL FLOOR	V	V	V	V	NV		YELLOW
5	—	SEALED	SEALED	SEALED	SEALED	SEALED		
6	—	SEALED	SEALED	SEALED	SEALED	SEALED		
7	SOURCE	V	V	V	V	V		BLACK
8	—							
9	—	SEALED	SEALED	SEALED	SEALED	SEALED		

CCL 4221-B

If a vacuum motor is inoperative, check its operation using Rotunda Vacuum Tester 021-00014 or equivalent. If the vacuum motor operates properly, the vacuum hose is probably pinched, kinked, disconnected or has a hole.

2. Remove three screws retaining control assembly to mounting bracket.

REMOVAL AND INSTALLATION

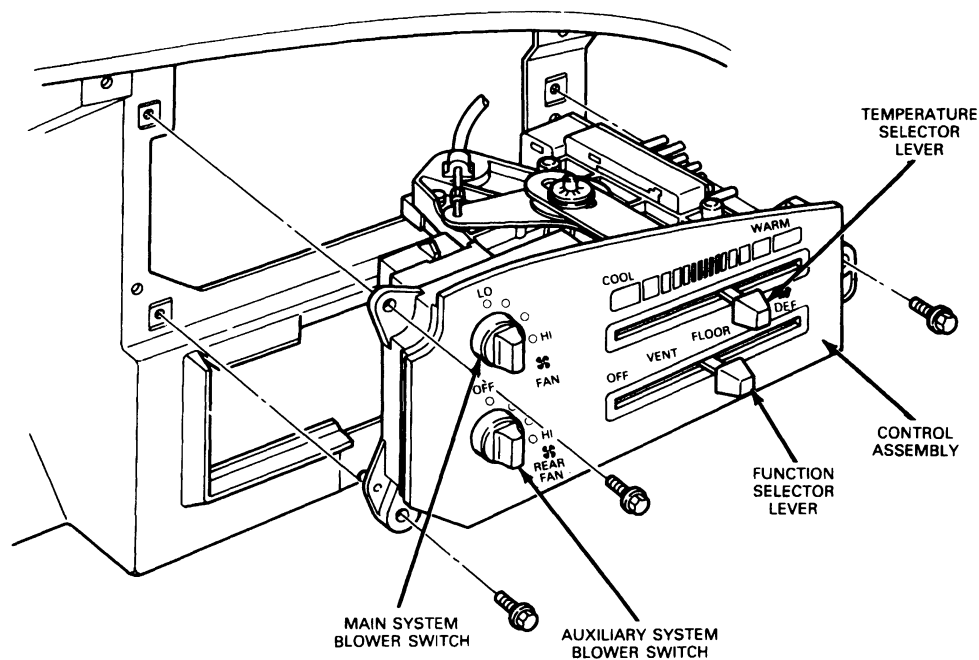
Control Assembly

Removal

1. Remove trim applique.

REMOVAL AND INSTALLATION (Continued)

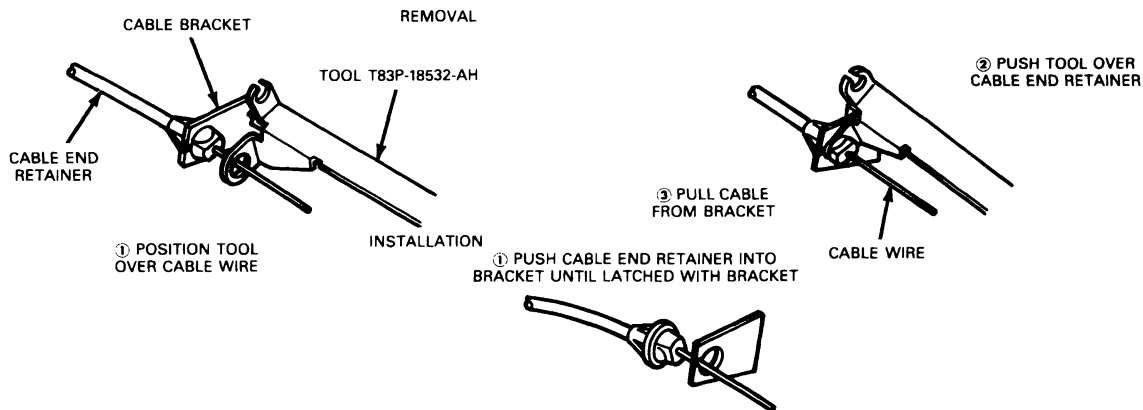
Heater Control Assembly Installation



CCL 4217-A

3. Carefully pull control assembly from opening in the mounting bracket.
4. Disconnect electrical connectors from blower switch(s), vacuum selector, and illumination bulb.
5. Remove push-on vacuum harness retaining clips from vacuum selector.
6. Disconnect vacuum harness from vacuum selector.
7. Remove temperature control cable from control assembly. Disconnect bullet-type cable retainer from bracket using Control Cable Removal Tool T83P-18532-AH or needlenose pliers to compress retaining ears. The cable "S" bend is removed from bottom side of the lever by rotating the cable wire 90 degrees to the lever.

Temperature Control Cable Removal and Installation



CCL 4247-A

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Connect temperature control cable to control assembly.
2. Connect vacuum harness to vacuum selector and retain with two push-on clips.
3. Connect electrical connectors to blower switches, vacuum selector valve and illumination bulb wire and socket assembly.
4. Carefully position control assembly against the mounting bracket and install four retaining screws.
5. Install applique.
6. Adjust the control cable as described in this section.

Blower Switch**Removal and Installation**

1. Remove knob from blower switch.
2. Remove trim applique.
3. Remove three screws retaining control assembly mounting bracket to instrument panel.
4. Carefully remove control mounting bracket and control assembly from instrument panel opening.
5. To remove blower switch, disconnect wiring connector from blower switch and remove one screw retaining switch mounting bracket to control assembly.

For installation, follow removal steps in reverse order. Operate system to verify correct operation.

Vacuum Selector Valve**Removal**

1. Remove instrument panel trim panel.
2. Remove four screws retaining control assembly mounting bracket to instrument panel.
3. Carefully remove control mounting bracket and control assembly from instrument panel opening.
4. Disconnect wiring connector from vacuum selector valve.
5. Remove two push-on vacuum harness retainer clips from vacuum selector and disconnect harness from valve.
6. Remove two screws retaining vacuum selector valve to control assembly. Remove vacuum selector valve.

Installation

1. Position temperature lever at left side of slot and the function control lever approximately 9.5mm (3/8 inch) from left side of slot.
2. Position vacuum selector valve against the control assembly, engaging selector lever arms with selector valve. Install two retaining screws.
3. Connect vacuum harness to selector valve and retain with two pushnuts.
4. Connect wiring connector to selector.
5. Position control assembly and bracket in instrument panel. Install four retaining screws.
6. Install trim panel.

REMOVAL AND INSTALLATION (Continued)

Heater Control Assembly, Rear View

ITEM	PART NUMBER	DESCRIPTION
1	18549/19980	CONTROL ASSEMBLY
2	14401	WIRING ASSEMBLY
3	—	VACUUM HARNESS
4	19D674	TEMP. CONTROL CABLE ASSY.
5	E8UH-19D961-AA	VACUUM SELECTOR VALVE

CCL 4190-A

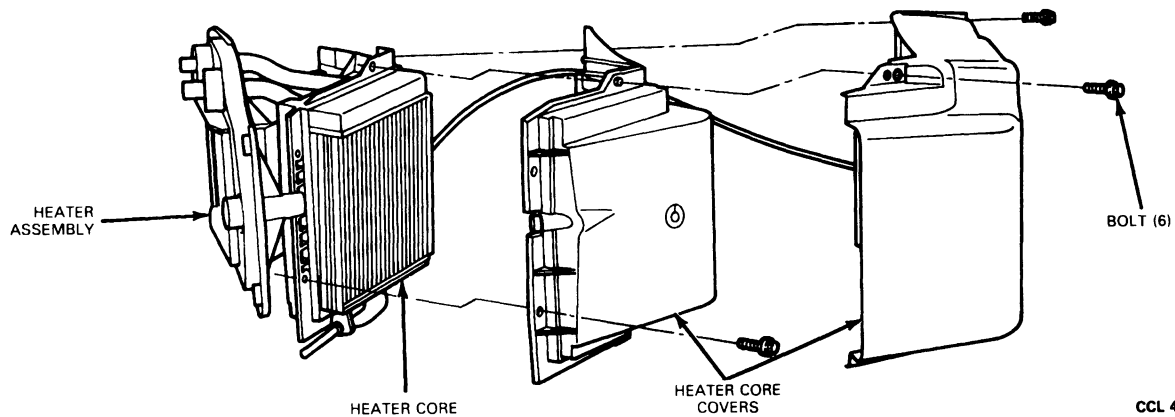
Heater Core

Removal and Installation

1. Remove the inlet and outlet hoses from the heater core in the engine compartment. Plug the hoses with a suitable 15.87mm (5/8-inch) plug.
2. Remove the snap-in modesty panel which runs along the lower edge of the instrument panel.
3. Remove six screws from the heater core cover located on both sides of the case underneath the instrument panel.

4. Remove the heater core cover.
5. Remove the heater core and seal from the case.

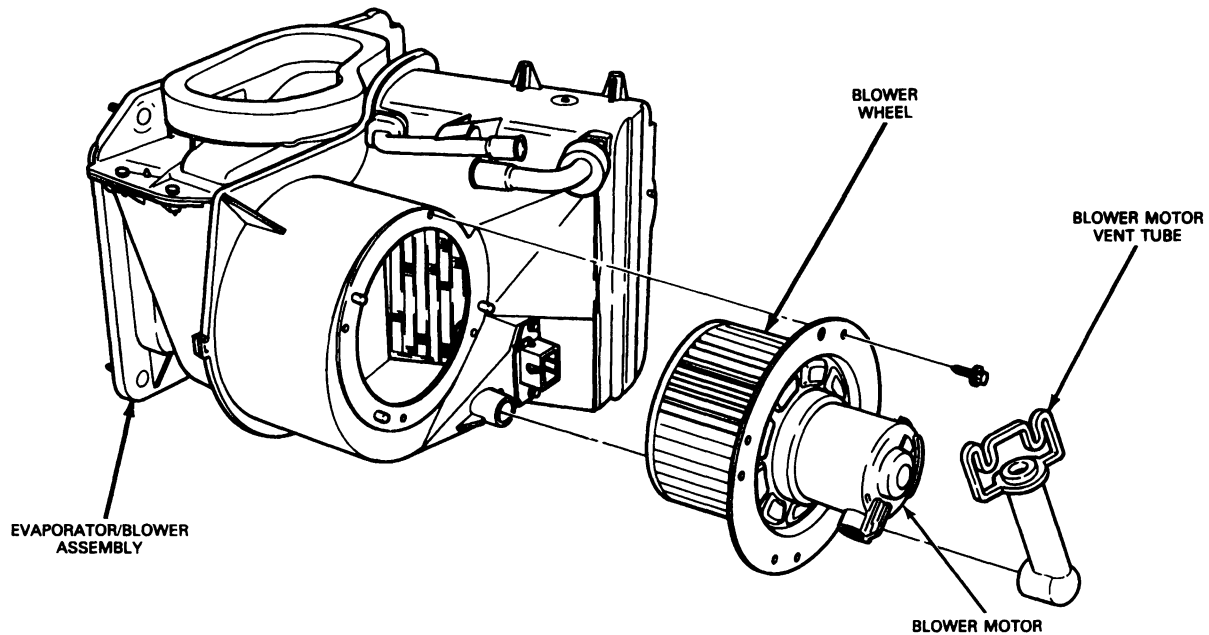
For installation, follow removal steps in reverse order. For fill procedures, refer to the Powertrain / Drivetrain Manual, Section 03-03.

REMOVAL AND INSTALLATION (Continued)**Heater Core and Covers****Blower Motor and Wheel Assembly****Removal**

1. Disconnect blower motor wiring connector and remove vent tube.
2. Remove four screws retaining the blower motor mounting plate to the evaporator case assembly.
3. Remove the motor and wheel assembly from the evaporator case. Align the flat spot on the motor mounting plate with the accumulator to provide clearance with the accumulator.
4. If the wheel is to be used on the new motor, install it on motor shaft so that distance from mounting plate to base of wheel is the same as the old motor installation.

Installation

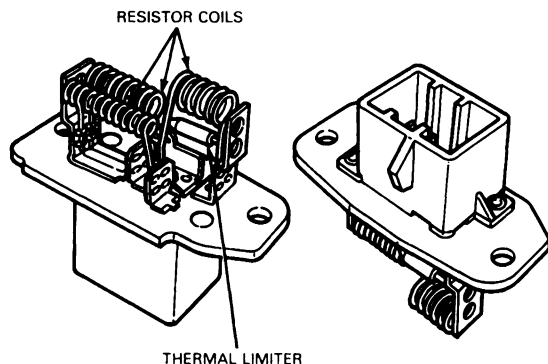
1. When wheel is properly installed on new motor, insert wheel into evaporator case and align locator pins with the holes in the base plate.
NOTE: Align the flat spot on the motor mounting plate with the accumulator to provide clearance with the accumulator.
2. Install four retaining screws.
3. Connect electrical wiring connector to blower motor and install vent tube.
4. Check blower motor for proper operation.

REMOVAL AND INSTALLATION (Continued)**Blower Motor and Wheel Assembly**

CCL 4252-B

Blower Motor Resistor**Removal and Installation**

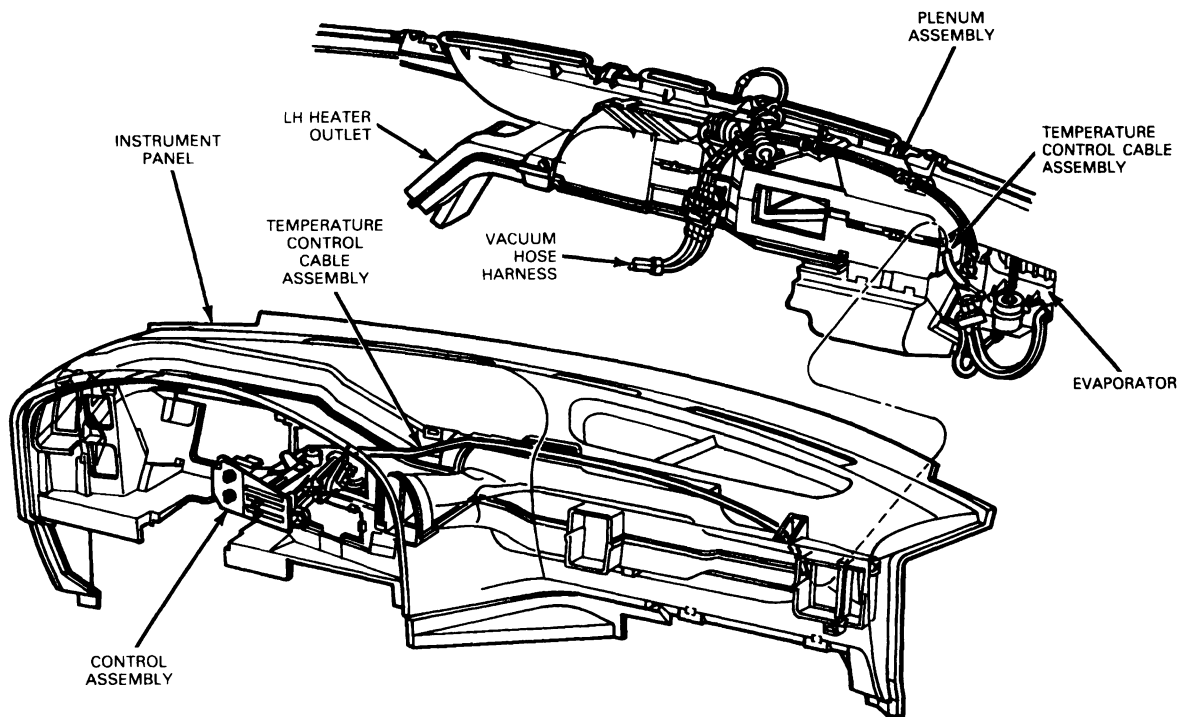
1. Disconnect the electrical lead from the blower motor resistor.
2. Remove the two screws which attach the resistor to the heater case.
3. To install, align the resistor with the holes in the case and in the baffle.
4. Install the attaching screws.
5. Install the electrical M-10 connector.

Blower Motor Resistor

CCL 4394-A

Instrument Panel

NOTE: It will be necessary to remove and install the instrument panel to service some components in the heater system. Refer to Section 01-12B.

REMOVAL AND INSTALLATION (Continued)**Heater System Components, Instrument Panel**

CCL 4237-A

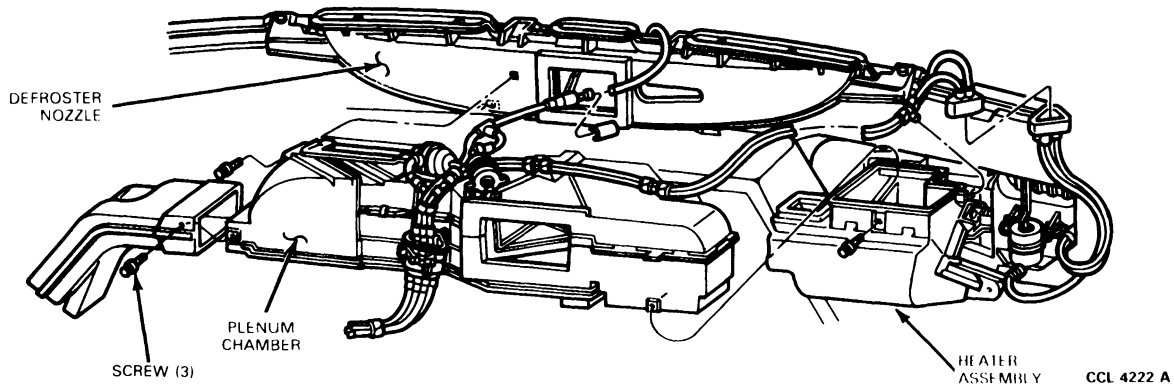
Register Ducts**Removal and Installation**

1. Remove the instrument panel. Refer to the procedures in Section 01-12B.
2. Remove the register duct mounting bolts and remove the duct.

For installation, follow removal steps in reverse order.

Plenum Chamber

The plenum chamber is located under the instrument panel on top of the heater core housing. For servicing the plenum-chamber, vacuum harness, and plenum doors, it is necessary to remove the instrument panel as described in Section 01-12B. It is not necessary to remove the instrument panel to service the vacuum motors attached to the plenum.

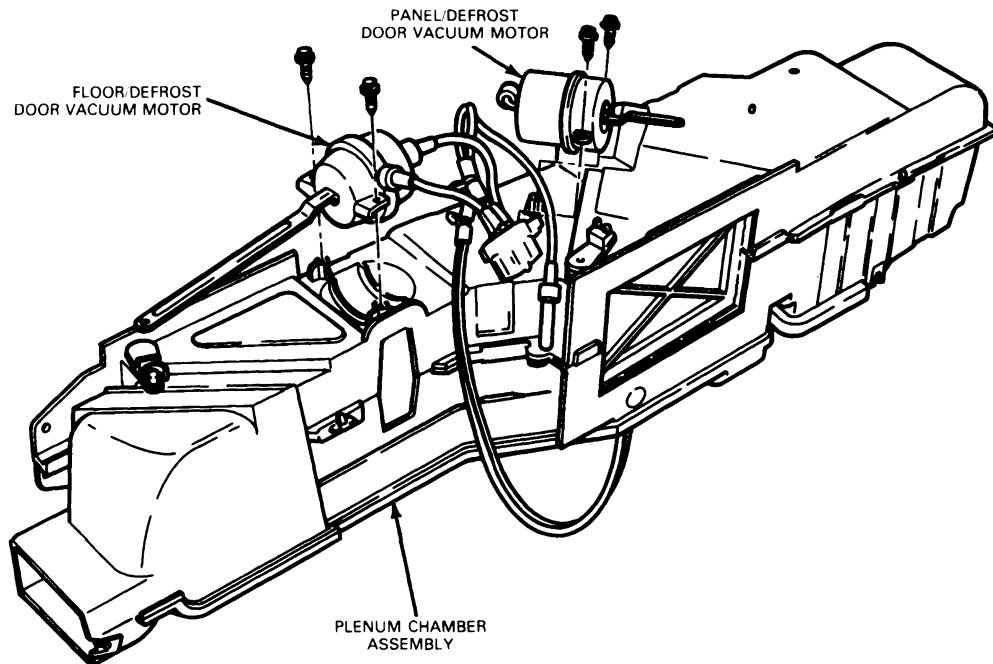
REMOVAL AND INSTALLATION (Continued)**Plenum Chamber Installation****Removal**

1. Disconnect vacuum hoses from panel / defrost vacuum motor and floor / defrost vacuum motor.
2. Separate plenum from evaporator-heater housing, center register duct, and heater air outlet duct and remove plenum.
3. Remove panel / defrost and floor / defrost vacuum motors from plenum.

Installation

1. Install panel / defrost and floor / defrost vacuum motors against the plenum.
2. Position plenum to center register duct, heater air outlet duct and evaporator-heater housing. Make sure clip on plenum is hooked over flange on evaporator-heater housing.

3. Install one retainer attaching center register duct and one retainer attaching heater air outlet duct to plenum.
4. Connect blue vacuum hose to top (end) of floor / defrost vacuum motor.
5. Connect yellow vacuum hose to top (end) of panel / defrost vacuum motor and red vacuum hose to side of panel / defrost vacuum motor.
6. Install instrument panel. Refer to Section 01-12B.
7. Check system for proper operation.

REMOVAL AND INSTALLATION (Continued)**Door Vacuum Motor Installation**

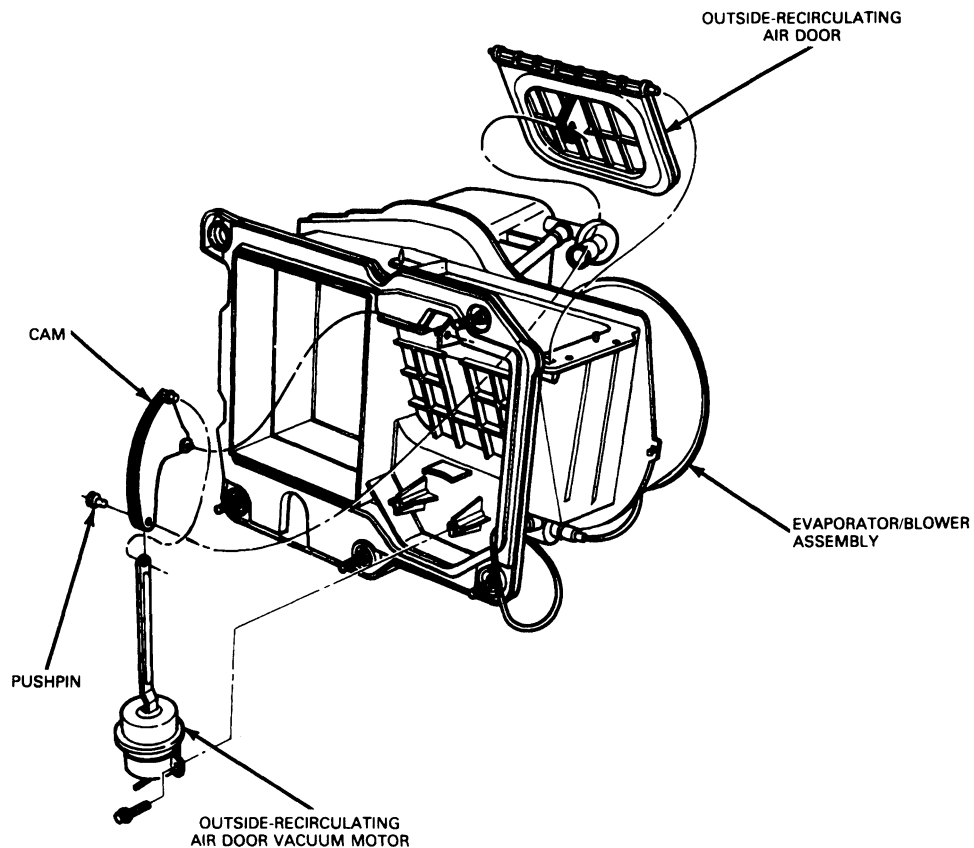
CCL 4223-A

Outside-Recirculation Air Door Vacuum Motor**Removal and Installation**

1. Remove two screws retaining motor to evaporator housing.
2. Disconnect vacuum hose from outside / recirculation vacuum motor.

3. Lift the vacuum motor until its arm is out of the channel which retains the arm to the pin. Slide the arm off the pin on the door lever. Remove the motor.

For installation, follow removal steps in reverse order.

REMOVAL AND INSTALLATION (Continued)**Outside-Recirculation Air Door Installation**

CCL 4224-A

Defroster Nozzle

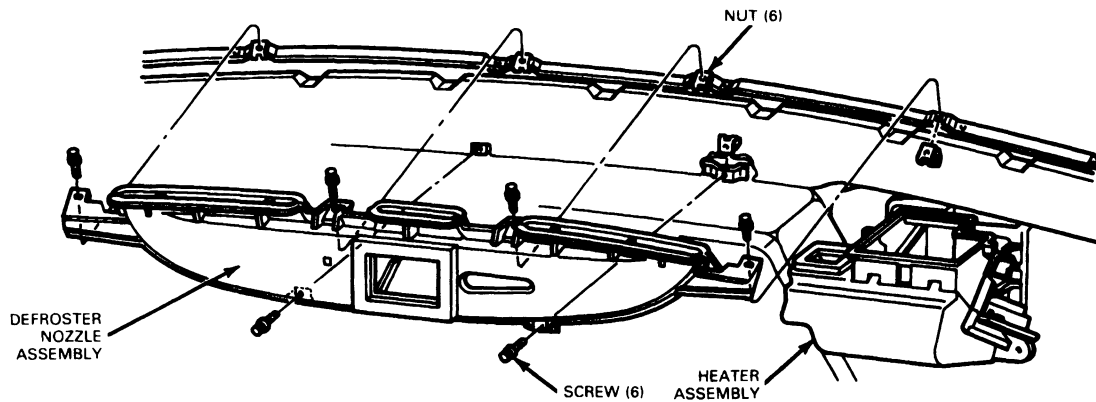
To remove the defroster nozzle, it is first necessary to remove the instrument panel. Refer to Section 01-12B. Remove heater ducts and register ducts as described in this section.

Removal and Installation

1. Remove the instrument panel. Refer to the procedures in Section 01-12B.

2. Remove the plenum assembly as described in this section.
3. Remove the defroster nozzle mounting screws (four screws at the cowl top and two screws attached to instrument panel brackets).
4. Remove the defroster nozzle assembly.

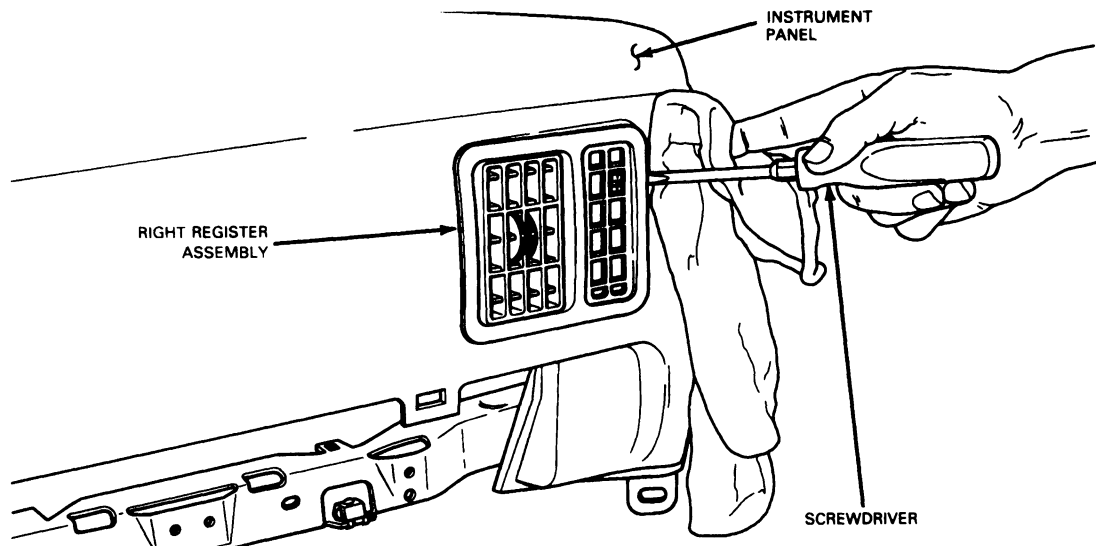
For installation, follow removal steps in reverse order.

REMOVAL AND INSTALLATION (Continued)**Defroster Nozzle Installation**

CCL 4238-A

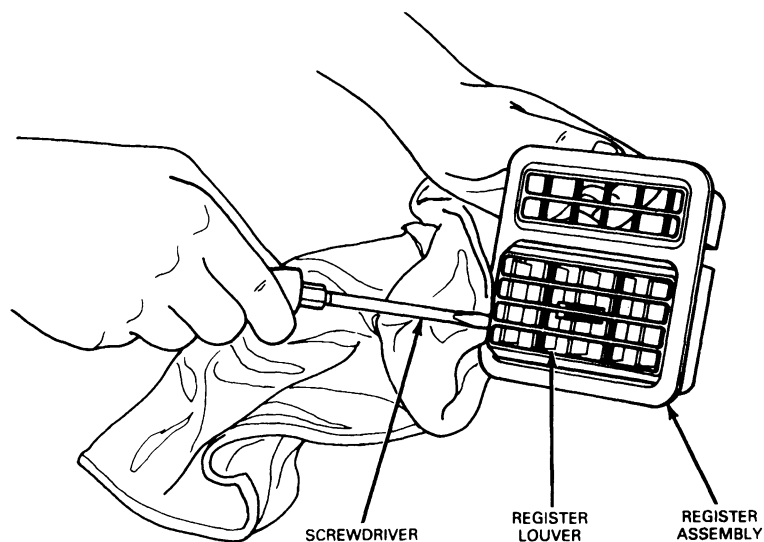
Right, Center and Left Register Louver Assembly**Removal and Installation**

1. Using a screwdriver, push in the four register assembly retaining tabs and pry the register assembly out of the instrument panel.

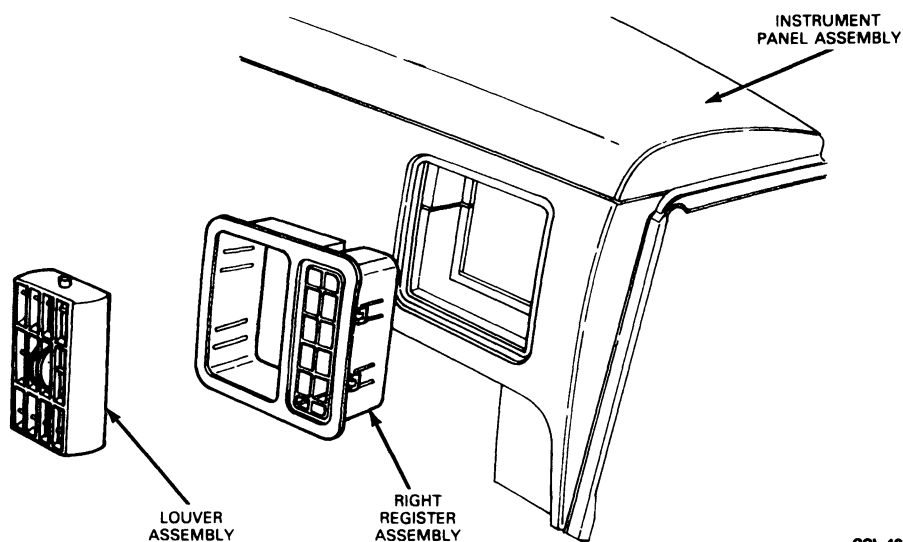
Right Register Assembly Removal

CCL 4256-A

2. Using a small bladed screwdriver, pry the louver assembly pivot pins out of their pivot holes. Remove the louver assembly from the register assembly.

REMOVAL AND INSTALLATION (Continued)**Register Louver Removal**

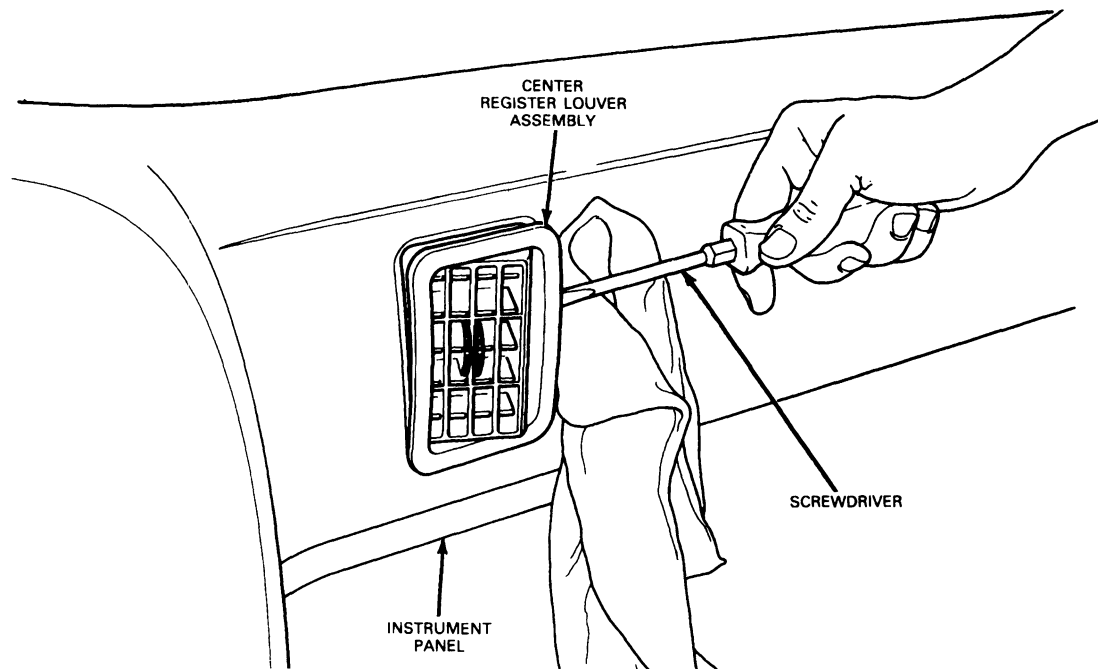
CCL 4255-A

Louver and Register, Disassembled View

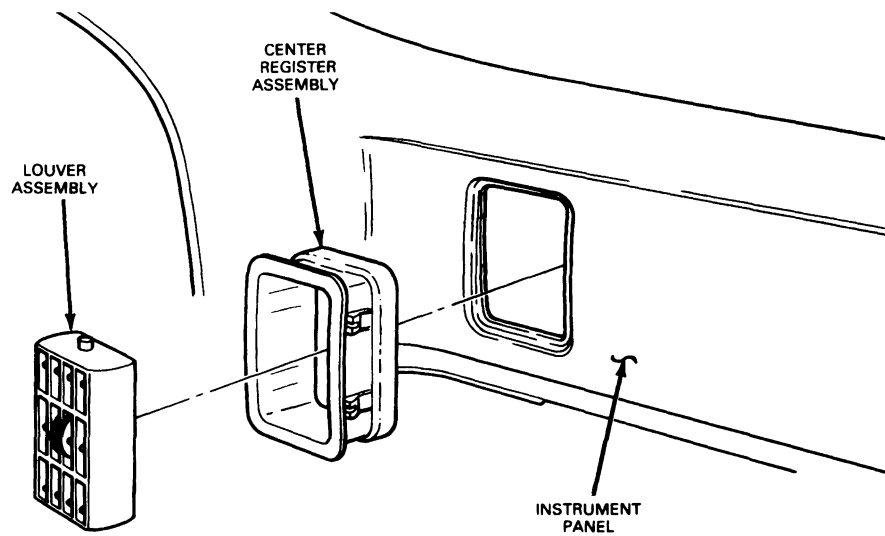
CCL 4254-A

For installation, follow removal steps in reverse order, assembling components by hand.

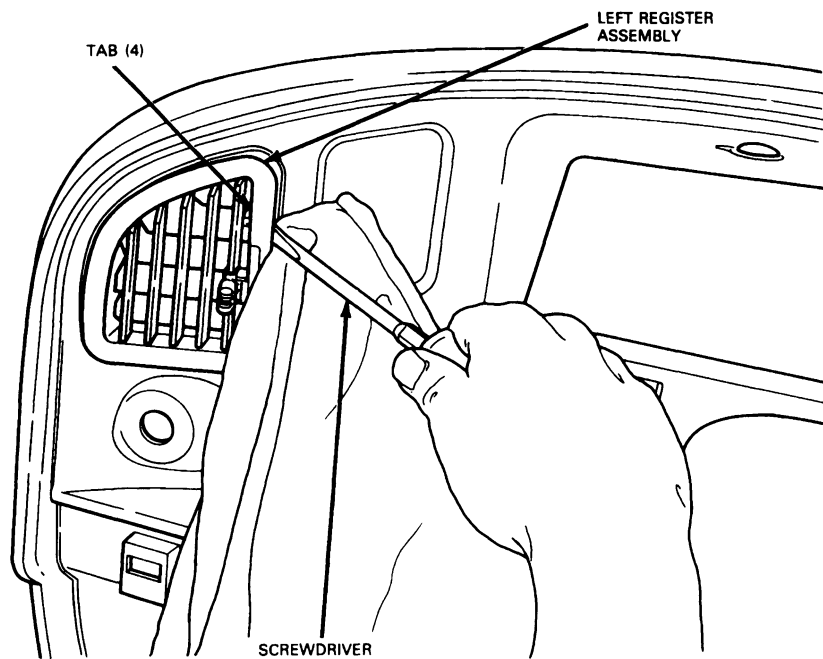
NOTE: The pivots on each end of some louver assemblies are different diameters and therefore determine the installed position.

REMOVAL AND INSTALLATION (Continued)**Center Register Assembly Removal**

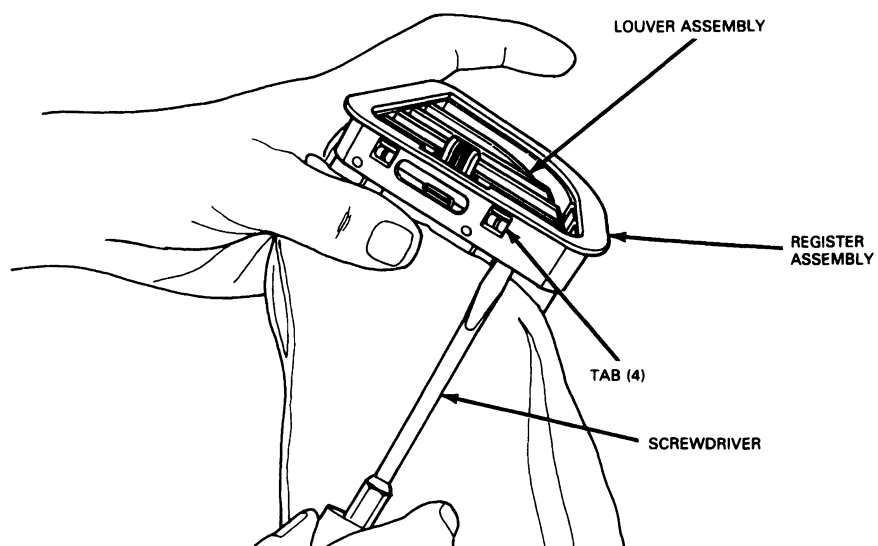
CCL 4258-A

Center Register and Louver Installation

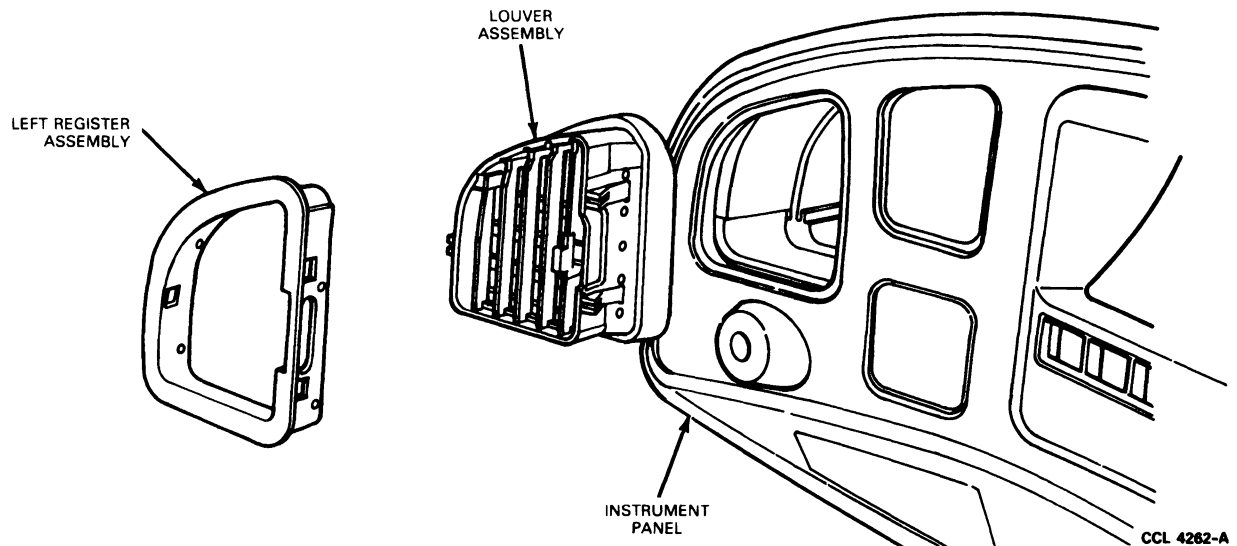
CCL 4257-A

REMOVAL AND INSTALLATION (Continued)**Left Register Assembly Removal**

CCL 4259-A

Left Louver Assembly Removal

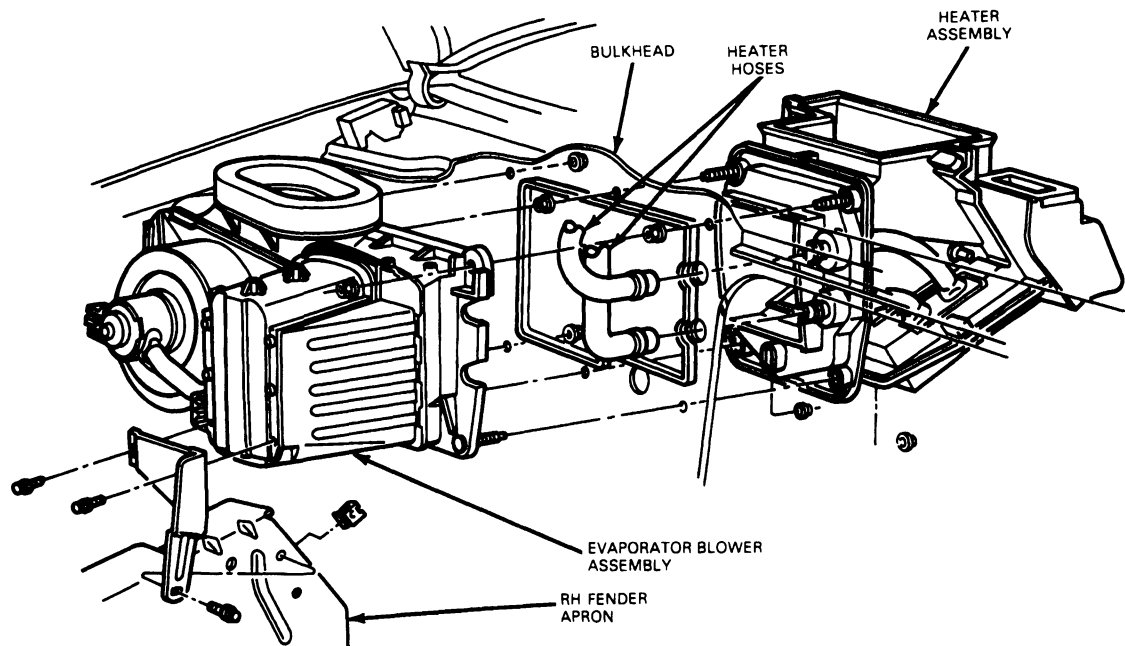
CCL 4260-A

REMOVAL AND INSTALLATION (Continued)**Left Register and Louver Installation****Heater Assembly**

There are four carriage bolts which pass through holes in the instrument panel, located around the edges of a large cutout in the panel. This cutout is an opening between the heater blower housing assembly (Part No. 18456) on the engine compartment side of the instrument panel and the evaporator housing assembly (Part No. 19A583), which houses the evaporator core when air conditioning is provided as an option. This evaporator housing assembly includes other components which are common to heating and air conditioning-heating systems, on the passenger compartment side of the panel. Nut and washer assemblies draw the two major components together through their gaskets at the instrument panel.

REMOVAL AND INSTALLATION (Continued)

Heater Assembly

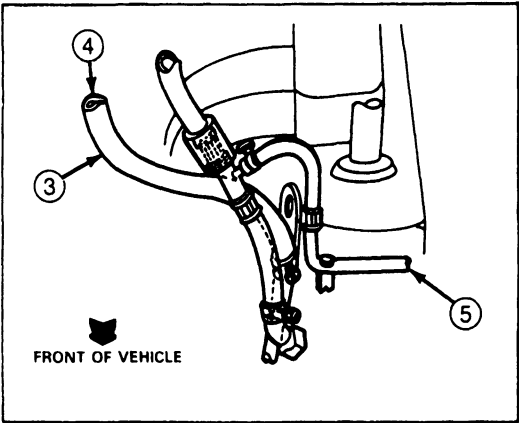
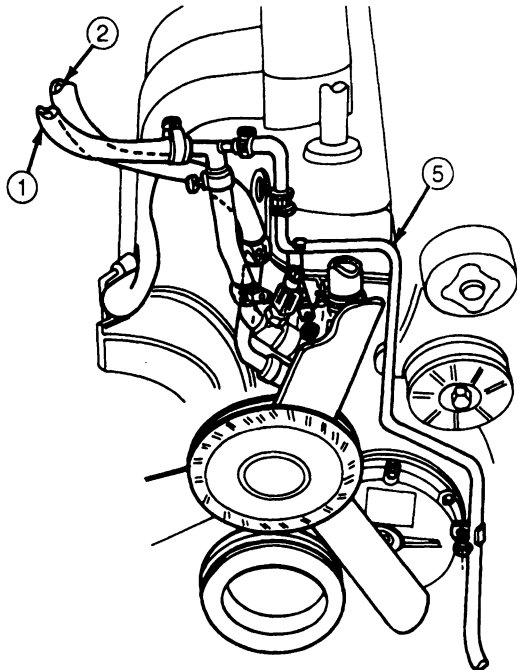


CCL 4235-A

Heater Hose Installations

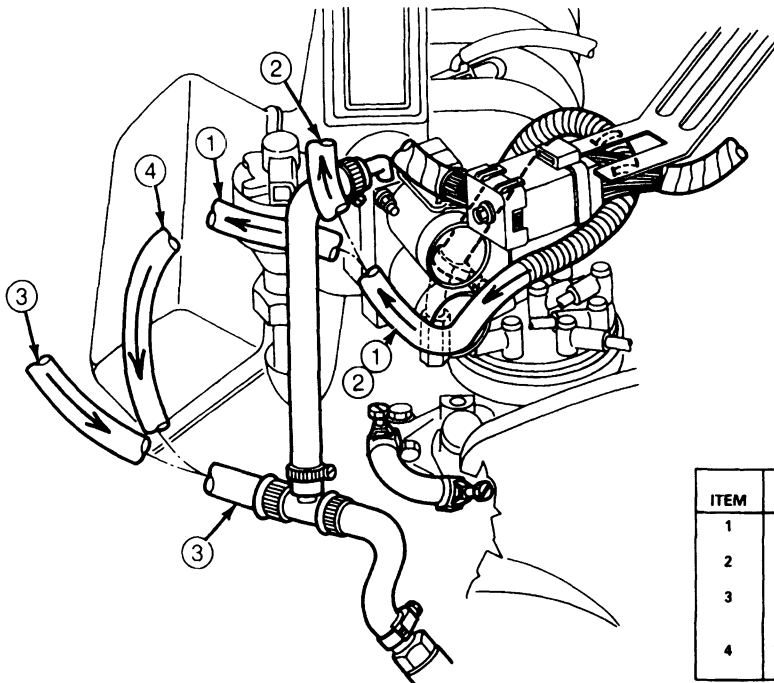
Refer to the following illustrations for heater hose installations.

4.9L (300 CID-6 Cylinder) Engine



ITEM	PART NUMBER	DESCRIPTION
1	18C266	BASE HEATER HOSE (ENGINE TO LOWER HEATER CORE TUBE)
2	18C266	BASE HEATER HOSE (UPPER HEATER CORE TUBE TO WATER PUMP)
3	18C266	AUX. HEATER HOSE (FRONT COWL TUBE TO WATER PUMP)
4	18C266	AUX. HEATER HOSE (ENGINE TO REAR COWL TUBE)
5	8548	WATER BYPASS TUBE

CCL 4263-B

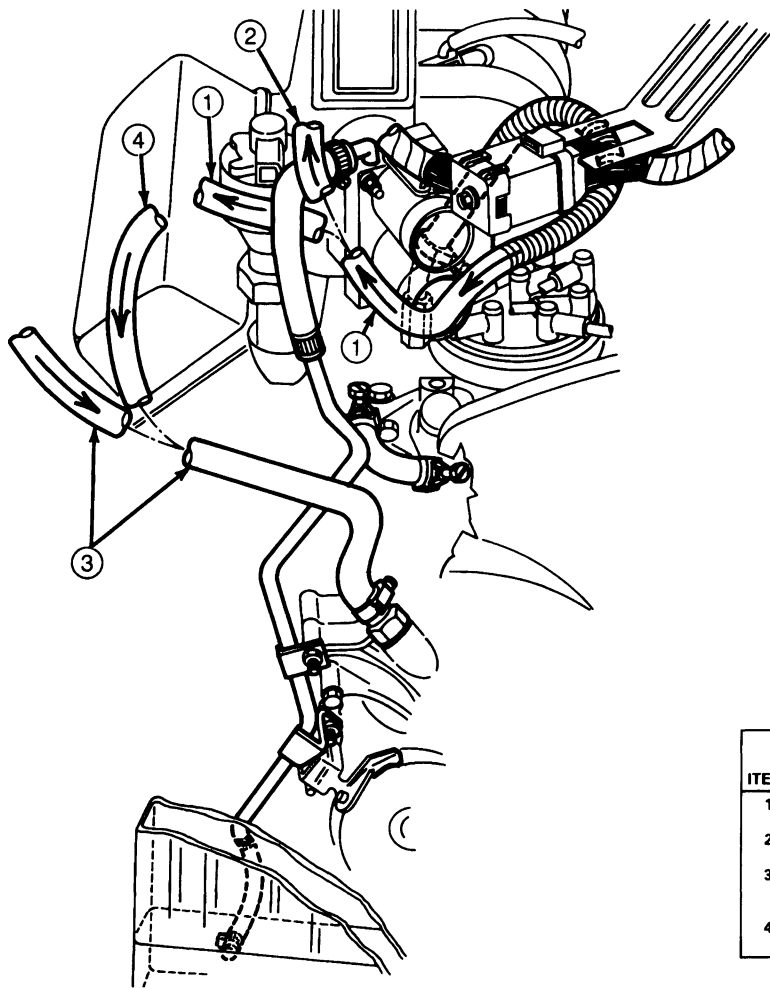
REMOVAL AND INSTALLATION (Continued)**5.0L (302 CID-8 Cylinder) Engine**

ITEM	PART NUMBER	DESCRIPTION
1	18C266	BASE HEATER HOSE (ENGINE TO LOWER HEATER CORE TUBE)
2	18C266	AUX. HEATER HOSE (ENGINE TO REAR COWL TUBE)
3	18C266	BASE HEATER HOSE (UPPER HEATER CORE TUBE TO WATER PUMP)
4	18C266	AUX. HEATER HOSE (FRONT COWL TUBE TO WATER PUMP)

CCL 4284-B

REMOVAL AND INSTALLATION (Continued)

5.8L (351 CID-8 Cylinder) Engine

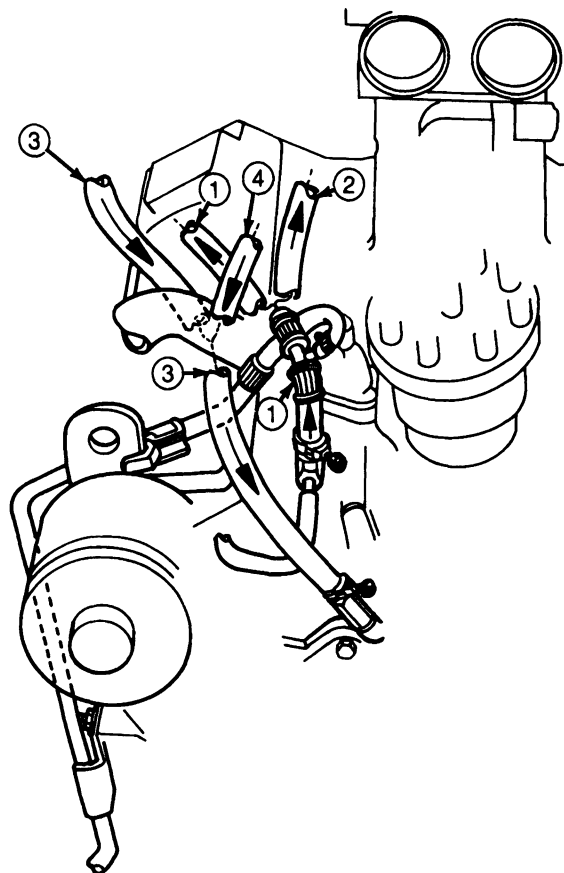


ITEM	BASIC PART NUMBER	DESCRIPTION
1.	18C266	BASE HEATER HOSE (ENGINE TO LOWER HEATER CORE TUBE)
2.	18C266	AUX. HEATER HOSE (ENGINE TO REAR COWL TUBE)
3.	18C266	BASE HEATER HOSE (UPPER HEATER CORE TUBE TO WATER PUMP)
4.	18C266	AUX. HEATER HOSE (FRONT COWL TUBE TO WATER PUMP)

CCL 4265-B

REMOVAL AND INSTALLATION (Continued)

7.5L (460 CID) 8 Cylinder

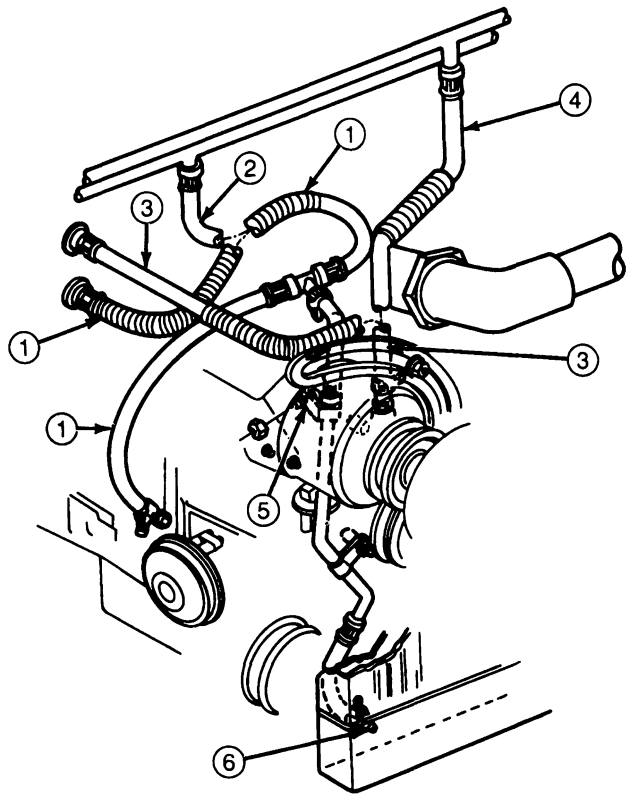


ITEM	BASIC PART NUMBER	DESCRIPTION
1	18C266	BASE HEATER HOSE (ENGINE TO LOWER HEATER CORE TUBE)
2	18C266	AUX. HEATER HOSE (ENGINE TO REAR COWL TUBE)
3	18C266	BASE HEATER HOSE (UPPER HEATER CORE TUBE TO WATER PUMP)
4	18C266	AUX. HEATER HOSE (FRONT COWL TUBE TO WATER PUMP)

CCL 4266-B

REMOVAL AND INSTALLATION (Continued)

7.3L (445 CID) Diesel Engine



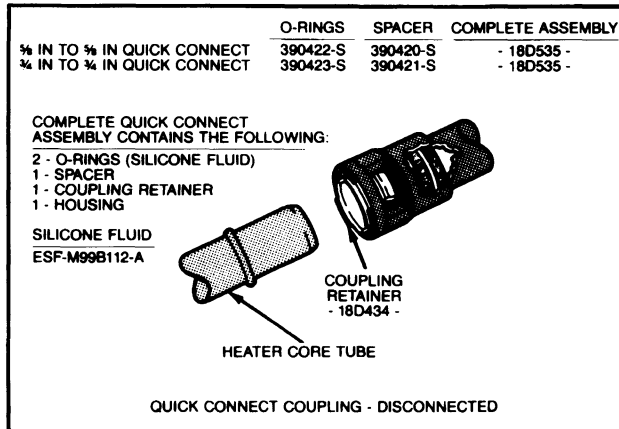
ITEM	BASIC PART NUMBER	DESCRIPTION
1	18C266	BASE HEATER HOSE (ENGINE TO LOWER HEATER CORE TUBE)
2	18C266	AUX. HEATER HOSE (ENGINE TO REAR COWL TUBE)
3	18C266	BASE HEATER HOSE (UPPER HEATER CORE TUBE TO WATER PUMP)
4	18C266	AUX. HEATER HOSE (COWL TUBE TO WATER PUMP)
5	8548	HOSE & TUBE ASSY.
6	18C603	NIPPLE

CCL 4267-B

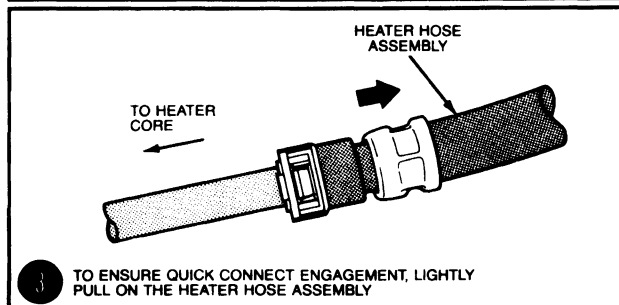
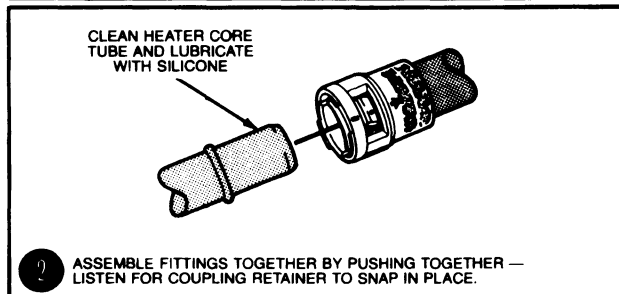
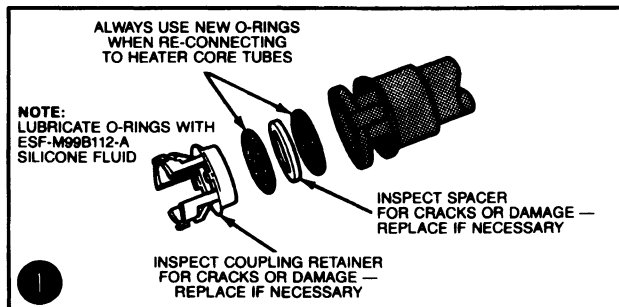
REMOVAL AND INSTALLATION (Continued)

Quick Connect/Disconnect Hose Couplings

The quick connect and disconnect tools for hoses having a quick connect coupling are shown in the following illustration.

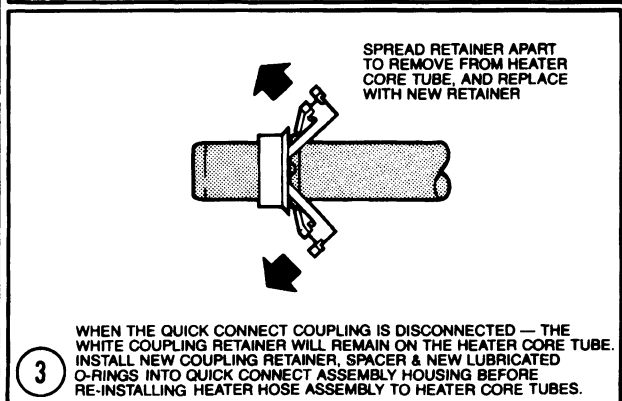
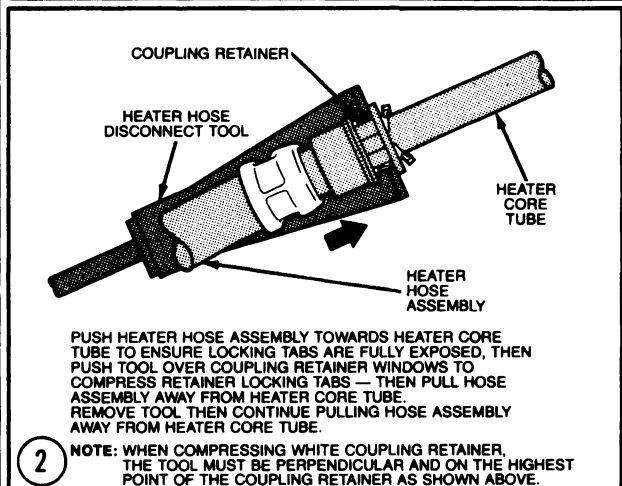
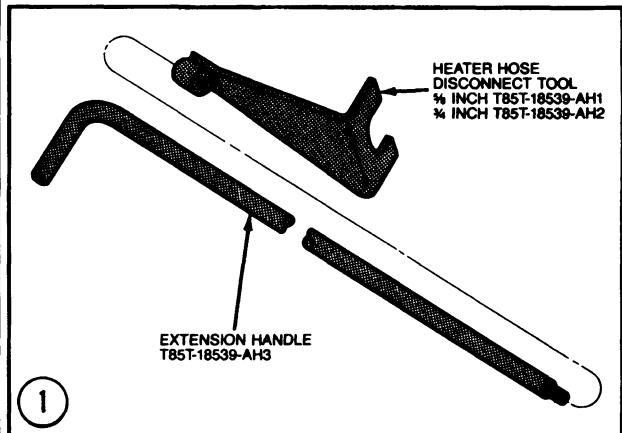


TO CONNECT COUPLING



TO DISCONNECT COUPLING

CAUTION — ENGINE SHOULD BE OFF BEFORE DISCONNECTING COUPLING



CCL 2443-A

SPECIFICATIONS**BLOWER MOTOR CURRENT DRAW AND VOLTAGE SPECIFICATIONS**

Switch Setting	Amps	Volts
Low	4.0	4.0
Medium Low	7.3	6.0
Medium High	13.8	9.0
High	23.0	12.8
Blower Circuit Protection — 30 Amp Fuse in Fuse Panel F-6		
Control Assembly Illumination — One ICP-161 Bulb		

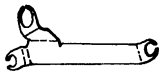
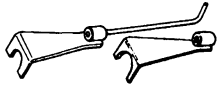
TORQUE SPECIFICATIONS

Item	N·m	In-Lb
Heater Hose Clamps	1.5-2.0	13 to 18

ROTUNDA EQUIPMENT

Tool Number	Description
021-00014	Vacuum Tester

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number/ Description	Illustration
T83P-18532-AH Heater Control Cable Disconnect Tool	 T83P-18532- AH
T85T-18539-AH 5/8 and 3/4 Inch Heater Hose Disconnect Tool	 T85T-18539- AH

SECTION 12-02B Heater and Ventilation System, F-Series and Bronco

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Temperature Control Cable	12-02B-26	Heater Core.....	12-02B-18
DESCRIPTION AND OPERATION		Heater Hoses.....	12-02B-20
Air Flow Distribution	12-02B-4	Heater Plenum Assembly	12-02B-14
Blower Control	12-02B-6	Heater Plenum Door Vacuum Motors	12-02B-17
Function Control Vacuum Circuit	12-02B-4	Heater Plenum Doors.....	12-02B-17
Temperature Selection	12-02B-4	Instrument Panel	12-02B-12
DIAGNOSIS AND TESTING		Mix Door Motor	12-02B-18
Blower Motor Current Draw Test	12-02B-7	Outside Air/Recirculated Air Door, Vacuum	
Blower Motor Voltage Test	12-02B-7	Motor, Crank and/or Door	12-02B-15
REMOVAL AND INSTALLATION		Panel/Defrost Door Vacuum Motor	12-02B-17
Blower Motor and Wheel.....	12-02B-19	Temperature Control Cable	12-02B-10
Blower Motor Resistor	12-02B-20	Temperature Control Cam/Cam Assist	
Blower Switch	12-02B-8	Spring.....	12-02B-11
Control Assembly	12-02B-7	Vacuum Selector Valve	12-02B-9
Defroster and Ventilation Ducts	12-02B-12	SPECIAL SERVICE TOOLS/EQUIPMENT	12-02B-27
Demister Nozzles and Hoses.....	12-02B-12	SPECIFICATIONS	12-02B-27
Floor Duct	12-02B-13	VEHICLE APPLICATION	12-02B-1
Heater Blower Assembly.....	12-02B-14		

VEHICLE APPLICATION

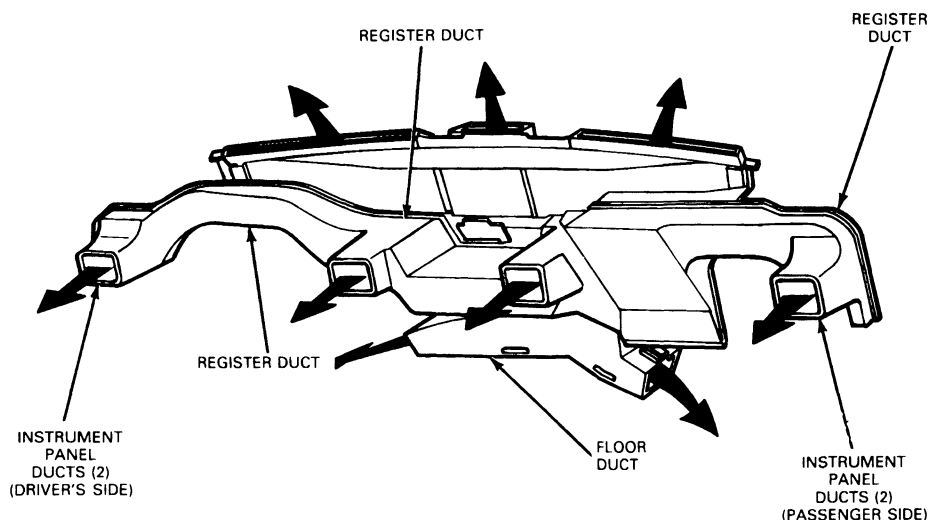
F-150-250-350, F-Super Duty Chassis Cab and
Bronco Vehicles

DESCRIPTION AND OPERATION

The heater-ventilation system is a blend air design. Outside air is supplied to the system through the cowl top grille. This air supply enters the blower housing where the blower motor and wheel directs some or all through or around the heater core depending upon the setting of the temperature control knob. Air flow through the plenum assembly is determined by the setting of the function control knob in the control assembly. The outlets through which air may be distributed into the passenger compartment are shown in the following illustration.

DESCRIPTION AND OPERATION (Continued)

Air Distribution



CCL 4191-B

The heater blower assembly is housed in a case which is similar to that used to house the air conditioning / heater system. The primary differences are the absence of refrigerant line openings in the case and the absence of exterior air conditioning components such as the suction accumulator / drier assembly.

The heater blower assembly includes:

- *Blower motor assembly
- *Blower motor resistor
- *Outside air / recirc air door
- *Vacuum motor to operate outside / recirc door

The heater blower assembly is installed on the engine compartment side of the dash panel. Electrical wire receptacles for the blower motor and resistor are provided on the case and a vacuum connection is provided on each vacuum motor.

A plenum assembly, on the passenger compartment side of the dash panel attaches to the heater blower assembly through the panel with an air passage between the assemblies provided through an opening in the panel.

The plenum includes the following components:

- heater core
- temperature blend door
- panel / defrost door
- floor / defrost door
- vacuum motors and electrical and vacuum harnesses

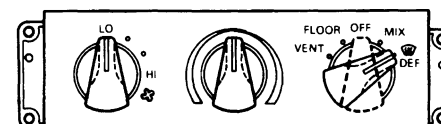
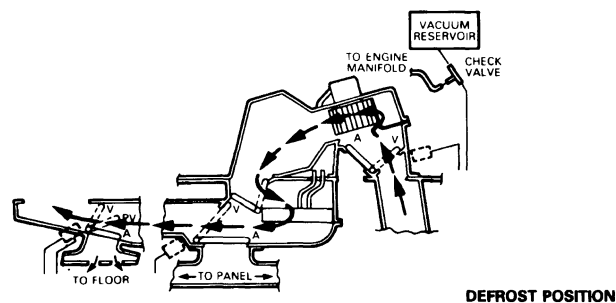
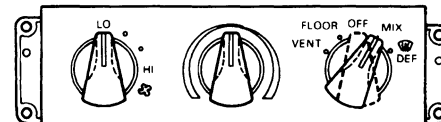
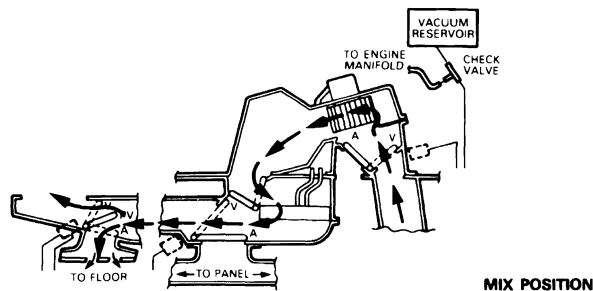
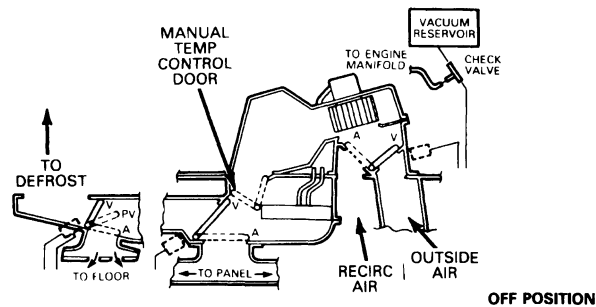
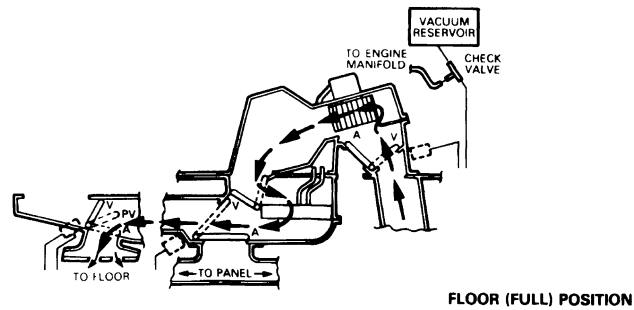
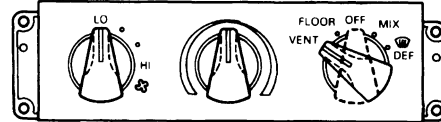
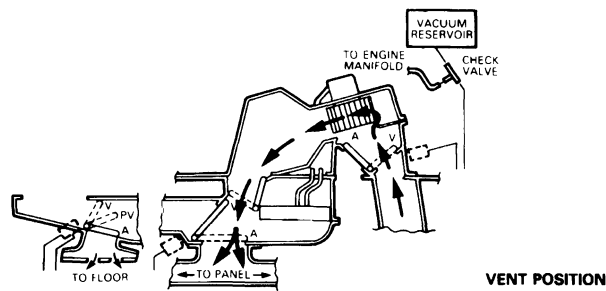
The vacuum motors and their vacuum harness lines operate the floor / defrost and panel / defrost doors. The temperature blend door is operated mechanically by a cable attached to the temperature control lever in the control assembly.

Refer to the following illustration to identify instrument panel ducts, floor duct, defroster nozzle, demister and demister hoses.

It shows the function control knob in each of its five positions. These five positions are: VENT, OFF, FLOOR, MIX and DEFROST. The direction of air flow through the system in each of the function knob settings is shown.

DESCRIPTION AND OPERATION (Continued)

Heater-Ventilation System Air Flow



CCL 4192-A

DESCRIPTION AND OPERATION (Continued)

The rate and volume of air flow is determined by the setting of the four-position blower switch knob. The blower switch is located in the control assembly at the left of the temperature and function selector knobs. The knob settings are: LOW, MEDIUM LOW, MEDIUM HIGH, and HIGH. The switch does not have an OFF position. To stop blower operation, the function knob must be in its OFF position.

The temperature control is located between the blower and function knobs in the control assembly to indicate the amount of cool and/or warm air being directed through the system. The function knob, located at the right of the blower speed and temperature selector knobs, can be rotated to either of the five positions called out around the knob.

To start air flow through the system, set the function knob in the desired position (VENT, OFF, FLOOR, MIX, or DEFROST). Set the blower switch in either of its four positions (LOW, MEDIUM LOW, MEDIUM HIGH or HIGH).

Temperature Selection

Depending upon its position, the temperature blend door in the plenum chamber directs a given amount of air through the heater core to provide a desired amount of heat. As the amount of air directed by the blend door through the heater core is reduced, less heat will be directed into the passenger compartment.

Conversely, a fully open damper door, in response to a fully WARM setting of the temperature control knob, will provide maximum heat into the passenger compartment.

Air Flow Distribution

The position of the function knob in the control assembly determines which of the damper doors are open, partially open, or closed.

If the knob is in the VENT position, the OUTSIDE AIR door is open and the PANEL / DEFROST door is open. The air flow is directed to the registers in the instrument panel. The position of the BLEND AIR door, based upon the setting of the temperature knob in the control assembly, may be set as desired between cool and warm to obtain the desired blend of cool or heated air.

If the knob is in the OFF position, the OUTSIDE AIR door is closed to block the entry of air from the cowl into the plenum chamber.

If the knob is in the FLOOR position, the OUTSIDE AIR door is open. Air flow is directed through the TEMPERATURE BLEND door opening, through the heater core, past the closed PANEL / DEFROST door, and out through the open MIX door to the floor outlets. There will be an air bleed past the closed DEFROST door to the defrosters.

If the lever is in the FLOOR / DEFROST position, the air flow follows the same path as described for FLOOR position, except the MIX door is in the partial vacuum or mid-position with an equal amount of vacuum being applied to each side of the door. This allows equal amounts of air flow to the floor outlet and defrosters.

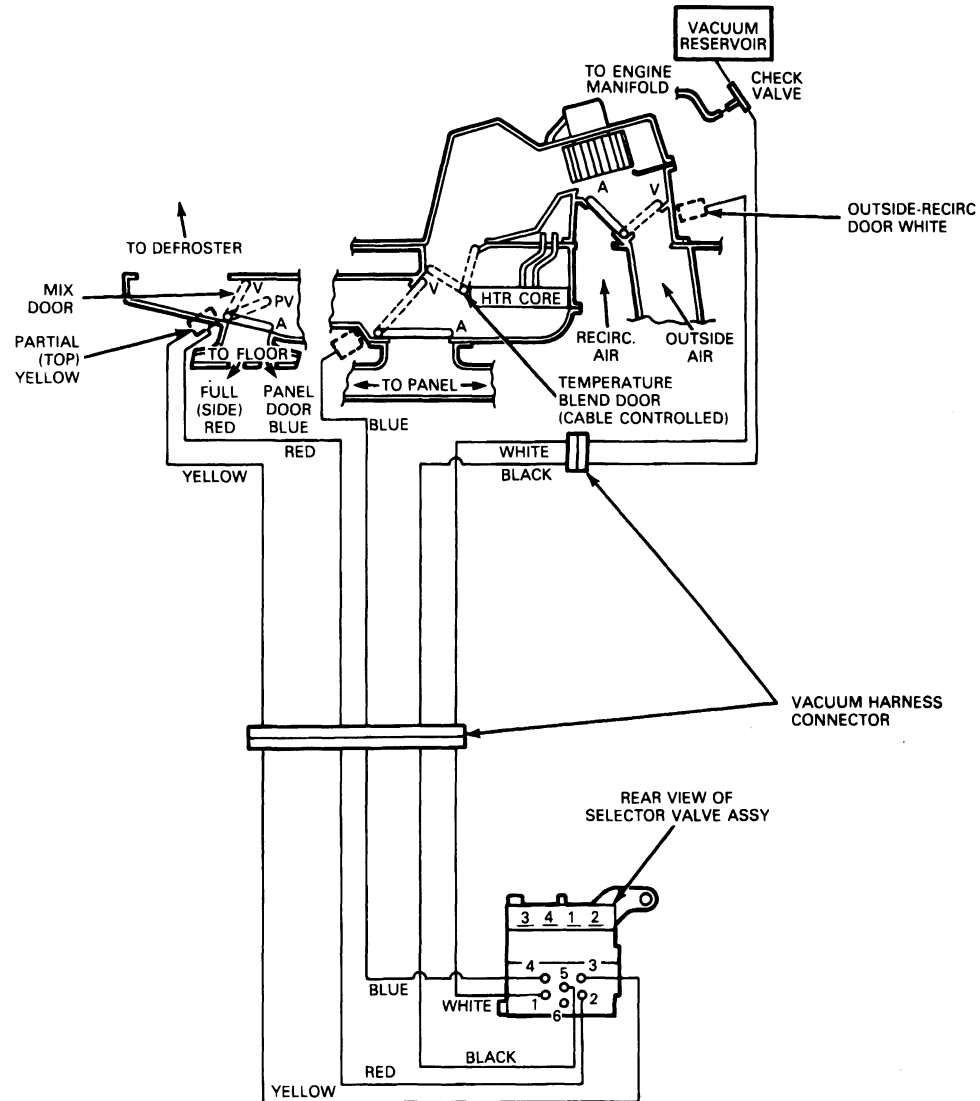
If the knob is in the DEFROST position, the MIX door is fully open to the defroster nozzle with a bleed amount going past the closed door to the floor outlet.

Function Control Vacuum Circuit

The following diagram illustrates the vacuum hose connections between the vacuum source, vacuum motors, and vacuum selector valve. The diagram also identifies the color coding of the vacuum hoses and charts the function knob settings and vacuum application by vacuum selector valve port and function.

DESCRIPTION AND OPERATION (Continued)

Vacuum Diagram and Selector Test

FUNCTION SELECTOR VALVE
DETENT POSITIONS

PORT	FUNCTION	VENT	OFF	FLOOR	MIX	DEF
1	RECIRC — O/S	A	V	A	A	A
2	FULL FLOOR	A	V	V	A	A
3	PANEL	V	V	V	V	A
4	MIX	V	V	A	A	A
5	SOURCE	V	V	V	V	V

V = VACUUM
A = ATMOSPHERE

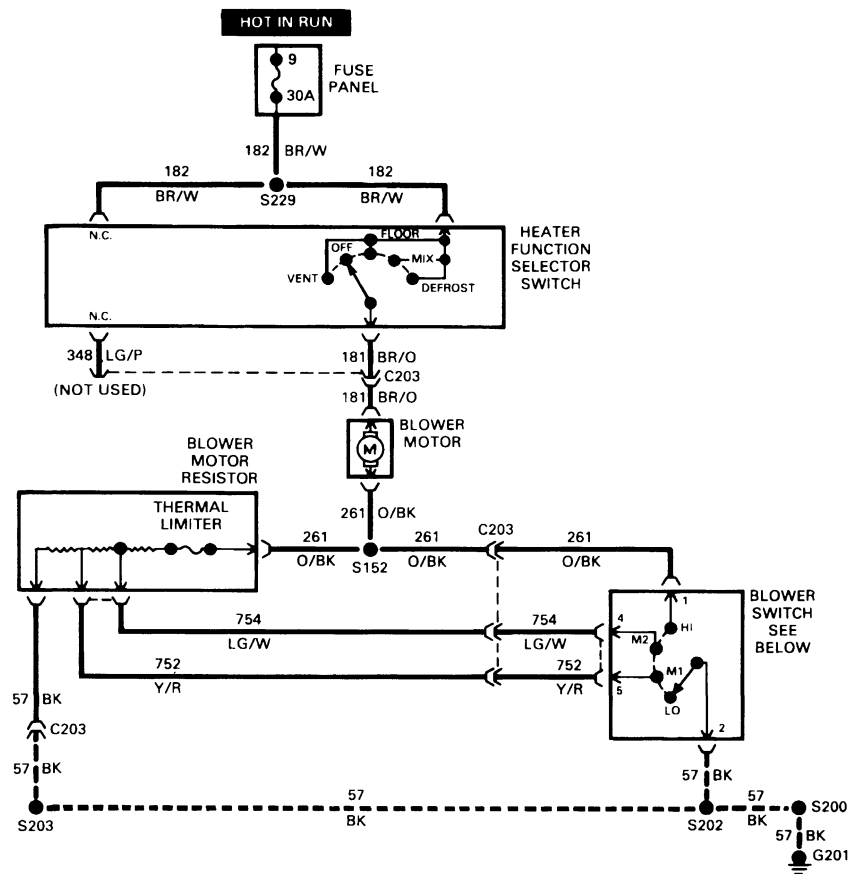
CCL 4193-B

DESCRIPTION AND OPERATION (Continued)

Blower Control

Three of four blower operating speeds (LOW, MEDIUM LOW and MEDIUM HIGH) are controlled by a resistor assembly connected in series with three of the blower switch operating positions and the blower motor ground. The MEDIUM LOW and MEDIUM HIGH switch positions on the control assembly are identified by asterisks rather than word callouts.

Heater System Electrical Schematic



TERMINAL LOCATIONS	SCHEMATIC	COMPONENT TESTING PROCEDURE			
		TO TEST	Connect Self-Powered Test Lamp or Ohmmeter to Terminals	Move Switch to These Positions	A Good Switch Will Indicate
		Medium-Low Speed	57 (BK) 2 and 752 (Y/R) 5	Lo M1 M2 Hi	Open circuit Closed circuit Open circuit Open circuit
		Medium Speed	57 (BK) 2 and 754 (LG/W) 4	Lo M1 M2 Hi	Open circuit Open circuit Closed circuit Open circuit
		High Speed	57 (BK) 2 and 261 (O/BK) 1	Lo M1 M2 Hi	Open circuit Open circuit Open circuit Closed circuit

CCL 4099-B

DESCRIPTION AND OPERATION (Continued)

With the switch in its LOW position, current flow in the motor ground circuit passes through three of the coils in the resistor. In MEDIUM LOW, current flows through two resistor coils. In MEDIUM HIGH, current flows through one resistor coil. In HIGH, current flow in the motor ground circuit by-passes the resistor to provide maximum blower speed.

DIAGNOSIS AND TESTING**Blower Motor Voltage Test**

1. Place temperature selector lever in mid-range position (halfway between COOL and WARM).
2. Place function control lever in PANEL position (air through registers).
3. Insert probes of Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, into connector at rear of blower motor and make contact with wire terminals. With engine running, measure voltage drop across motor.
4. With engine running (battery voltage approximately 14.2 volts), voltage reading should be within range specified for each blower motor knob position. (Refer to Specifications at the end of this section.)

Blower Motor Current Draw Test

1. Disconnect blower motor electrical wire harness.
2. Connect Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent between left (positive) terminal on motor and corresponding terminal in the wire harness connector. Set meter in the AMPS position. Connect a jumper wire between right (ground) terminal on motor and corresponding terminal in the wire harness connector.
3. Place system temperature control knob in the mid-range position (halfway between COOL and WARM) and function control lever in PANEL position (air through registers).
4. With battery fully charged, start engine and operate blower in all blower speeds. Record current draw for each blower speed.
5. The current draw for each blower speed should be within the limits shown in Specifications at the end of this section.
6. Disconnect Digital Volt-Ohmmeter and jumper wire. Connect the harness connector to blower motor.
7. Check blower system for proper operation.

REMOVAL AND INSTALLATION**Control Assembly****Removal**

1. Disconnect the battery ground cable(s).
2. Remove the trim strip above the control assembly and glove compartment area.
3. Remove the two screws which attach the center finish panel to the instrument panel to gain access to the four screws which attach the control assembly to the instrument panel. Refer to Section 01-12.
4. Remove the four screws. Then, pull the control assembly far enough through the opening in the panel to allow disengagement of the electrical connectors for the blower switch and control illumination lamp.
5. Disconnect the electrical harness connectors from the fan control switch and illumination connectors on the control assembly.
6. Remove the vacuum harness connector from the stowage notch in the floor distribution duct. Disconnect the vacuum harness from the plenum vacuum harness connector.
7. Using a screwdriver or needlenose pliers, carefully release the temperature control snap-in flag from the underside of the control assembly.
8. Rotate the control assembly 90 degrees and disconnect the temperature control cable from the temperature control tab on the gear rack.
9. Move the control assembly away from the instrument panel.

Installation

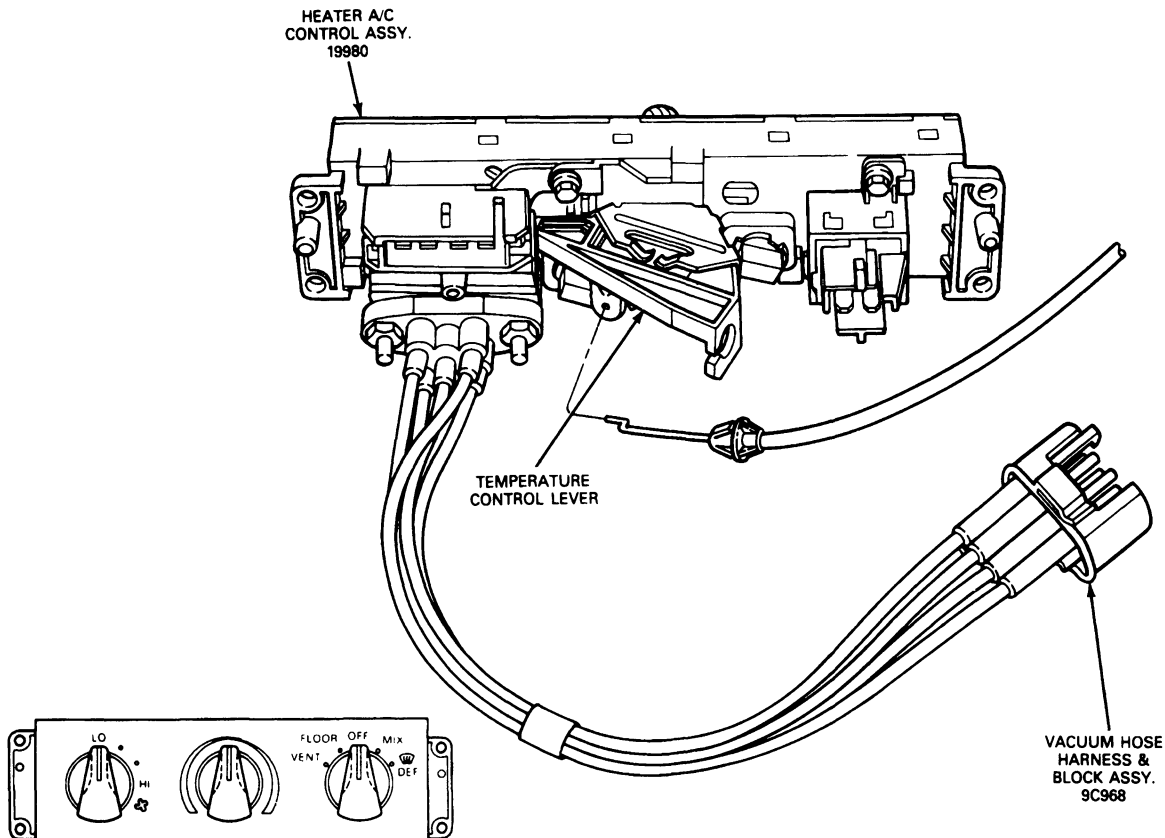
1. Pull the temperature control cable through the control assembly opening in the instrument panel for a distance of approximately 200mm (8 inches).
2. Hold the control assembly against the instrument panel with the face of the control directed toward the roof of the vehicle. Attach the temperature cable to the gear rack.
3. Rotate the control assembly back to the position it occupies for insertion into its instrument panel opening. Snap the cable end into the control bracket. Be sure that the end is firmly seated.
4. Connect the wire harness to the blower switch and control illumination lamp. Attach the vacuum harness to the vacuum selector valve and to the plenum harness.
5. Attach the vacuum harness connector to the stowage notch in the floor distribution duct.
6. Position the control assembly into its instrument panel opening while being careful that the vacuum and electrical harness are properly stowed and install four retaining screws.
7. Install the trim strip above the control assembly and glove compartment area and install two retaining screws.

REMOVAL AND INSTALLATION (Continued)

8. Connect the battery ground cable(s).

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

9. Check the system for proper operation.

Heater Control Assembly, Rear View

CCL 4195-B

Blower Switch**Removal**

1. Remove the instrument panel center finish panel. Refer to Section 01-12A.
2. Disconnect the battery ground cable(s).
3. Remove the control assembly from the instrument panel as described previously. Do not detach cables.
4. Remove the knob from the blower switch by pulling on the knob.
5. Pull control assembly through instrument panel opening far enough to allow removal of blower switch electrical connector.

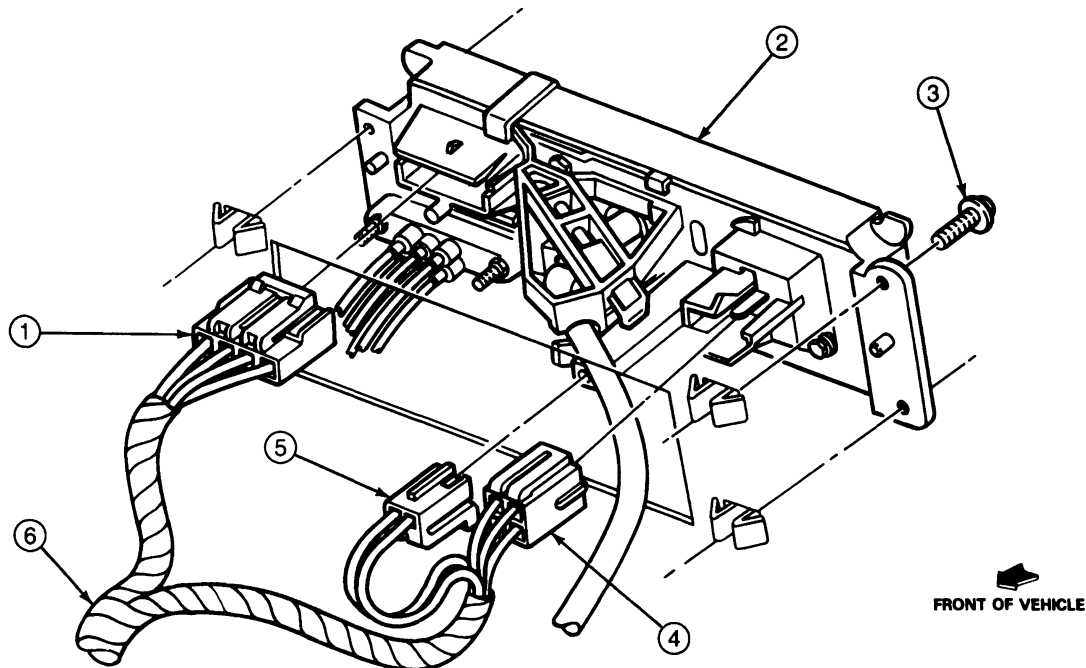
6. Remove electrical connector from switch by lifting snap-lock retainer with a screwdriver and pulling on the connector.
7. Remove the attaching screw and rotate the switch counterclockwise to release it from the retaining tabs.

Installation

1. Insert the switch shaft without its knob through the opening in the control assembly.
2. Rotate the switch clockwise to engage it with the retaining tabs. Install the attaching screw.
3. Install the switch knob.
4. Attach the electrical connector to the blower switch.

REMOVAL AND INSTALLATION (Continued)

5. Position the control assembly in its instrument panel opening. Then, install its four attaching screws.
6. Install the instrument panel finish panel. Refer to Section 01-12A.
7. Connect the battery ground cable(s).
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
8. Check the blower switch for proper operation.

Heater Control Assembly Electrical Connections

ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1.		TO HEATER MODE SWITCH	4.		TO A/C BLOWER SWITCH
2.	18159	CONTROL ASSY. HEATER	5.		TO A/C ILLUMINATION
3.	19980	CONTROL ASSY. HEATER/AC	6.	14401	WIRING ASSY.
	N803877-S36B	SCREW 876			

CCL 4196-A

Vacuum Selector Valve**Removal**

1. Disconnect the battery ground cable(s).
2. Remove the control assembly from the instrument panel as described in this section.
3. Disconnect the electrical connector from the switch by lifting the snap lock retainer with a screwdriver while pulling on the connector.
4. Remove the screw which attaches the vacuum selector valve to the control assembly and rotate the assembly counterclockwise to release it from the retaining tabs.

5. Remove the two nuts which secure the vacuum harness to the selector valve, and remove the harness.

Installation

1. Install the vacuum harness on the vacuum selector valve.
2. Position the vacuum selector valve over its mounting location on the control assembly. Rotate the selector valve clockwise to engage its retaining tab. Install the attaching screw.
3. Connect the vacuum harness to the selector valve.

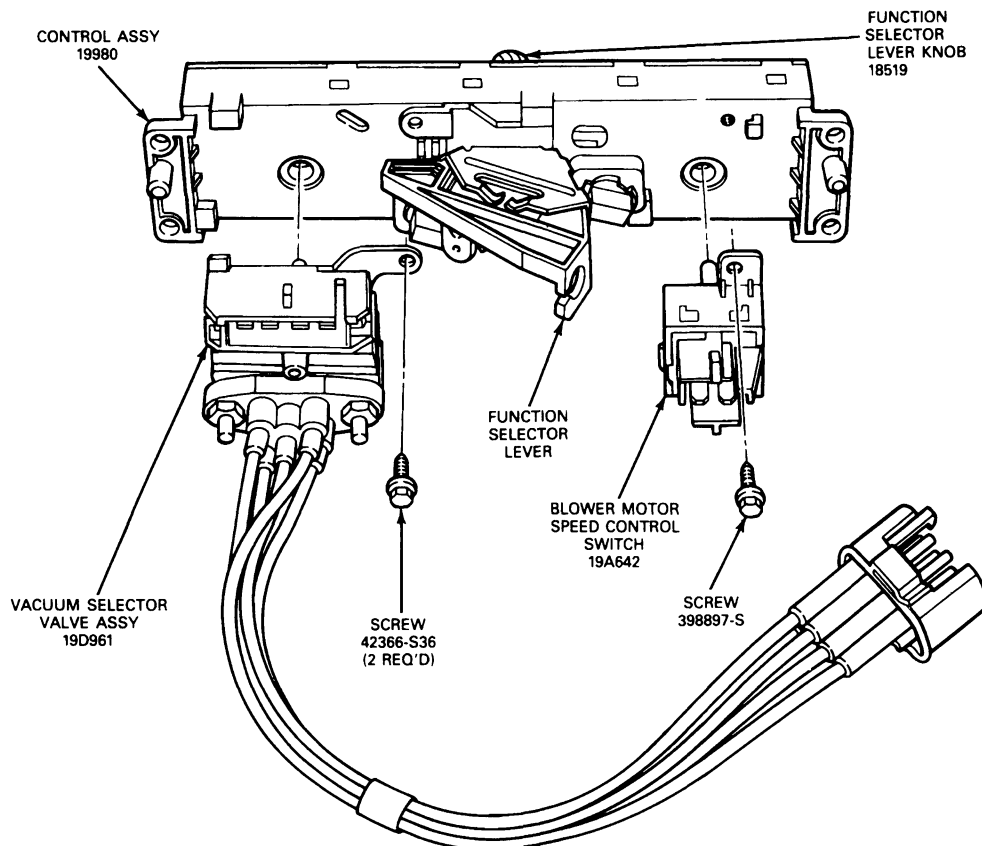
REMOVAL AND INSTALLATION (Continued)

4. Position the control assembly in its instrument panel opening. Be sure that the electrical and vacuum harnesses are properly stowed. Install the four attaching screws.

5. Connect the battery ground cable(s).

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

6. Start the engine to provide vacuum. Then, move the function lever to each of its operating positions to verify that vacuum is being distributed properly through the selector valve to the applicable vacuum motor.

Vacuum Selector Valve Assembly Installation

CCL 4197-A

Temperature Control Cable**Removal**

1. Remove the control assembly from the instrument panel and disconnect the cable.
2. Disengage the glove compartment by squeezing the sides at the door stops. Swing the door down and remove it from its hinges.
3. Remove two screws which attach the Rear Anti-lock Brake System (RABS) module.

4. Working through the glove compartment, opening, use A/C-Heater Temperature Cable Clip Remover D91T-18532-A or equivalent, to release the temperature control cable from the heater core cover on the plenum.
5. Disconnect the temperature control cable from the cam on top of the plenum.
6. From underneath the lower edge of the instrument panel, pull the cable from the upper retaining tabs. These tabs are part of the electrical harness retaining brackets.

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Feed the control end of the wire up to the control from beneath the instrument panel.
2. Snap the cable into the cable upper retaining tabs. These tabs are part of the electrical harness retaining brackets which are located along the bottom edge of the instrument panel. The part number imprinted on the cable should be installed in the right clip which is located on the panel in the area below the ash receptacle.
3. Attach wire loop end of cable to the temperature cam assembly on top of plenum. Make sure that the wire loop coil is up and that the cable is routed under cable hold-down on cam assembly.
4. Install the cable into the square retaining hole in the heater core cover.
5. Attach temperature control cable to temperature control knob.
6. Position the control assembly close to the opening in the instrument panel. Working through this opening, route the cable so that it will not have kinks or sharp bends anywhere along its course between the control assembly and the cam on the plenum.
7. Actuate the temperature control knob and check for proper cable movement.
8. Connect wire and vacuum harness to control assembly and plenum.
9. Install control assembly in instrument panel using four attaching screws.
10. Check system for proper operation.

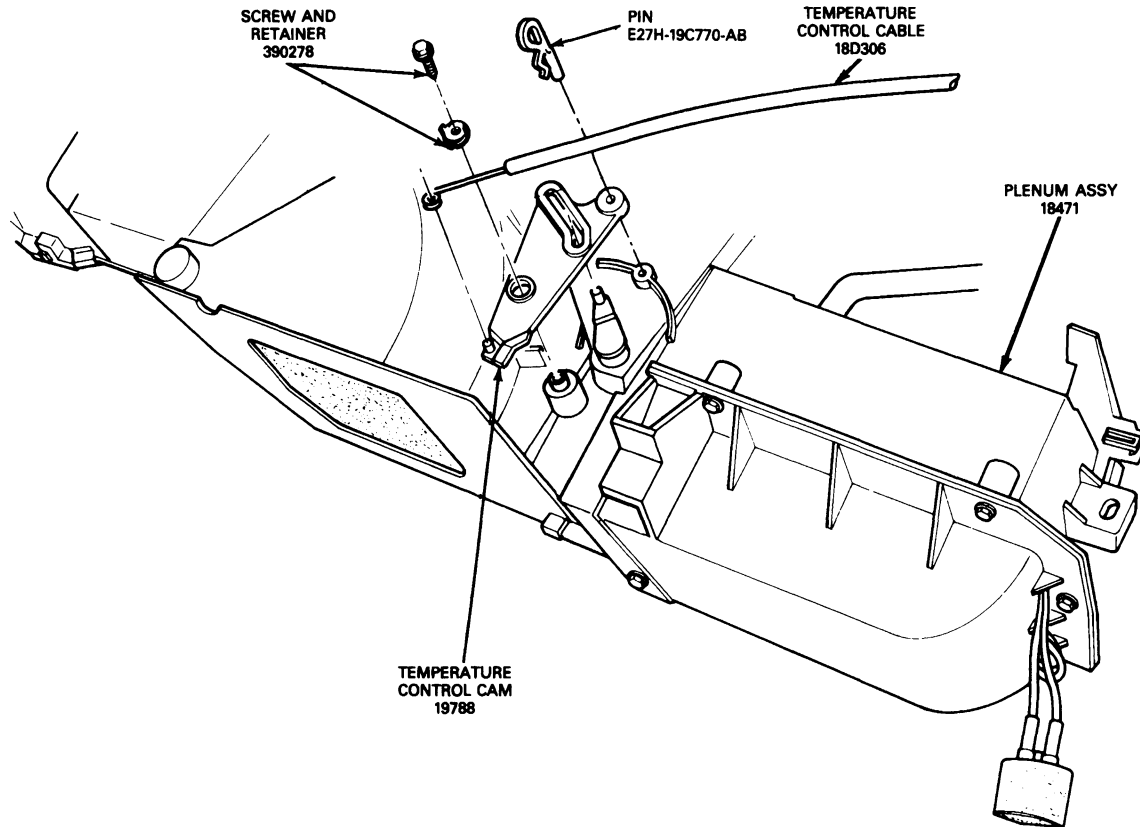
11. Complete installation of control assembly, RABS module and glove compartment.

Temperature Control Cam/Cam Assist Spring

1. Disengage the glove compartment door by squeezing the sides at the door stops. Swing the door down and disengage from the hinges.
2. Remove two screws which attach the RABS module.
3. Remove the temperature control cable from the heater core cover.
4. Working through the glove compartment opening, remove the temperature control cam retaining screw and lift the cam away from plenum.
5. Move the cam as necessary, to disconnect the temperature control cable and remove the cam from vehicle.

Installation

1. Position temperature control cam on top of plenum and install retaining screw.
2. Connect the temperature control cable to the temperature control cam. Make sure that the cable is routed under the cable retainer on the cam.
3. Check operation of cam for a full range of temperature control. Adjust temperature control cable if necessary.

REMOVAL AND INSTALLATION (Continued)**Temperature Control Cam Installation**

CCL 4194-B

Instrument Panel

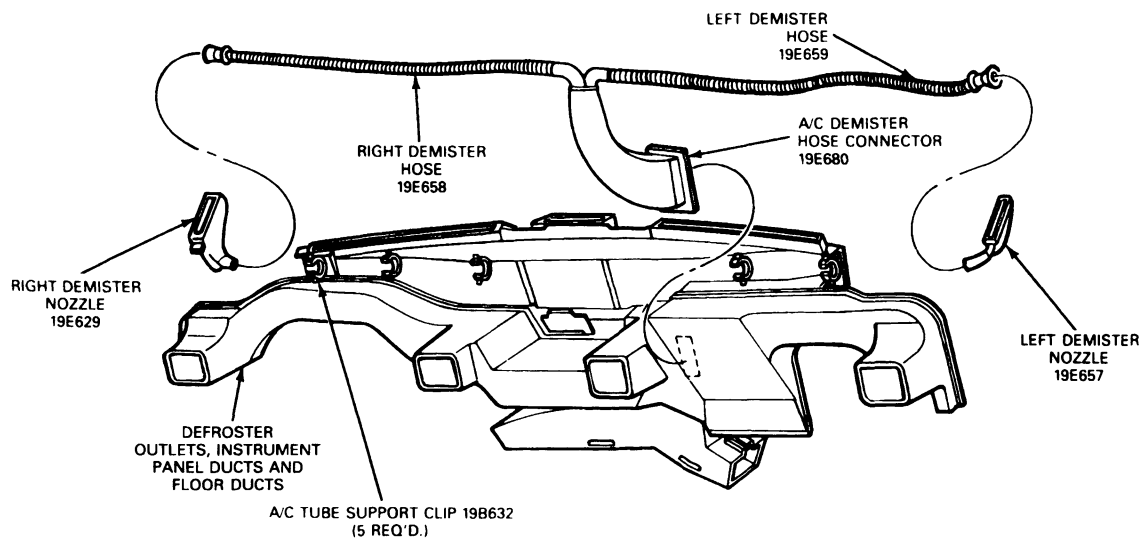
Procedures for removal and installation of the instrument panel are covered in Section 01-12A.

Defroster and Ventilation Ducts

The defroster duct and ventilation ducts are a two-piece, adhesively bonded construction which attaches as an assembly to the instrument panel. Refer to Section 01-12A for instrument panel service.

Demister Nozzles and Hoses**Removal and Installation**

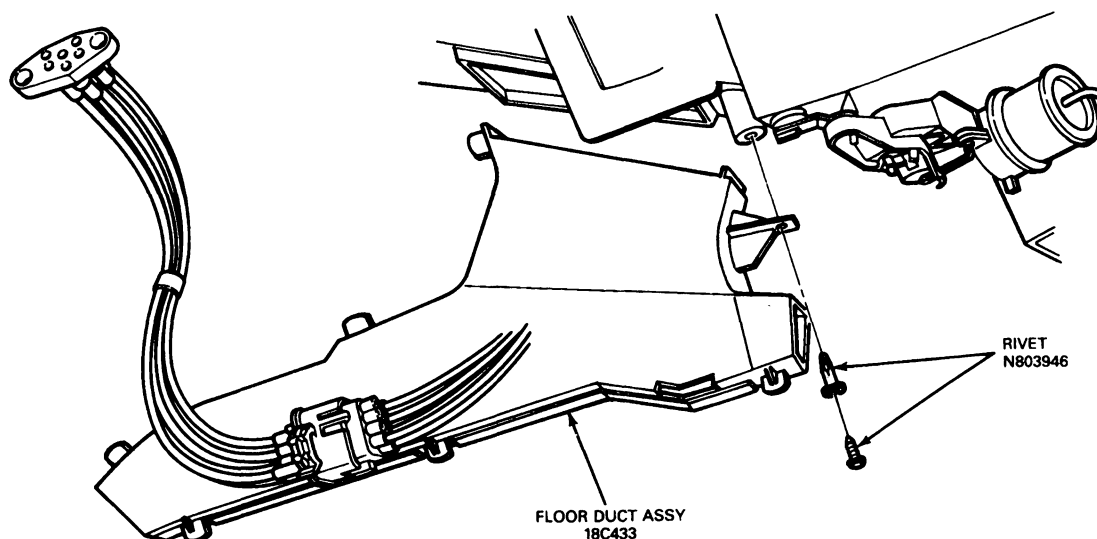
1. Remove the instrument panel as outlined in Section 01-12A.
2. Remove two nuts attaching the right and one nut and one spring nut attaching the left demister nozzles to the instrument panel. These nozzles are located in opposite corners of the panel.
3. Disconnect the flexible hoses which slide over the input end of each nozzle.
4. Remove three push screws which attach the connector to the structural duct assembly. Disconnect the flexible hoses which slide over the input end of each nozzle.
5. To install nozzles, hoses, and/or connector, install two attaching nuts to the right nozzle and one nut to the left nozzle, attach three push screws through the connector into the structural duct. Then, slide the demister hoses over their attaching locations.
6. Install instrument panel as outlined in Section 01-12A.

REMOVAL AND INSTALLATION (Continued)**Demister Nozzle and Hose Assembly Installation**

CCL 4199-B

Floor Duct**Removal and Installation**

1. Remove the vacuum harness from the stowage slot in the floor duct.
2. Remove the plastic attaching screw from the bottom side of the plenum.
3. Remove the push nut sleeve from the attaching hole.
4. Disengage the floor duct from the plenum.
5. To install the duct, position it on the plenum and engage the lugs inside the duct with their mating slots in the plenum. Tilt the duct into place. Then, push it into secure engagement.
6. Start the plastic screw into the push nut sleeve. Then, install them both through the floor duct flange and into the attaching hole in the plenum. Be sure that the attachment is secure.

Floor Duct Assembly Installation

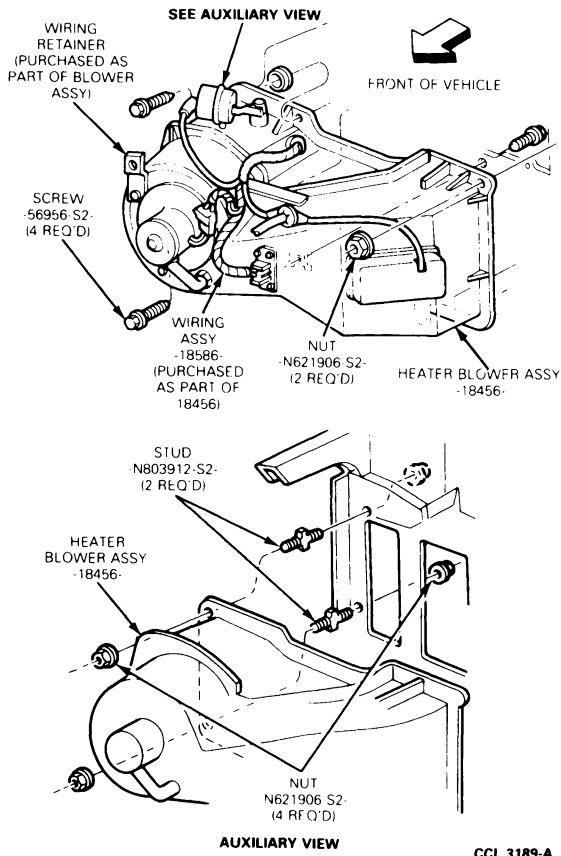
CCL 4200-A

REMOVAL AND INSTALLATION (Continued)**Heater Blower Assembly****Removal and Installation**

1. Disconnect battery ground cable(s).
2. In passenger compartment, remove nut from the bottom of plenum assembly just to the right of heater core access cover.
3. In engine compartment, remove electrical connector from blower motor by pushing on connector tab and pulling connector off motor. Remove connector from blower motor resistor.
4. Remove bolt from heater blower assembly (upper right side of engine compartment).
5. Remove three attaching nuts from the heater blower assembly.
6. Pull the heater blower assembly away from the dash panel.

For installation, follow removal steps in reverse order.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

**Heater Plenum Assembly****Removal**

1. Loosen all of the instrument panel retaining screws. Refer to Section 01-12. Move the panel rearward to gain access to the plenum assembly. Remove the glove compartment.
2. Remove the floor air distribution duct from the plenum as described previously.
3. Remove the two nuts and one screw which retain the left end of the plenum to the dash panel.
4. Disconnect the temperature cable and vacuum connections from the control assembly.
5. Disconnect the source vacuum block which is secured to the right side of the heater core cover.
6. Pull the heater case forward to disengage three heater case studs from the dash panel.
7. Lower the plenum assembly from its location under the instrument panel.

Care must be taken to avoid spilling any coolant from the heater core.

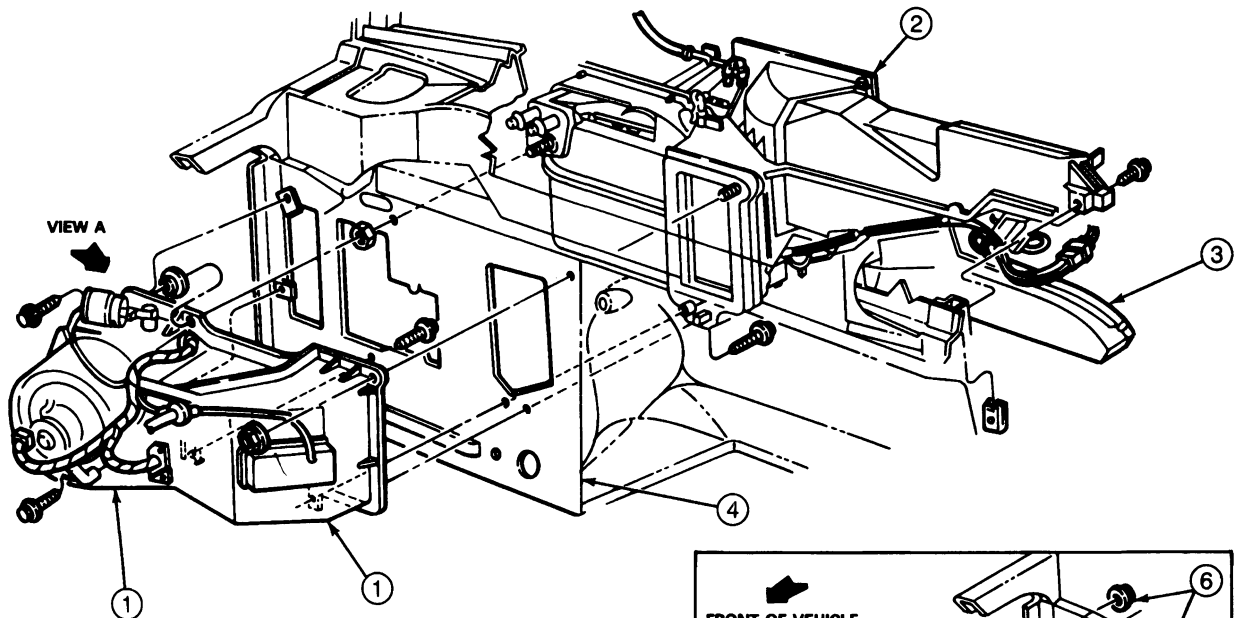
NOTE: On some vehicles it may be necessary to remove the instrument panel lower right attaching screw and the screws attaching the two braces to the lower center area of the instrument panel.

Installation

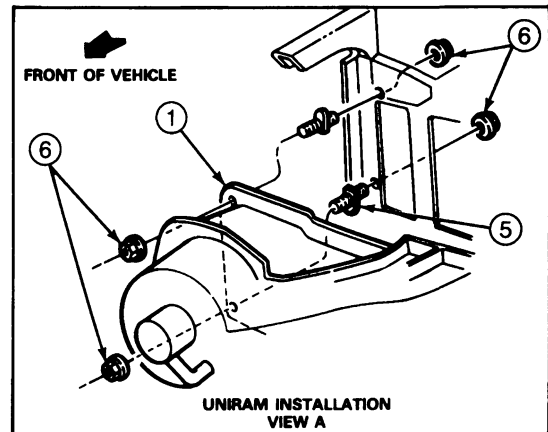
1. Position the plenum against the dash panel. Install one screw to attach the left end of plenum to dash panel.
2. Position the heater case against the dash panel, making sure that the heater case studs are inserted through holes in the dash panel and plenum flange.
3. Position the instrument panel and tighten its retaining screws.
4. Snap the temperature control cable into the cable mounting bracket on the plenum.
5. Connect the control vacuum and source vacuum.
6. Position the floor duct and install its push pin.
7. Adjust the temperature control cable as described in this section.
8. Install the glove compartment.
9. Check the system for proper operation.

REMOVAL AND INSTALLATION (Continued)

Heater Blower and Plenum Assemblies, Installation



FRONT OF VEHICLE



ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1.	18456	HEATER BLOWER ASSY.	4.	REF.	DASH PANEL
2.	18471	PLENUM CHAMBER ASSY.	5.	N803912-S2	STUD (2 REQ'D.)
3.	18C433	FLOOR DUCT	6.	N612906-S2	NUT (4 REQ'D.)

CCL 4201-A

Outside Air / Recirculated Air Door, Vacuum Motor, Crank and / or Door

Removal

1. Disconnect the blower motor connector and remove the blower motor.
2. If only the vacuum motor is to be removed, disconnect the two screws which attach the motor to the upper surface of the outside door duct.

3. Pry the motor and arm assembly upward at the arm end to free it from its mounting peg. A retaining flange which is an integral part of the crank, peg, and flange component may partially obstruct the motor arm in its upward movement along the peg. If this retaining flange should break off when forcing the motor arm upward, a 3/16-inch spring nut (Part No. 383358-S) must be used to retain the motor arm when the same or replacement motor is installed. The following illustration shows motor removal in View A and the area in which retainer flange breakage might occur in View B.

REMOVAL AND INSTALLATION (Continued)

4. Look through blower motor opening in the case and use a screwdriver to depress the snap-on door crank, while pulling up on the door shaft to release the crank from the door.
5. Remove the door through the blower motor opening.

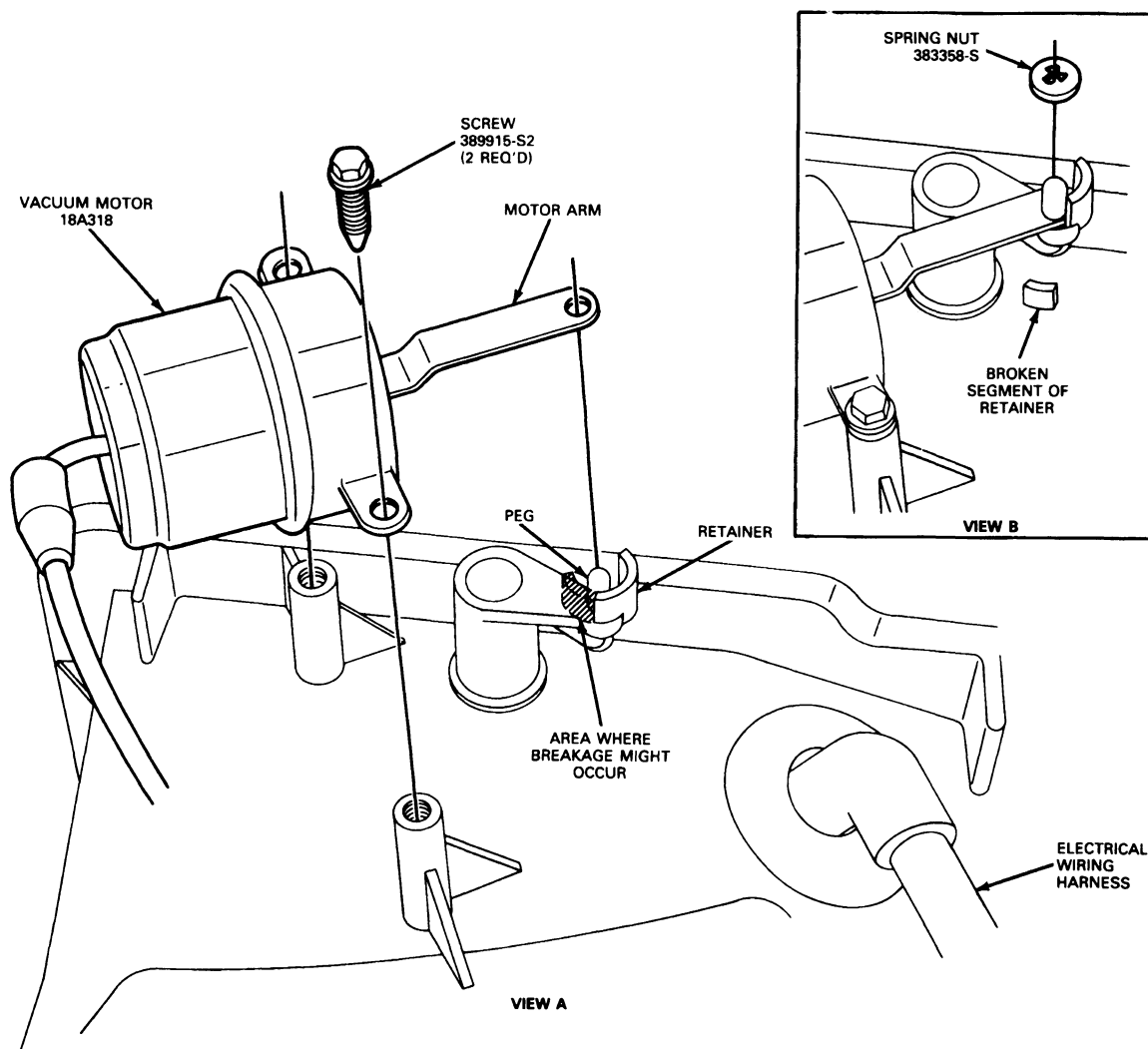
Installation

1. Insert the door through the blower motor opening. Seat the bottom door pivot first, then swing top door pivot into place.

2. Hold door in full outside air position (swing to full-in board position) and snap in crank.
3. Align the hole in the vacuum motor arm with the peg in the door crank.
4. Slide the arm downward over the peg and along the inner surface of the retaining flange where the arm seats below the base of the flange surface.

NOTE: If the flange has been broken off, install the spring nut as described in Step 3 of the Removal procedure.

5. Install the blower motor in housing and connect blower motor electrical harness.

Outside Air / Recirculation Vacuum Motor Installation

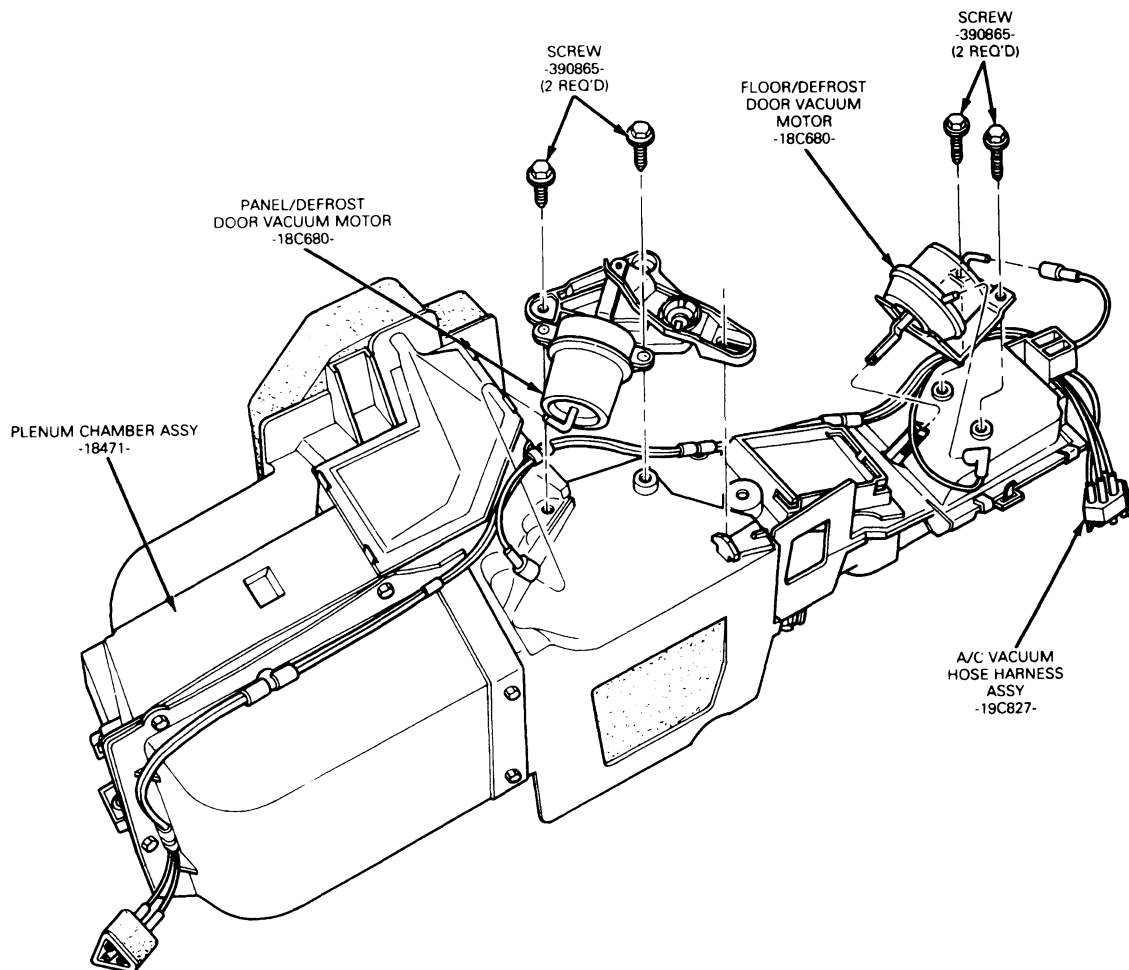
CCL2716-A

REMOVAL AND INSTALLATION (Continued)**Heater Plenum Doors**

The damper doors inside the heater plenum assembly cannot be replaced. As a result, if there is a problem in the mix or the panel/defrost door, the plenum, including these doors, must be replaced. The plenum must also be replaced if there is damage to the heater case mounting studs which cannot be repaired.

Heater Plenum Door Vacuum Motors

The vacuum motors for the panel/defrost and mix damper doors are attached to the underside of the heater plenum assembly. The following illustration shows these motors disassembled from the plenum.

Heater Plenum Door Vacuum Motor Installation

CCL 3150-A

Panel/Defrost Door Vacuum Motor**Removal**

1. Remove the vacuum hose from the vacuum motor.

2. Remove the two screws which attach the motor and bracket assembly to the plenum.

REMOVAL AND INSTALLATION (Continued)

3. Rotate the assembly so that the slot in the bracket is parallel with the tee-shaped end of the door crank arm. Pull the motor and bracket assembly off the crank arm.

For installation, follow removal steps in reverse order, engaging tee-shaped end of door crank arm into slot in motor and bracket assembly, then rotating assembly into proper position.

Mix Door Motor**Removal and Installation**

1. Remove the floor duct as described previously.
2. Disconnect the two vacuum hoses from the vacuum motor.
3. Remove the two screws which secure the motor and bracket assembly to the plenum.
4. Using a small screwdriver, depress the tang on the side of the door operating lever and pull the motor arm out of the lever.

For installation, follow removal steps in reverse order. Make sure locking tangs are securely engaged when motor arm is slid into door lever.

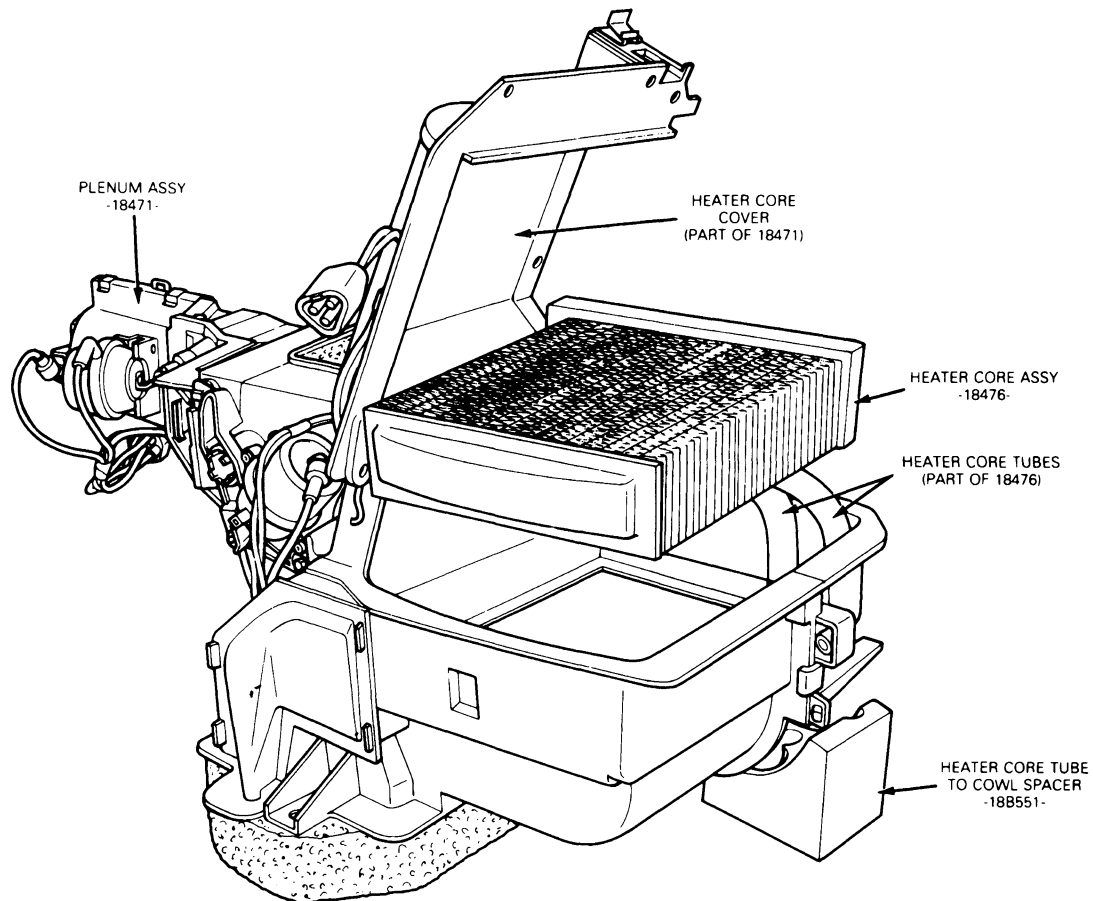
Heater Core**Removal**

1. Allow the engine to cool. Then, observing the safety precautions described in the Powertrain / Drivetrain Manual, Section 03-03, proceed as follows.
2. Place a thick cloth over the radiator cap.

3. Turn the cap slowly to its first stop to release system pressure.
4. When the pressure has been released, tighten the radiator cap.
5. Disconnect the heater hoses from the heater core tubes, and plug the hoses.
6. For easier access, remove the glove compartment.
7. From inside the passenger compartment, remove the seven screws which attach the heater core access cover to the plenum.
8. Disconnect the vacuum source. Leave the vacuum harness attached to the cover. Remove the cover.
9. Remove the heater core from the plenum.

Installation

1. Position the heater core and seal in the plenum assembly.
2. Install the heater core access cover on the plenum assembly and secure it with its seven attaching screws. Be certain that the vacuum harness is not trapped or pinched during the cover installation.
3. Connect the vacuum harness to its source connection.
4. Install heater hoses on the core tubes at dash panel in engine compartment. Do not over-tighten the hose clamps.
5. Check coolant level and add coolant as required. Refer to the Powertrain / Drivetrain Manual, Section 03-03.
6. Check system for proper operation and coolant leaks.

REMOVAL AND INSTALLATION (Continued)**Heater Core Installation**

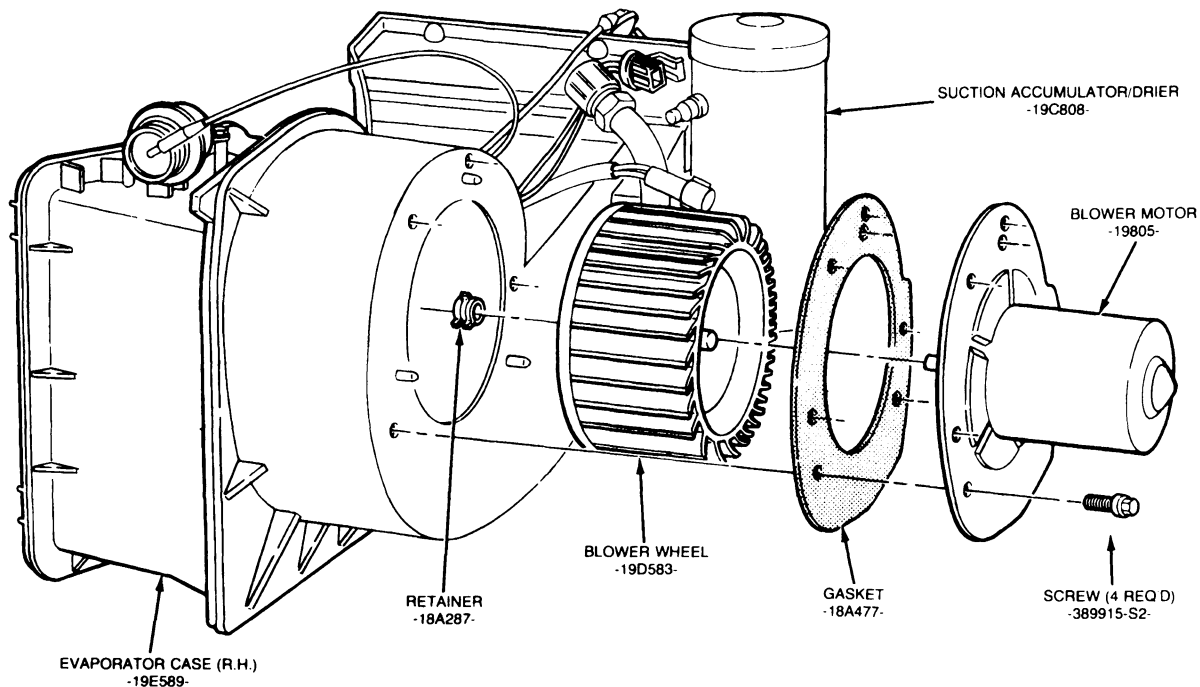
CCL 3151-A

Blower Motor and Wheel**Removal and Installation**

1. Disconnect battery ground cable(s).
2. On California vehicles, remove emission module forward of blower motor.
3. Disconnect wire harness connector from blower motor by pushing down on connector tabs and pulling connector off motor.
4. Disconnect blower motor cooling tube at blower motor.
5. Remove four screws attaching blower motor and wheel to heater blower assembly.
6. Holding cooling tube aside, pull blower motor and wheel from heater blower assembly and remove it from vehicle.
7. If the blower wheel is to be installed on the new blower motor, remove the retainer and then gently pull the wheel from the blower motor shaft.

For installation, follow removal steps in reverse order.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

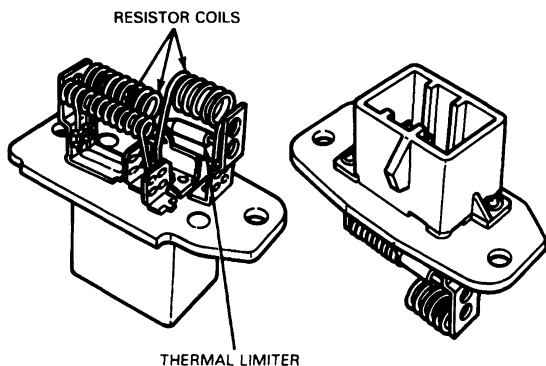
REMOVAL AND INSTALLATION (Continued)**Blower Motor Assembly Installation**

CCL 2731-B

Blower Motor Resistor**Removal and Installation**

1. Pry the wire connector from the blower motor resistor.
2. Remove the two screws which attach the resistor assembly to the heater blower assembly.

For installation, follow removal steps in reverse order.
Check operation in all blower speeds.



CCL 4394-A

Heater Hoses**Removal and Installation**

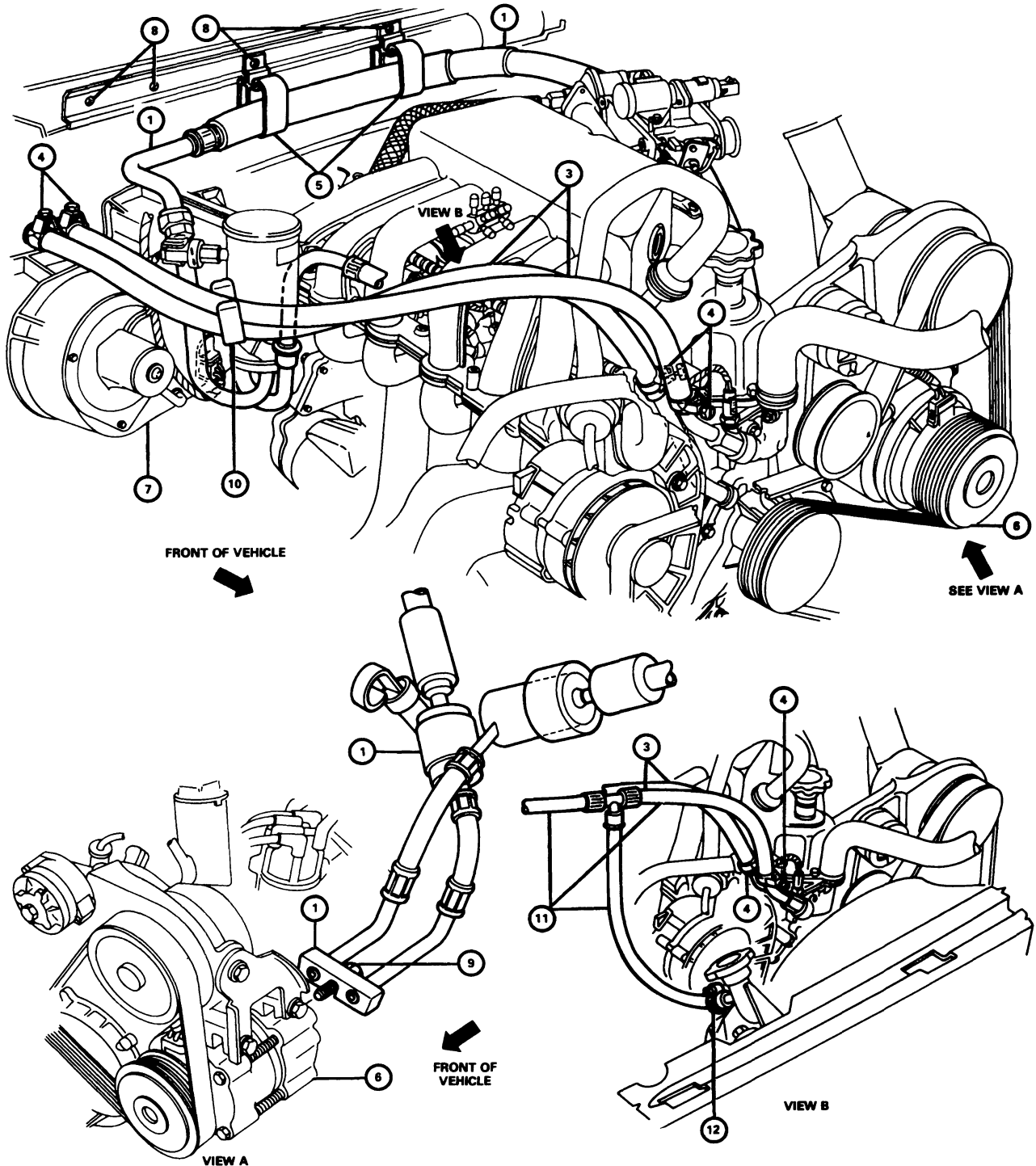
The following illustrations show the heater hose installations on the 4.9L (300 CID), 5.0L (302 CID), 5.8L (351 CID), 7.3L (447 CID), and 7.5L (460 CID) engines.

The following procedure applies to each of the installations.

1. Drain the coolant from the cooling system.
2. Loosen the hose clamps and remove the hoses from the vehicle.
3. Cut a length of heater hose from bulk stock which is the same length and diameter as that of the hose which has been removed.
4. Route the hoses as shown in the applicable illustration.
5. Install the hoses on their fittings and tighten the attaching to 2-3 N·m (18-27 in·lb).
6. Fill and bleed the cooling system. Refer to the Powertrain / Drivetrain Manual, Section 03-03.
7. Check for coolant leaks and proper operation of the system.

REMOVAL AND INSTALLATION (Continued)

Heater Hose Installation, 4.9L (300 CID) MFI Engine



ITEM DESCRIPTION

1. MANIFOLD & TUBE ASSY - 19D734
2. LIQUID LINE - 19N651
3. HEATER HOSE (FOR VEHICLES W/O E4OD TRANS.)-381260-S420A (2 REQ'D)
4. CLAMP - 390761-S100 OR 389628
5. CLIP - 19N704 (2 REQ'D)
6. COMPRESSOR & CLUTCH ASSY - 19D629

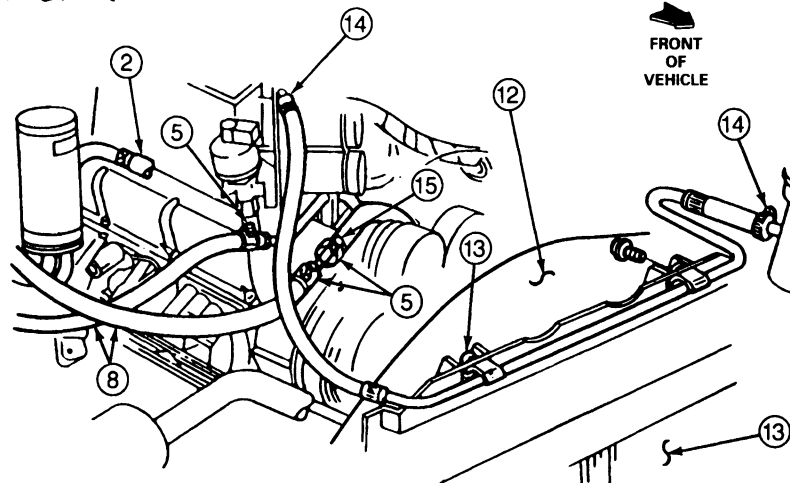
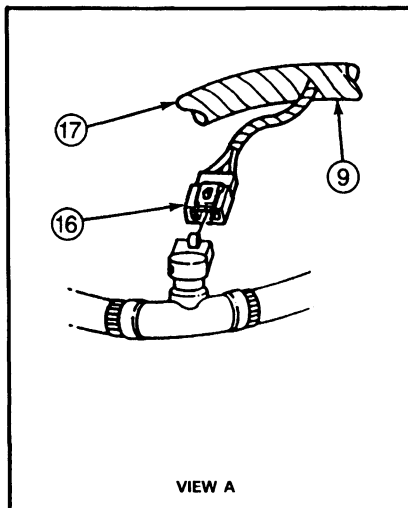
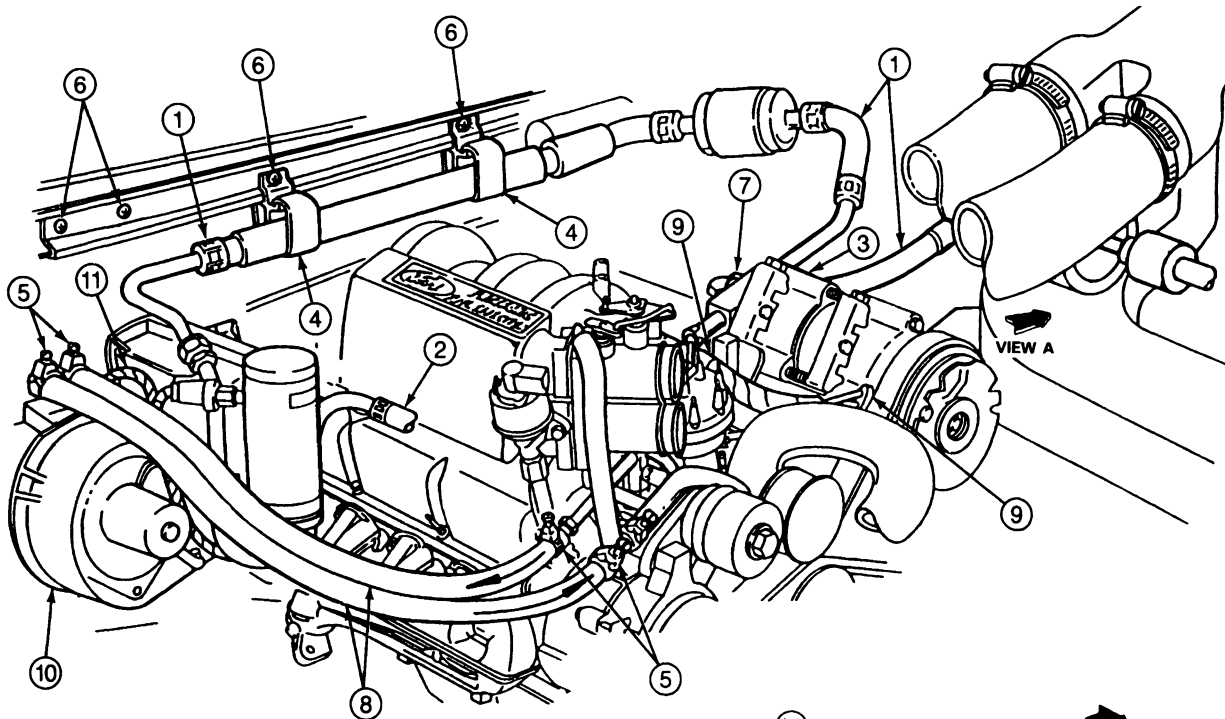
ITEM DESCRIPTION

7. EVAPORATOR ASSY - 19850
8. EXISTING SCREW
9. BOLT - MANIFOLD TO COMPRESSOR - N805334-S2
10. HEATER HOSE CLIP - 18D331
11. HEATER HOSE ASSY. - 18C266 (FOR VEHICLE W/E4OD TRANS.)
12. CLAMP - 376240-S100

CCL 4102-B

REMOVAL AND INSTALLATION (Continued)

Heater Hose Installation, 5.0L (302 CID) MFI Engine

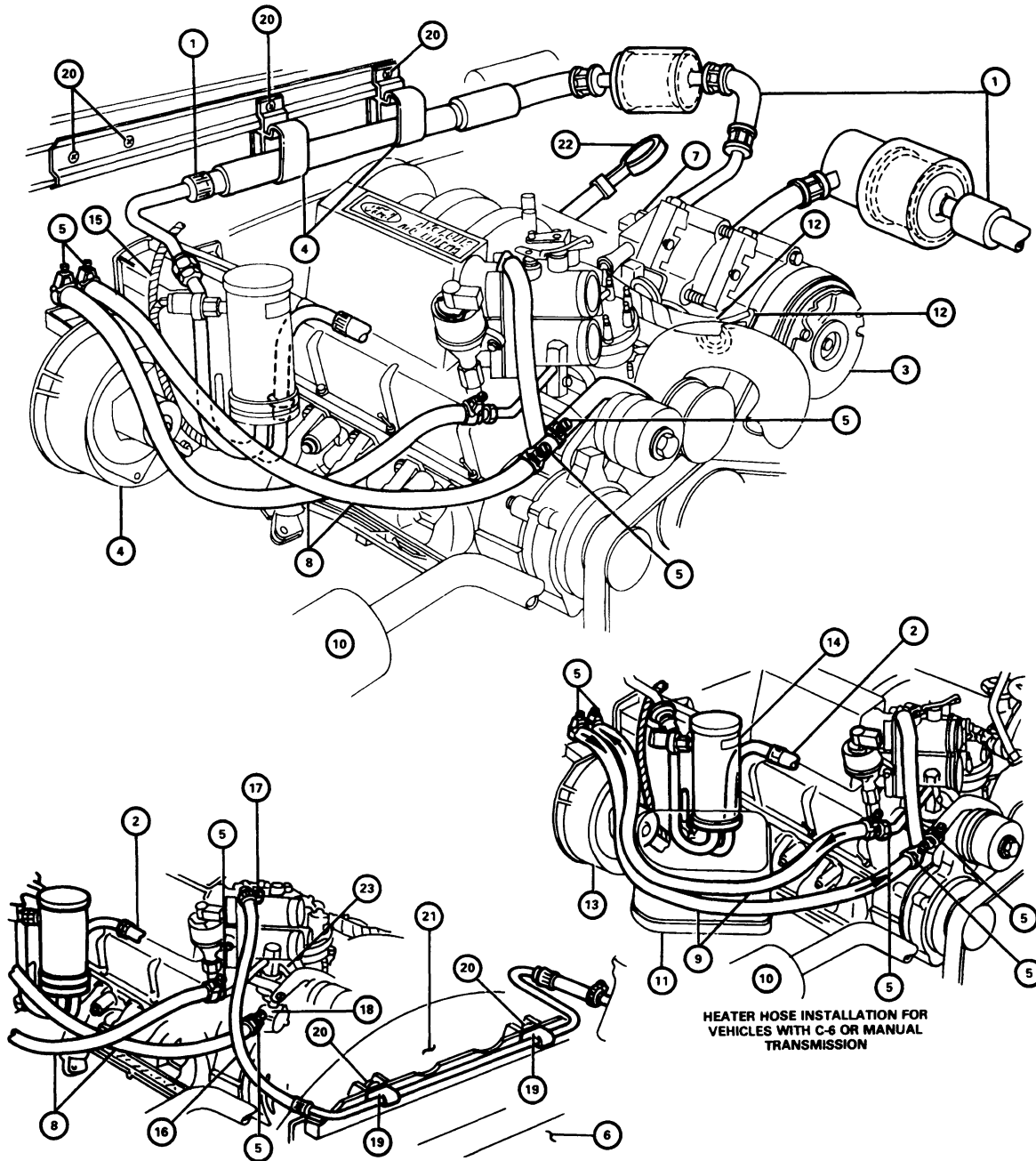


ITEM	BASIC PART NUMBER	DESCRIPTION	ITEM	BASIC PART NUMBER	DESCRIPTION
1.	19D734	MANIFOLD AND TUBE ASSY.	10.	(REF.)	EVAPORATOR ASSY.
2.	19N651	HOSE ASSY. (LIQUID LINE)	11.	181586	WIRING ASSY. (P.I.A. EVAPORATOR ASSY.)
3.	19D629	COMPRESSOR & CLUTCH ASSY.	12.	(REF.)	FAN SHROUD
4.	19N704	CLIP (2 REQ'D)	13.	(REF.)	RADIATOR
5.	39761-S100 or 389628-S100	CLAMP, (4 REQ'D)	14.	(REF.)	HOSE CLAMPS (2 REQ'D)
6.	—	EXISTING SCREW	15.	18A568	CONNECTOR
7.	N805334-S2	BOLT (P.I.A. COMPRESSOR 19D629)	16.	(REF.)	POWER STEERING PRESSURE SWITCH
8.	381260-S360A	HOSE (2 REQ'D)	17.	(REF.)	TO 12A581 WIRING ASSY.
9.	9D930	WIRING ASSY.			

CCL 4395-A

REMOVAL AND INSTALLATION (Continued)

Heater Hose Installation, 5.8L (351 CID) MFI Engine



HEATER HOSE ASSY INSTALLATION FOR VEHICLES WITH E40D TRANSMISSION

HEATER HOSE INSTALLATION FOR
VEHICLES WITH C-6 OR MANUAL
TRANSMISSION

ITEM DESCRIPTION

1. MANIFOLD & TUBE ASSY - 19D734
2. LIQUID LINE
3. COMPRESSOR & CLUTCH ASSY - 19D629
4. CLIP - 19N704 (2 REQ'D)
5. CLAMP - 390761-S100 OR 389628-S100 (5 REQ'D)
6. RADIATOR (REF.)
7. BOLT - N805334-S2
8. HOSE - 381260S320A (2 REQ'D)
9. HOSE - 381260-S360A (2 REQ'D)
10. THERMACTOR SYSTEM
11. ENGINE VACUUM SUPPLY RESERVOIR

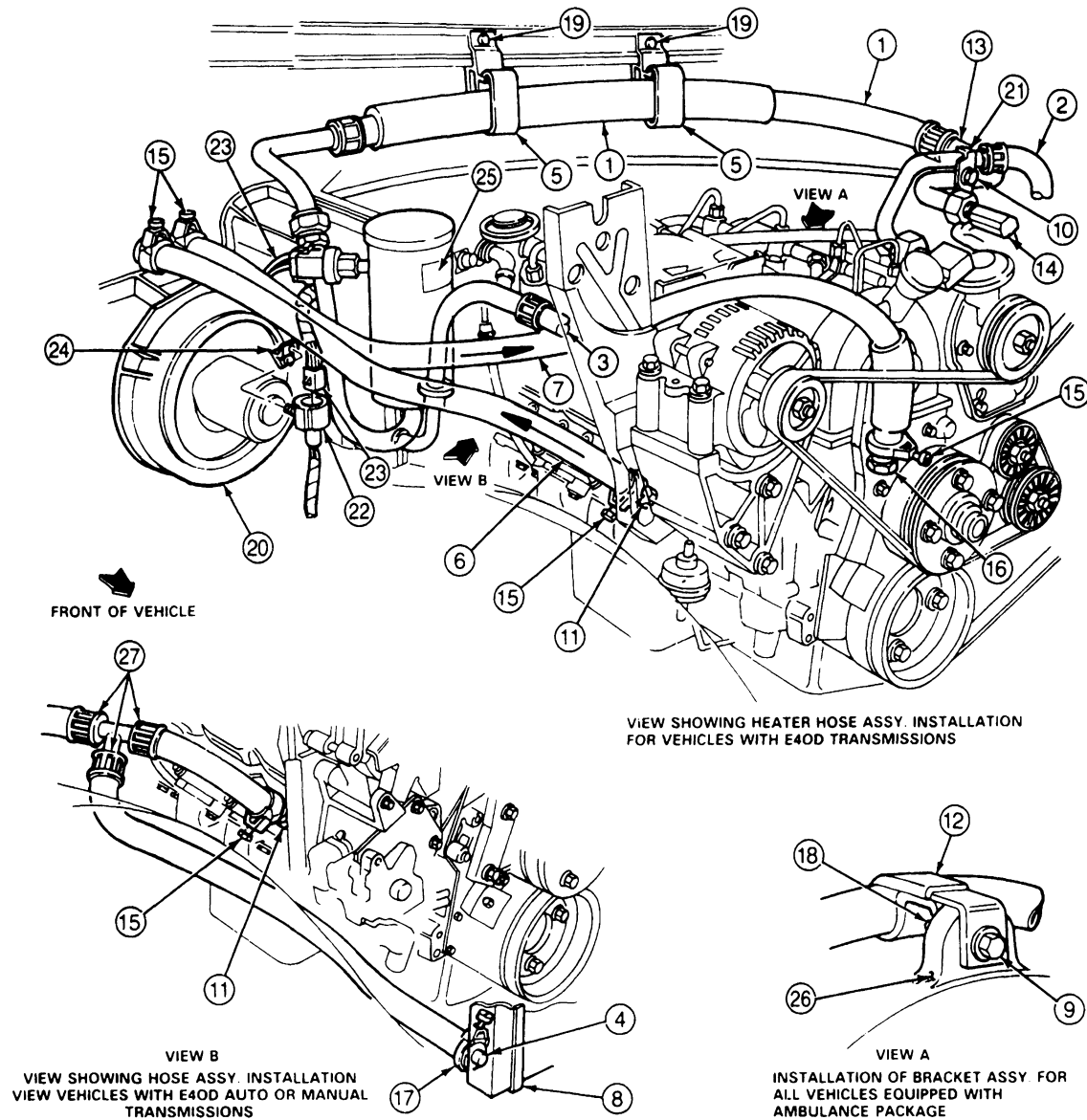
ITEM DESCRIPTION

12. WIRING ASSY - 9D930
13. EVAPORATOR ASSY
14. TAG - A/C SERVICE INSTRUCTIONS
15. WIRING
16. HOSE & TUBE ASSY - 8548
17. HOSE CLAMP - 376240-S100 (2 REQ'D)
18. CONNECTOR - 18A568
19. U-NUTS
20. EXISTING SCREW
21. FAN SHROUD
22. DIPSTICK
23. HEATED THROTTLE BODY SYSTEM

CCL 4104-A

REMOVAL AND INSTALLATION (Continued)

Heater Hose Installation, 7.3L (447 CID) Diesel Engine

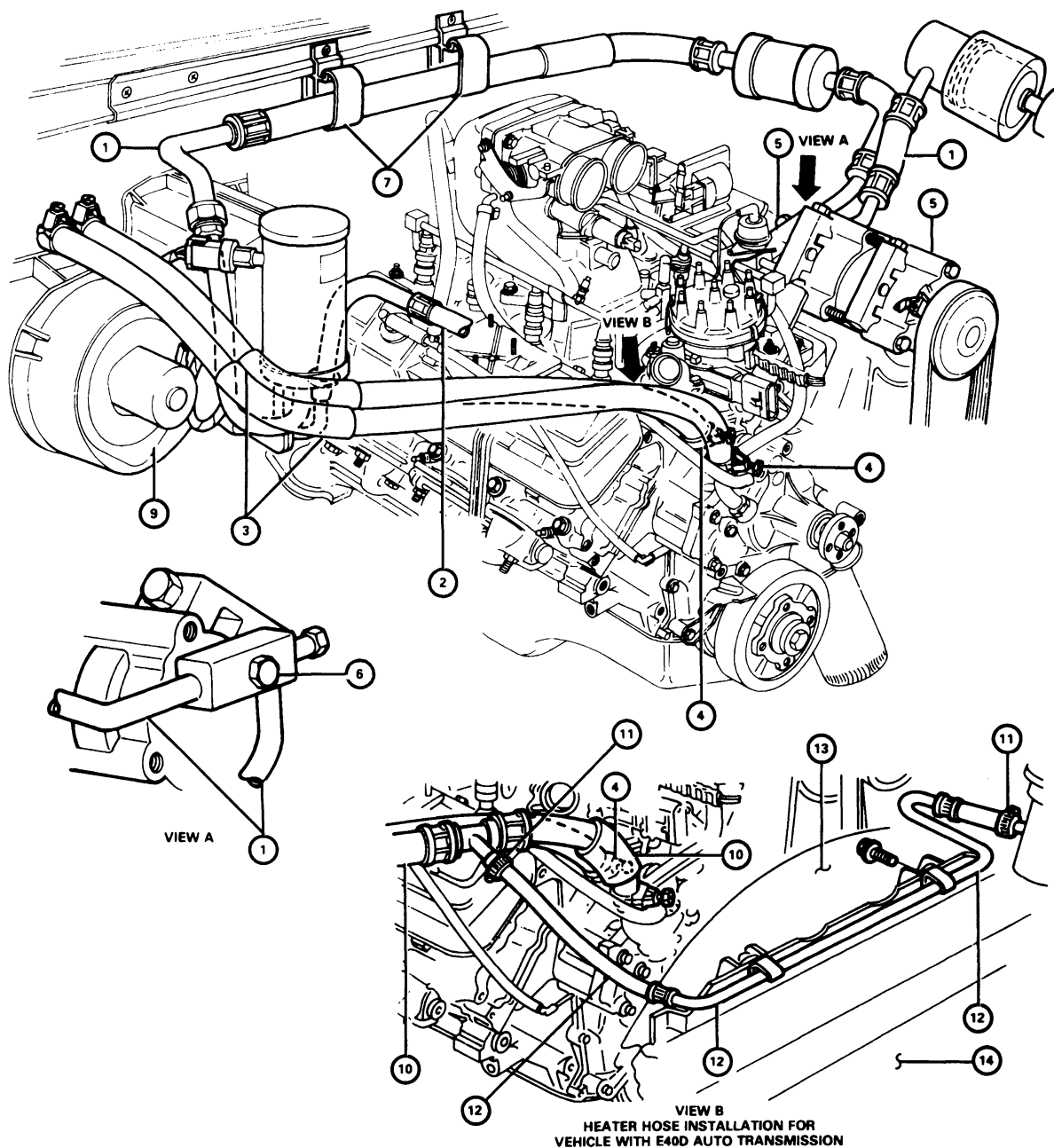


ITEM	BASE PART NUMBER	DESCRIPTION	ITEM	BASE PART NUMBER	DESCRIPTION
1.	19N617	HOSE ASSY. (SUCTION)	15.	390761-S100M	CLAMP (4-REQD.)
2.	19972	HOSE ASSY. (DISCHARGE)		389628-S100	HEATER HOSE CONNECTOR
3.	19N651	HOSE ASSY. (LIQUID LINE)	16.	389766-S100	HOSE CLAMP
4.	18C60	FITTING-HEATER HOSE (BYPASS)	17.	389772-S100	SPRING NUT, PART OF 18D331
5.	19N704	CLIP (2 REQ'D.)	18.	(REF.)	BRACKET ASSY.
6.	381260-S360A	HOSE	19.	(REF.)	EXISTING SCREW
7.	18C266	HOSE ASSY., FOR VEHICLES WITH C-6 AUTO OR MANUAL TRANSMISSIONS	20.	(REF.)	EVAPORATOR ASSY.
8.	(REF.)	RADIATOR	21.	(REF.)	SUPPORT BRACKET
9.	N606677-S2	SCREW & WASHER ASSY	22.	(REF.)	INSTALL LOCATOR IN RETAINER
10.	N611058-S2	SCREW	23.	18A586	WIRING ASSY. (P.I.A. EVAPORATOR ASSY.)
11.	18D406	CONTROL ASSY. - HEATER COOL FLO	24.	(REF.)	EXISTING RETAINER
12.	18D331	BRACKET ASSY.	25.	19850	EVAPORATOR A/C SERVICE INSTRUCTIONS TAG
13.	19B632	CLIP-A/C TUBE SUPPORT	26.	(REF.)	ALTERNATOR EAR
14.	19D629	COMPRESSOR & CLUTCH ASSY	27.	(REF.)	HEATER HOSE ASSY. CRIMPS

CCL 4396-A

REMOVAL AND INSTALLATION (Continued)

Heater Hose Installation, 7.5L (460 CID) Engine



ITEM DESCRIPTION

1. MANIFOLD AND HOSE ASSY - 19D734
2. HOSE ASSY - 19N651
3. HEATER HOSE ASSY (FOR VEHICLES WITH C-6 OR MANUAL TRANSMISSION) - 18C266 (2 REQ'D)
4. CLAMP - 390761-S100 OR 389268-S100 (4 REQ'D)
5. A/C COMPRESSOR AND CLUTCH ASSY - 19D629
6. BOLT (MANIFOLD TO COMPRESSOR) - N805334-S2
7. CLIP - 19N704 (2 REQ'D)
8. HEATER HOSE (FOR VEHICLES WITH E40D TRANS.) - 18C266 (1 REQ'D)

ITEM DESCRIPTION

9. EVAPORATOR ASSY (REF.)
10. HEATER HOSE ASSY. (ONLY FOR VEHICLES WITH E40D TRANS.) - 18C266
11. HOSE CLAMP ASSY. - 376240-S100 (2 REQ'D)
12. HOSE & TUBE ASSY. (ONLY FOR VEHICLES WITH E40D TRANS.) - 8548
13. FAN SHROUD (REF.)
14. RADIATOR ASSY (REF.)

CCL 4106-A

ADJUSTMENTS

Temperature Control Cable

The temperature control cable which links the knob in the control assembly with the blend air door cam on the plenum assembly operates mechanically. It is not intended that this cable should be adjusted as routine service. However, if an adjustment becomes necessary, the procedure is as follows:

To determine the need for adjustment:

1. Move the temperature control knob back and forth between the limits of its travel. Listen for the sound of the blend air door closing before the knob has reached the travel limit.
2. If the sound of the door seating is not heard, it is probable that the cable is either improperly adjusted or disconnected.

NOTE: If the temperature control knob cannot be moved back and forth, a cam retaining pin used during assembly in production may not have been removed.

To remove the temperature control cam adjustment pin:

1. Disengage the glove compartment door by squeezing the side at the door stops. Swing the door down and remove it from its hinges.

2. Working through the glove compartment opening, remove the red assembly pin from heater core cover.
3. Check for proper control cable operation.
4. Install the glove compartment and door.

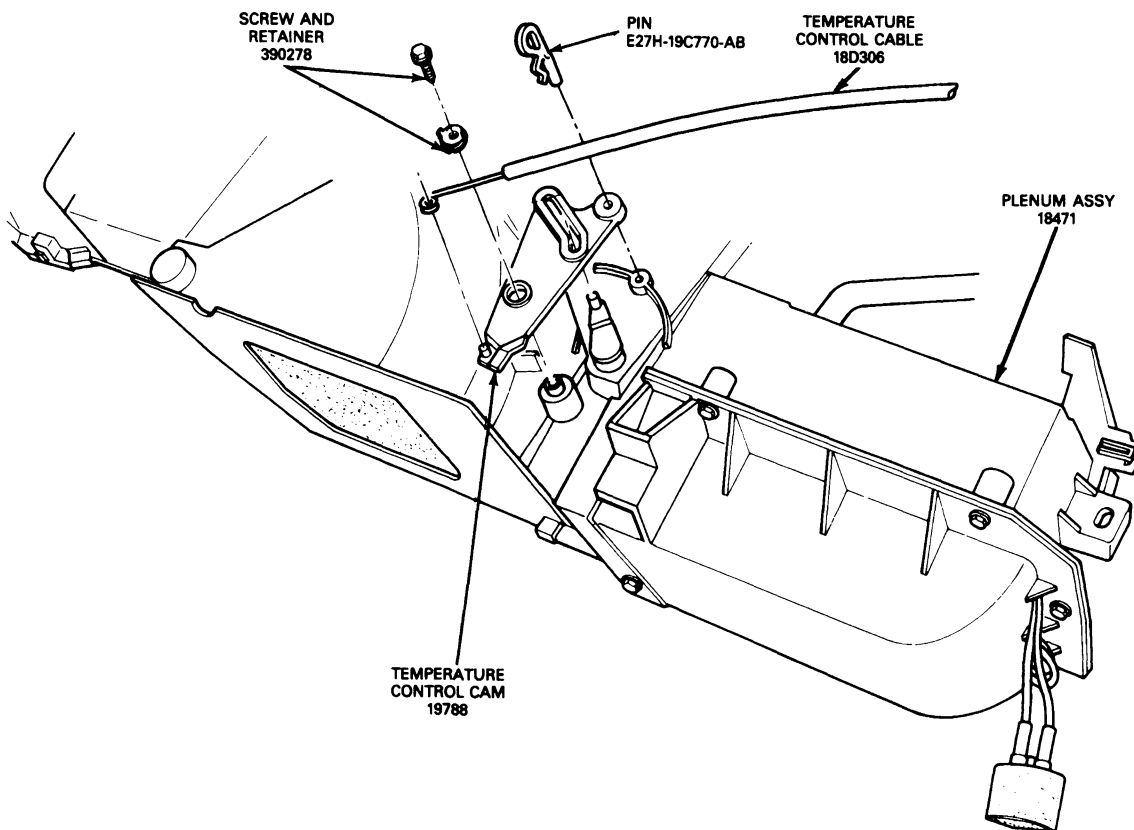
To adjust the cable:

1. Disengage the glove compartment door by squeezing the side at the door stops. Swing the door down and remove it from its hinges.
2. Working through the glove compartment opening, remove cable jacket from the metal attaching clip on the top of plenum by depressing the clip tab and pulling the cable rearward.

NOTE: The cable end should remain attached to door cam and / or crank arm.

3. Set the temperature control knob to COOL and hold it firmly.
4. With the cable end attached to the temperature door cam, push gently on the cable jacket to seat the blend door (push until resistance is felt). Install the cable into the clip by pushing the cable jacket into the clip from the top until it snaps into place.
5. Operate system to check temperature control.

Temperature Control Cable and Temperature Control Cam Installation



CCL 4194-B

SPECIFICATIONS**ELECTRICAL SPECIFICATIONS**

Blower Motor Current Draw and Voltages		
Switch Setting	Amps	Volts
Low	3-5	3-4
Medium Low	6-8	5-7
Medium High	10-14	7-10
High	15-22	11-14
Control Assembly, Illumination	One ICP-161 Bulb	
Blower Circuit System Protection	30 Amp Mini-Fuse (Light Green) in Panel F-14 (D9ZB-14A094-GA)	

TORQUE SPECIFICATIONS

Item	N·m	In-Lb
Heater Hose Clamps	2-3	18-27

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number	Description
D91T-18532-A	A/C-Heater Temperature Cable Clip Remover

ROTUNDA EQUIPMENT

Tool Number	Description
007-00001	Digital Volt-Ohmmeter

SECTION 12-03 Air Conditioning General Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		SERVICE PROCEDURES (Cont'd.)	
Basic Principles	12-03-1	Charging the System	12-03-17
Heat Transfer.....	12-03-2	Checking For Leaks.....	12-03-23
Latent Heat of Vaporization.....	12-03-3	Cleaning a Badly Contaminated Refrigerant System.....	12-03-18
Major Air Conditioner Components	12-03-3	Compressor Oil Level Check	12-03-18
DIAGNOSIS AND TESTING		Discharging the System	12-03-16
Know the Probability of Certain Conditions		Electronic Leak Detector	12-03-24
Developing.....	12-03-13	Evacuating the System	12-03-17
Know the Service History of the Condition	12-03-13	Evaluating Refrigerant System Performance	12-03-26
Know the Service History of the System	12-03-13	Flushing a Refrigerant System	12-03-26
Know the System.....	12-03-13	Installing a Mini-Tube Vacuum Hose.....	12-03-23
Preliminary Guidelines	12-03-13	Purging the Refrigerant System to Remove Air and Moisture Vapor	12-03-18
Safety Precautions	12-03-13	Recommendation to Avoid the Use of Small Containers for Charging	12-03-18
Service Precautions.....	12-03-14	Refrigerant Recovery/Recycling	12-03-17
Suction Accumulator/Drier Replacement.....	12-03-14	SPECIAL SERVICE TOOLS/EQUIPMENT	12-03-29
System Visual Inspection.....	12-03-14	SPECIFICATIONS	12-03-29
Tee Adapter Tool	12-03-15	VEHICLE APPLICATION	12-03-1
PERFORMANCE TESTING	12-03-27		
SERVICE PROCEDURES			
Attaching a Manifold Gauge Set	12-03-15		

VEHICLE APPLICATION

All E-150-250-350, F-150-250-350, F-Super Duty and Bronco Vehicles

DESCRIPTION AND OPERATION

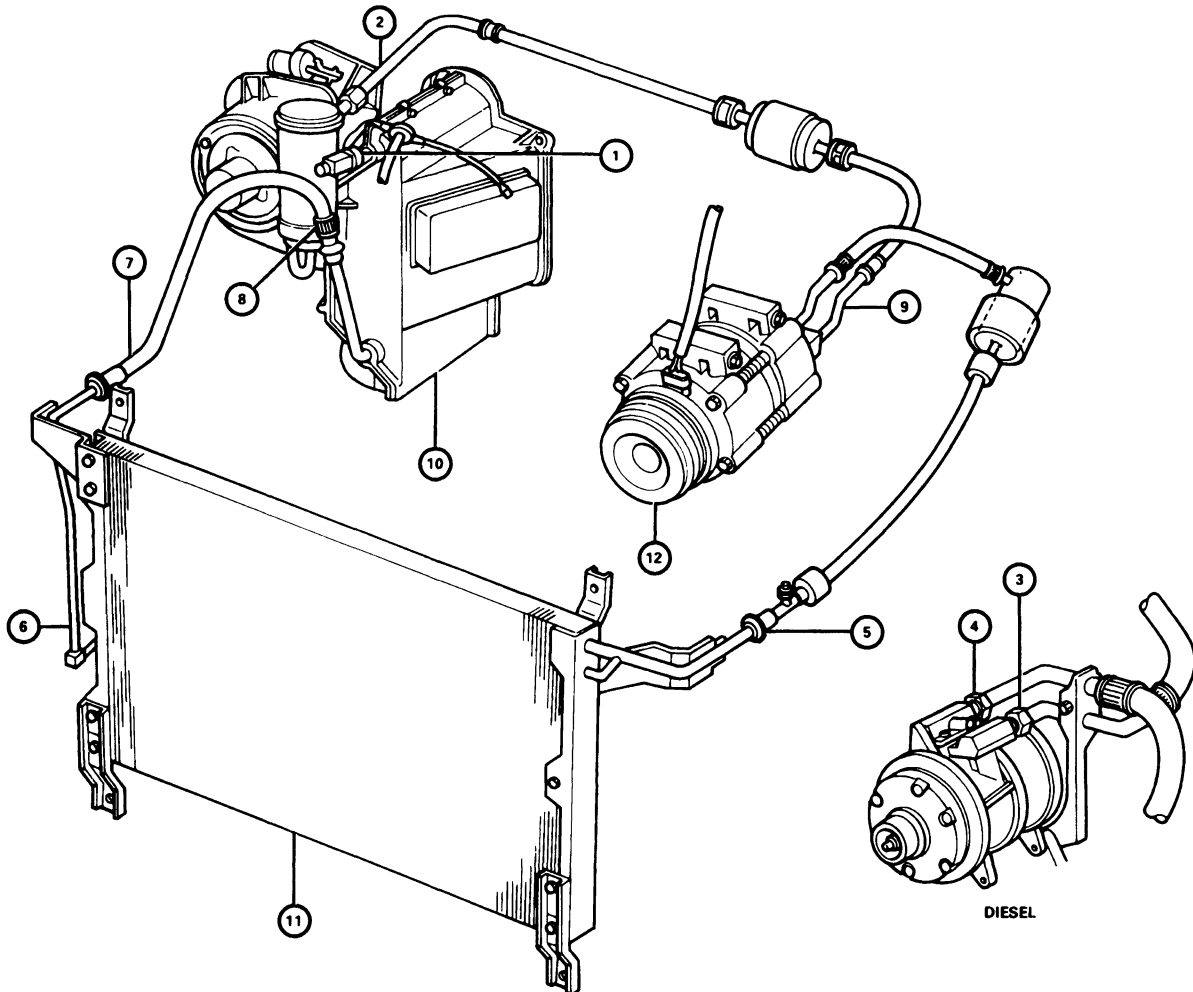
This section gives the basic principles and service procedures that apply to all Ford Light Truck air conditioning systems. Each of the following sections (beginning with Section 12-03A) covers only those procedures that are peculiar to the indicated vehicle system. **Reference both to this section and to the section covering the pertinent vehicle line is necessary for complete coverage of any given system.**

Basic Principles

Air conditioning is the cooling or refrigeration of the air in the passenger compartment. Refrigeration is accomplished by making practical use of three laws of nature. These laws and their practical application are described in the following paragraphs. A basic air conditioning system is shown in the illustration.

DESCRIPTION AND OPERATION (Continued)

Air Conditioning System



ITEM DESCRIPTION

1. EVAPORATOR CORE TO ACCUMULATOR INLET LINE
2. ACCUMULATOR TO SUCTION HOSE LINE
3. SUCTION HOSE TO COMPRESSOR LINE
4. DISCHARGE HOSE TO COMPRESSOR LINE
5. DISCHARGE HOSE TO CONDENSER LINE
6. CONDENSER TO OUTLET TUBE LINE

ITEM DESCRIPTION

7. OUTLET TUBE TO LIQUID HOSE LINE
8. LIQUID HOSE TO EVAPORATOR CORE LINE
9. MANIFOLD TO COMPRESSOR
10. EVAPORATOR ASSY
11. CONDENSER ASSY
12. COMPRESSOR

CCL 4107-A

Heat Transfer

If two substances of different temperature are placed near each other, the heat in the warmer substance will always travel to the colder substance until both are of equal temperature. For example, a cake of ice in an ice box does not communicate its coldness to the bottle of milk standing nearby. Rather, the heat in the warm milk automatically flows into the ice.

To determine the amount of heat that transfers from one substance to another, science uses the British Thermal Unit or BTU. One BTU is the amount of heat required to raise the temperature of one pound of water 0.55°C (1°F). For example, to raise the temperature of one pound of water from 0°C to 100°C (32°F to 212°F), one BTU of heat must be added for 0.55°C (1°F) rise in temperature or a total of 180 BTUs of heat. Conversely, in order to lower the temperature of one pound of water from 100°C to 0°C (212°F to 32°F), 180 BTUs of heat must be removed from the water.

DESCRIPTION AND OPERATION (Continued)**Latent Heat of Vaporization**

When a liquid boils (changes to a gas) it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (changes back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

For example, place one pound of water at 0°C (32°F) in a container over a flame. With each BTU of heat that the water absorbs from the flame, its temperature rises 0.55°C (1°F). Thus, after it has absorbed 180 BTUs of heat, the water reaches a temperature of 100°C (212°F). Even though the flame continues to give its heat to the water, the temperature of the water remains at 100°C (212°F). The water, however, starts to boil or change from the liquid to the gaseous state. It continues to boil until the water has passed off into the atmosphere as vapor. If this vapor were checked with a thermometer, it also would show a temperature of 100°C (212°F). In other words, there was a rise of only 100°C (212°F) (from 0°C to 100°C or 32°F to 212°F) in the water and vapor temperature even though the flame applied many more than 180 BTUs of heat. In this case, the heat is absorbed by the liquid in the process of boiling and disappears in the vapor. If the vapor were brought in contact with cool air, the hidden heat would flow into the cooler air as the vapor condensed back to water. Scientists refer to this natural law as the latent (hidden) heat of vaporization.

Water has a latent heat of vaporization of 970 BTUs and a boiling point of 100°C (212°F). This means that one pound of water at 100°C (212°F), will absorb 970 BTUs of heat in changing to vapor at 100°C (212°F). Conversely, the vapor will give off 970 BTUs of heat in condensing back to water to 100°C (212°F).

This tremendous heat transfer, occurring when a liquid boils or a vapor condenses, forms the basic principle of all conventional refrigeration systems.

For a liquid to be a refrigerant, it must also have a low boiling point. That is, the temperature at which it boils must be lower than the substance to be cooled.

Refrigerant-12 (or R-12) is the liquid most commonly used in automotive air conditioning systems because in an open container it boils at -5.7°C (-21.7°F). It is a liquid that boils or vaporizes well below passenger compartment temperatures and, in vaporizing, will absorb tremendous amounts of heat without getting any warmer itself.

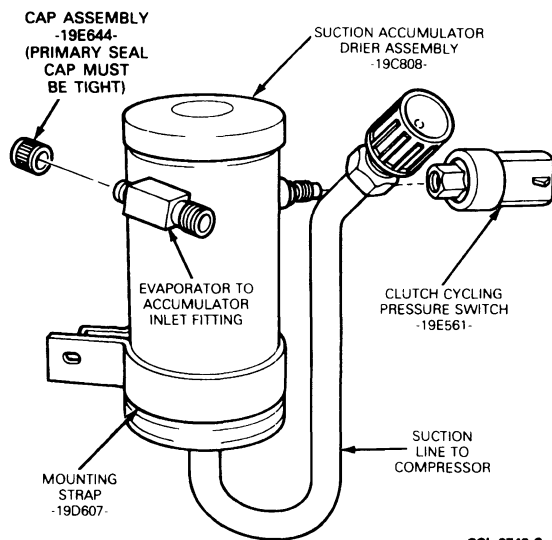
Major Air Conditioner Components**Suction Accumulator / Drier**

The suction accumulator / drier is mounted on the side of the evaporator core and attaches directly to the evaporator outlet tube. A suction service access gauge port valve is mounted on the inlet fitting of the suction accumulator / drier for F-Series. It is located on the suction line for E-Series. Its purpose is to provide service access to the suction side of the refrigerant system for pressure readings and system diagnosis. It also may be used for liquid charging the system when required. An inverted liquid diverter cup is mounted internally on top of the refrigerant vapor return tube, in the center of the suction accumulator / drier. Its purpose is to prevent the heavier, oil-laden liquid refrigerant from going directly into the compressor suction line. Upon entering the inlet of the suction accumulator / drier, the heavier, oil-laden refrigerant contacts the liquid diverter cup, which serves as an umbrella, and drips down onto the bottom of the housing. A small diameter aspirator tube, with air approximately 3.34mm (0.1315 inch) inside diameter, is placed close to the bottom of the accumulator at one end and to the top of the vapor return tube at the other end. It allows the accumulated heavier liquid refrigerant and oil mixture to re-enter the compressor suction line at a controlled rate. As the mixture passes through the aspirator tube, it has a second opportunity to vaporize and circulate through the compressor without causing compressor damage due to slugging. A fine mesh-screened filter fits tightly around the bottom of the aspirator tube to filter refrigerant contaminants which may be in the system and prevent them from plugging the aspirator tube.

A desiccant bag is mounted inside the suction accumulator / drier tank assembly to absorb any moisture which may be in the refrigerant system.

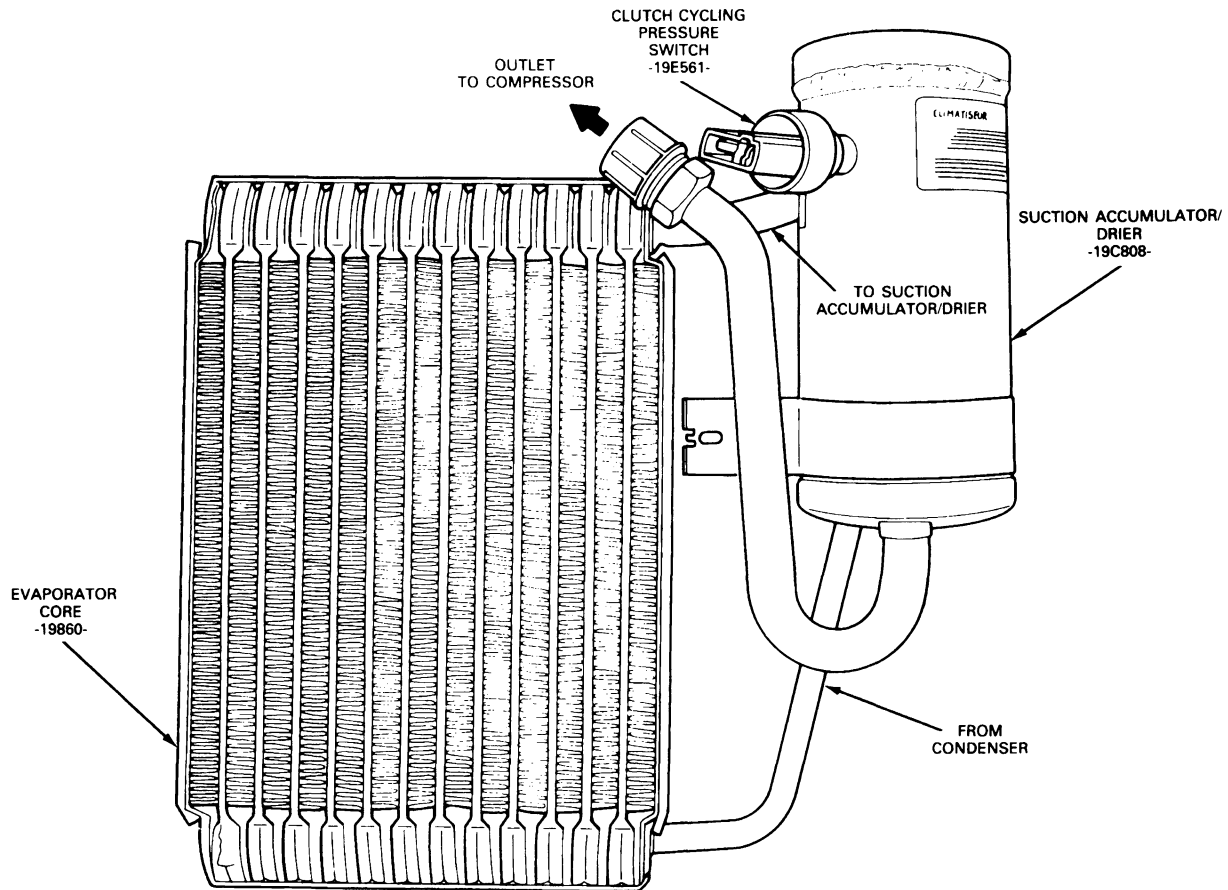
DESCRIPTION AND OPERATION (Continued)

Another fitting, on the suction accumulator / drier, is used to mount the clutch cycling pressure switch. It has a long-travel Schrader-type valve stem core installed in the fitting opening to prevent refrigerant loss when the clutch cycling pressure switch is removed.



Evaporator Core

The evaporator core is a multi-pass plate / fin aluminum core. The liquid line connects to the bottom of the core and the suction accumulator / drier connects to the top of the core. The outlet of the accumulator / drier then connects to the suction (low pressure) line. The liquid line tube is fitted with a fixed orifice to control refrigerant flow. This orifice can be removed from the evaporator core tube for replacement if it becomes necessary. However, a special tool is necessary to prevent breakage of the orifice.

DESCRIPTION AND OPERATION (Continued)**Evaporator Core and Suction Accumulator / Drier**

CCL 3162-A

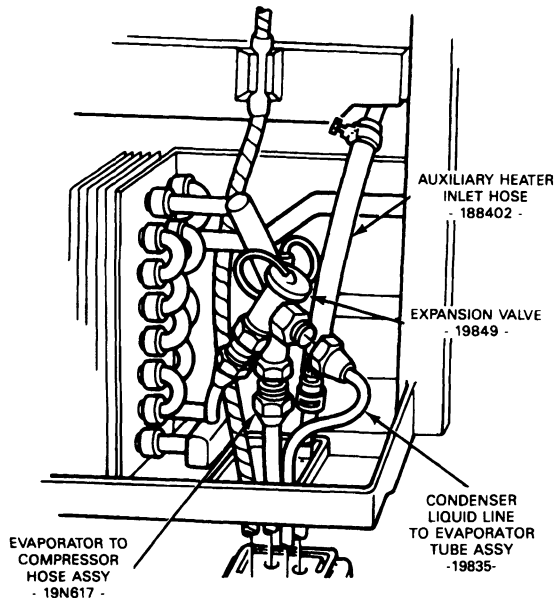
Expansion Valve, E-150-250-350 Auxiliary Unit

The expansion valve meters refrigerant into the evaporator according to cooling requirements. The restrictive effect of the expansion valve, while limiting the refrigerant flow to the evaporator, results in the reduced evaporator pressure.

The expansion valve consists of the valve and a temperature-sensing capillary tube and bulb. The valve is connected to the inlet tube of the evaporator and the sensing bulb is clamped to the outlet tube of the evaporator.

DESCRIPTION AND OPERATION (Continued)

The expansion valve is opened and closed by opposing pressures on either side of a diaphragm. The temperature-sensing bulb which is clamped to the evaporator outlet tube usually contains Refrigerant-12. As evaporator outlet temperature rises, the Refrigerant-12 expands and exerts pressure against the diaphragm to open the valve further and admit more refrigerant into the evaporator for increased cooling. As evaporator outlet temperature falls, the pressure against the diaphragm is decreased. Inlet pressure on the opposite side of the diaphragm then starts closing the valve. The valve tends to seek a position to control the Refrigerant-12 flow to maintain near maximum cooling from the evaporator.

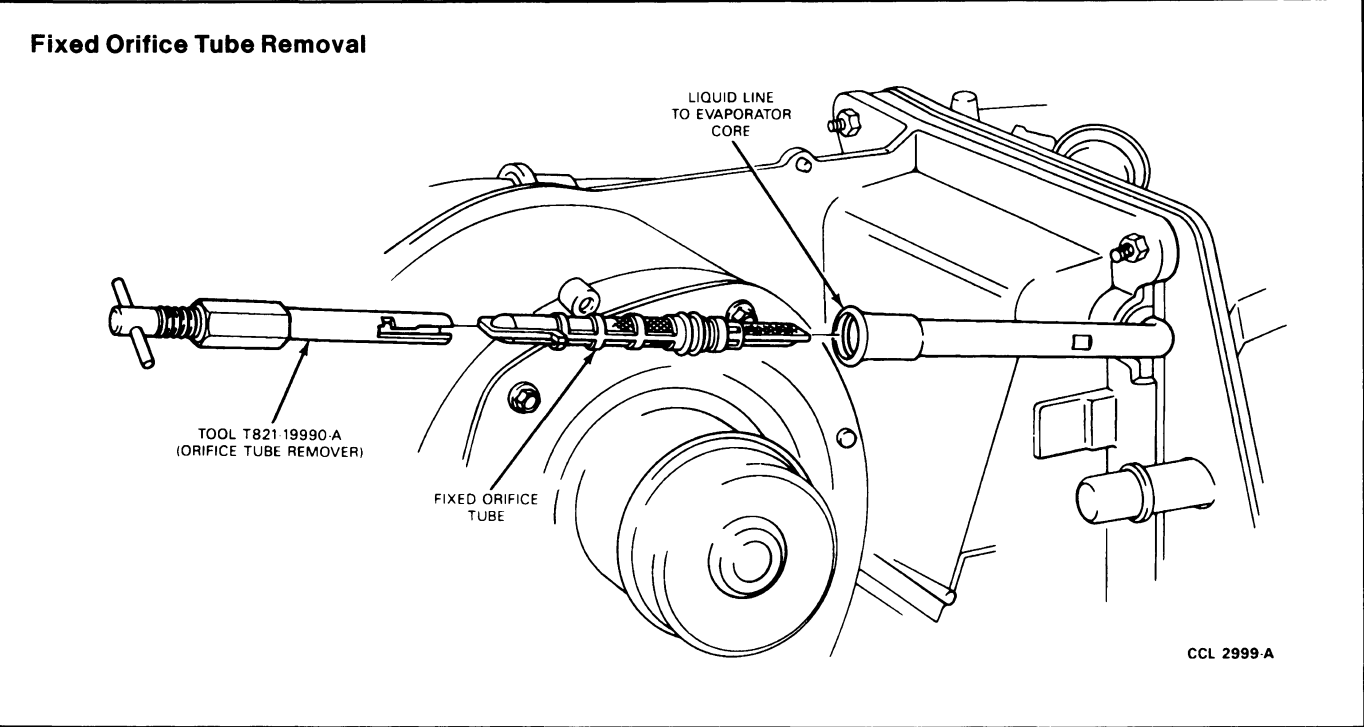


Fixed Orifice Tube

The fixed orifice tube is a restriction between the high and low pressure refrigerant and meters the flow of liquid refrigerant into the evaporator core.

The fixed orifice tube is located in the evaporator inlet tube and has filter screens on the inlet and outlet ends of the tube body. The filter screens act as strainers for the liquid refrigerant flowing through the fixed orifice opening. O-rings on the tube body prevent the high pressure liquid refrigerant from bypassing the orifice. Adjustment or repairs cannot be made to the fixed orifice tube assembly and it must be replaced as a unit. F-Series and Bronco vehicles use a 0.067-inch orifice tube color coded **blue** and the Econoline main system use a 0.057-inch orifice tube color coded **red**.

DESCRIPTION AND OPERATION (Continued)



Air Conditioner Compressor and Clutch

The following chart lists compressor applications by vehicle line, compressor type, and engine displacement.

Vehicle	Compressor Type	Engine Displacement
F-Series	FX-15	4.9L 5.0L / 5.8L 7.5L 7.3L
Bronco	FX-15	4.9L 5.0L / 5.8L

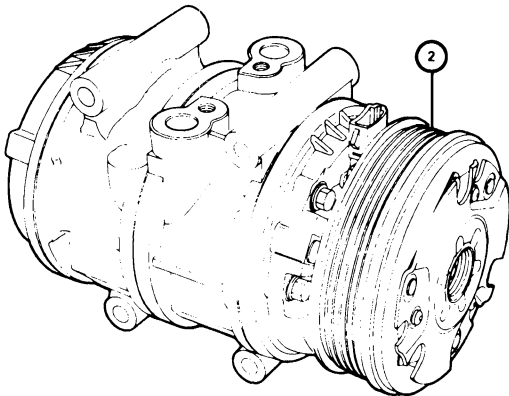
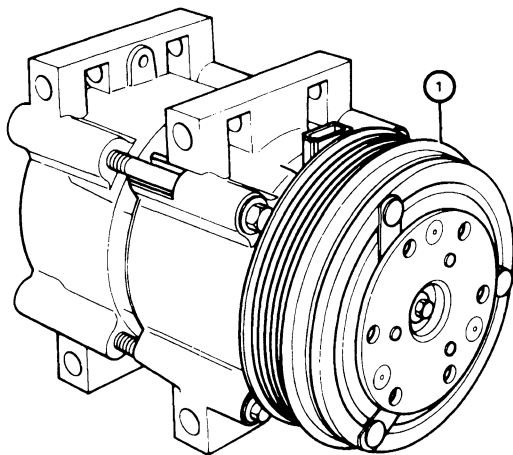
(Continued)

Vehicle	Compressor Type	Engine Displacement
Econoline	FS-6	4.9L 5.0L 5.8L
Econoline	FX-15	7.5L 7.3L

An electro-magnetic clutch, used with each of these compressors, is energized when the clutch cycling pressure switch, located on the suction accumulator-drier, closes. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor drive shaft.

DESCRIPTION AND OPERATION (Continued)

The pressure acting on the pressure switch and the ambient temperature existing at the temperature sensor combine their effect to control compressor clutch engagement. When both pressure and temperature are within specifications and the control knob/lever is set at MAX A/C, NORM A/C, or either of the settings calling for full or partial defroster operation, the compressor will be operating. (Compressor operation during defrost is provided to minimize humidity in the passenger compartment). The compressor is mounted on the side of the engine and is driven by a belt. Belt tension adjustment is obtained by means of an automatic tensioner (gasoline engines) or by moving the compressor braces away from the engine (diesel engines).



CCL 4113-A

ITEM DESCRIPTION

1. FX-15 COMPRESSOR & CLUTCH ASSY
2. FS-6 COMPRESSOR WITH TANGENTIAL MOUNTING PROVISIONS

High Pressure Relief Valve

Under extreme pressure conditions, the high pressure relief valve will momentarily open, allowing refrigerant vapor to escape. This relieves excessive pressure that might damage the compressor. The valve closes as soon as pressure is lower than the relief setting. This prevents loss of the complete refrigerant charge. The high pressure relief valve is located in the discharge manifold at the top of the compressor.

Condenser

The air conditioning condenser is located in front of the radiator. The condenser receives compressed (therefore heated) refrigerant gas from the compressor.

As the hot refrigerant gas flows through the condenser, it is cooled by air passing over the fins. The cooled, compressed refrigerant gas condenses to liquid refrigerant which flows directly to the evaporator through the fixed orifice tube in the evaporator inlet.

Spring Lock Coupling

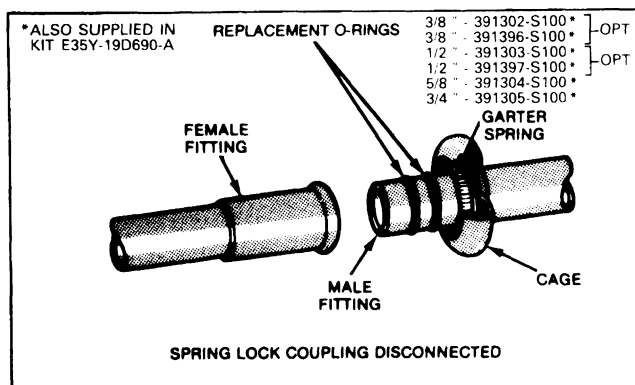
The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage. When the coupling is connected, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting. The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage.

Two O-rings are used to seal between the two components of the coupling. These O-rings are green and made of special material. They **must** be replaced with an O-ring made of the same material. The O-rings normally used in refrigerant system connections are not the same material and should not be used with the spring lock coupling. Use only the O-rings listed in the Master Parts Catalog for the spring lock coupling.

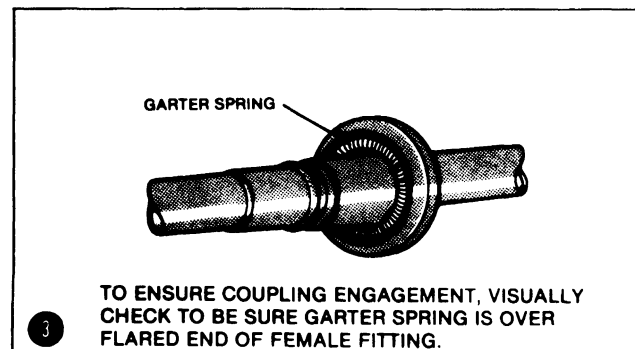
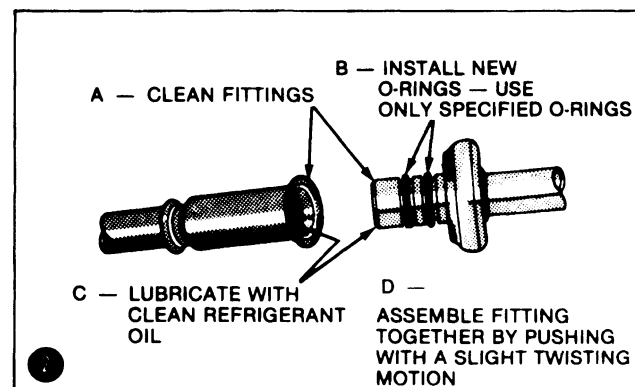
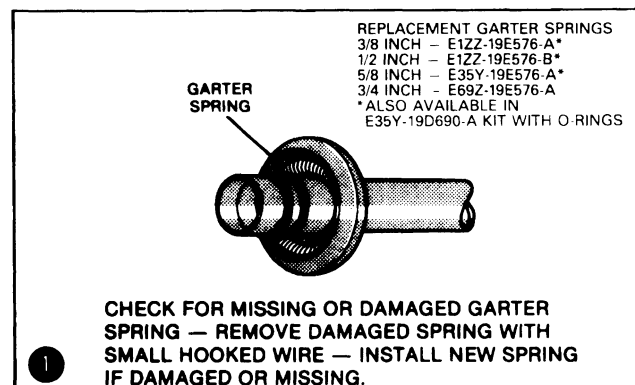
A plastic indicator ring is used on spring lock couplings to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening.

After the coupling has been cleaned, install new O-rings lubricated with clean refrigerant oil. Connect the coupling by pushing with a slight twisting motion. When the coupling is connected a distinct click or snap should be heard or felt, indicating positive engagement. If possible, visually inspect the cage to make sure that the flared end of the female fitting is fully behind the garter spring. Otherwise, push and pull on the fitting to verify engagement.

DESCRIPTION AND OPERATION (Continued)

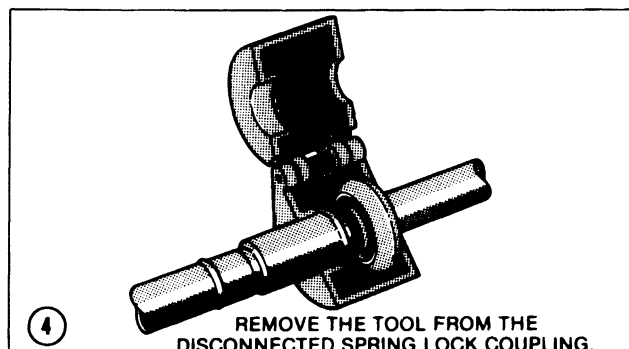
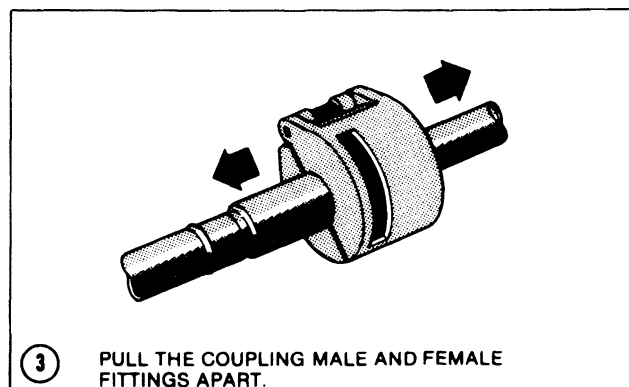
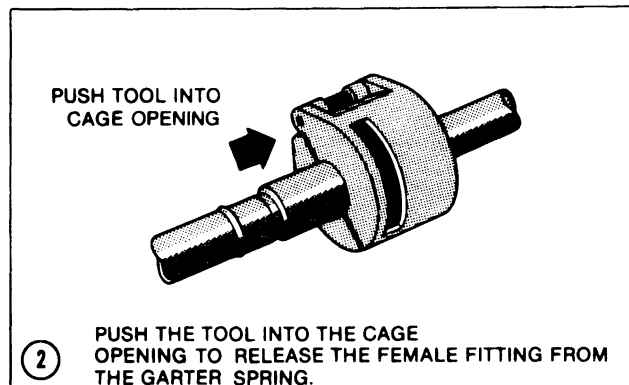
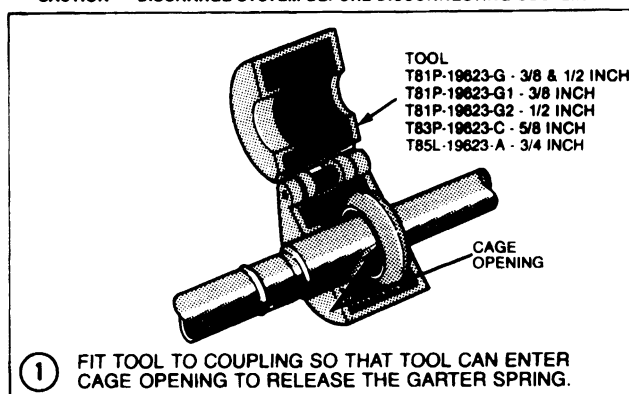


TO CONNECT COUPLING



TO DISCONNECT COUPLING

CAUTION — DISCHARGE SYSTEM BEFORE DISCONNECTING COUPLING



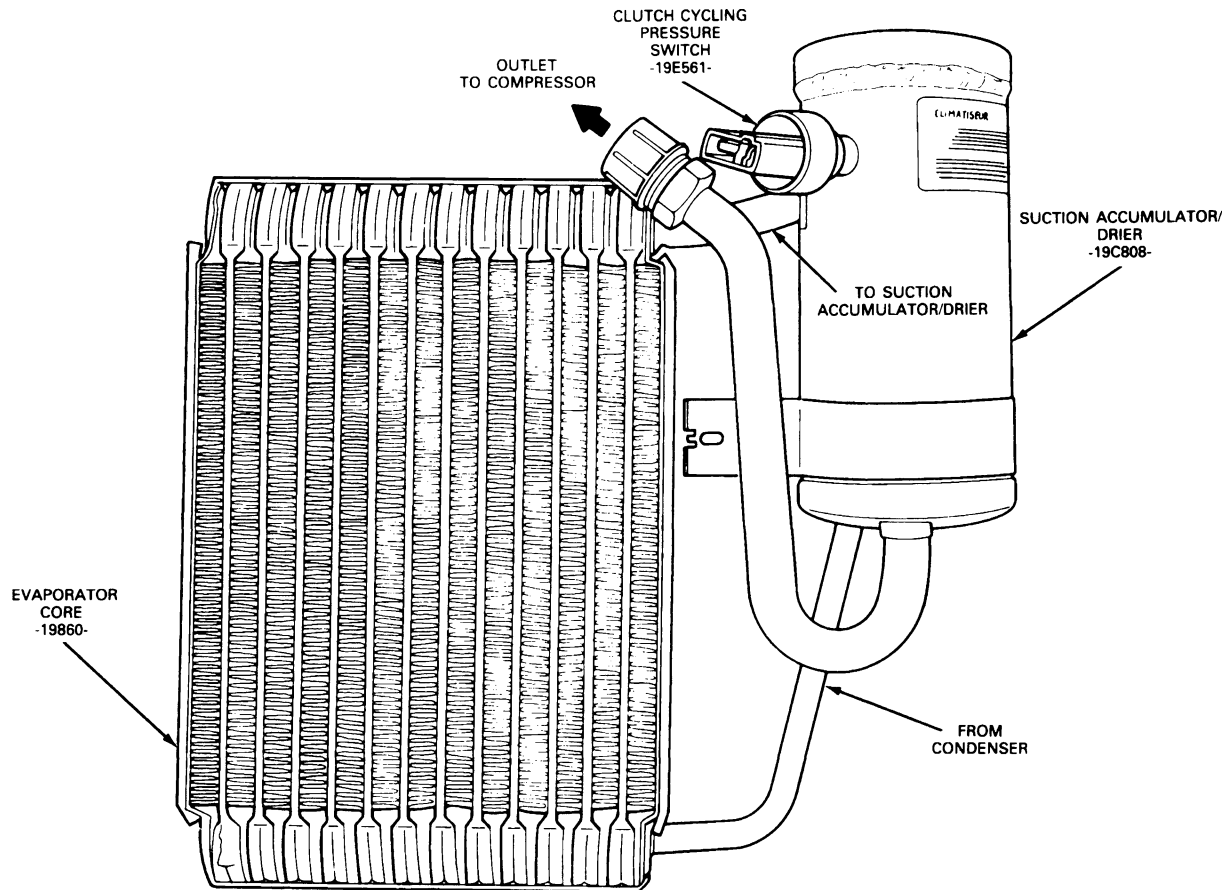
CCL 4011-C

DESCRIPTION AND OPERATION (Continued)**Clutch Cycling Pressure Switch**

As described previously under Air Conditioner Compressor and Clutch, the clutch cycling pressure switch is mounted on a Schrader valve-type of fitting on the accumulator / drier assembly. A valve depressor, located inside the threaded end of the pressure switch, depresses the Schrader valve stem as the switch is mounted and allows the suction pressure inside the accumulator / drier housing to control the switch operation. The electrical switch contacts are normally open when the suction pressure is at or below 152 kPa (22 psi); they will close when the suction pressure rises to approximately 290-324 kPa (42-47 psi) or above. Lower ambient temperatures (below 10°C or 50°F), during cold weather seasons, will also open the clutch cycling pressure switch contacts due to the pressure / temperature relationship of the refrigerant in the system. The electrical switch contacts control the electrical circuit to the compressor's magnetic clutch coil. When the switch contacts are closed, the clutch coil is energized and the air conditioner clutch is engaged to drive the compressor. When the switch contacts are open, the compressor's magnetic clutch coil is de-energized, the air conditioner clutch is disengaged and the compressor does not operate. The clutch cycling pressure switch, when functioning properly, will control the evaporator core pressure at a point where the plate / fin surface temperature will be maintained slightly above freezing which prevents evaporator icing and the blockage of airflow.

DESCRIPTION AND OPERATION (Continued)

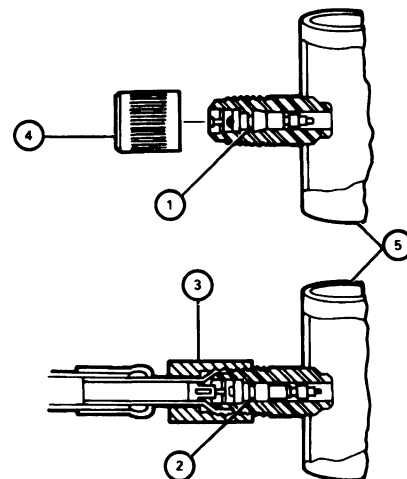
Evaporator Core and Suction Accumulator / Drier



CCL 3162-A

Service Access Gauge Port Valves

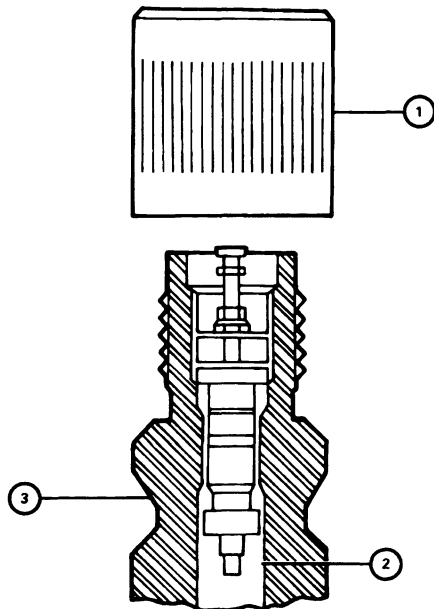
These valves are similar to a tire valve. The service valve in the high pressure line (from compressor to condenser) allows access to the high pressure side of the system for attaching a service hose and pressure gauge. The service valve in the low pressure line (from evaporator to compressor) allows access to the low pressure side of the system for attaching a service hose and pressure gauge. High pressure service valve adapters are shown in the illustration. An additional low pressure gauge port valve adapted to the accumulator is available for attaching a service hose or pressure gauge. Refer to Tee Adapter Tool procedure as outlined.



CCL 4122-A

- | ITEM | DESCRIPTION |
|------|--|
| 1. | VALVE (CLOSED) |
| 2. | VALVE (OPEN) |
| 3. | MANIFOLD GAUGE HOSE ASSEMBLY |
| 4. | PROTECTOR CAP (PRIMARY SEAL CAP MUST BE TIGHT) |
| 5. | LOCATED IN A/C TUBE |

DESCRIPTION AND OPERATION (Continued)



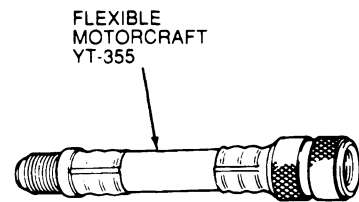
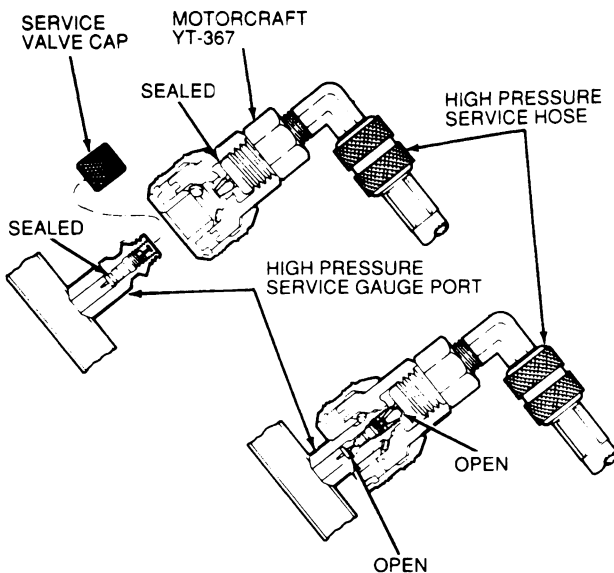
NOTE: Protective caps must be tightly installed, inasmuch as they contain the primary seal for the gauge port valve.

CCL 4121-A

ITEM DESCRIPTION

1. PROTECTIVE CAP (PRIMARY SEAL CAP MUST BE TIGHT)
2. VALVE CORE
3. VALVE BODY

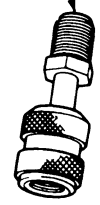
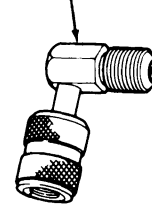
High Pressure Service Valve Adapters



45 DEGREE
MOTORCRAFT
YT-927

90 DEGREE
MOTORCRAFT
YT-354

STRAIGHT
MOTORCRAFT
YT-357



CCL 4068-A

DIAGNOSIS AND TESTING

Preliminary Guidelines

Diagnosis is more than following a series of interrelated steps to find the solution to a specific condition. It is a way of looking for systems that are not functioning properly and finding out why. Also, it is knowing how the system should work, and whether it is working correctly.

Know the System

Know how the parts go together and how the system operates, as well as its limits and what happens when something goes wrong. This may require checking the system against a known good system.

Know the Service History of the System

Know how old the system is and its service history, which might relate to the present condition. A clue in these areas may save time.

Know the Service History of the Condition

Find out if the condition started suddenly or gradually, or whether it was related to some other occurrence like an accident or another component that was replaced. Knowing how the condition was discovered may be an important clue to the cause.

Know the Probability of Certain Conditions Developing

Most conditions are caused by simple things rather than by complex ones, and they occur in a fairly predictable pattern. Electrical problem conditions usually occur at connections rather than in components. An engine "no start" is more likely to be caused by a loose wire or a component out of adjustment than a sheared-off camshaft. To avoid spending unnecessary diagnosis time, do not eliminate certain failures unless you are sure that these failures are impossible. Also, although a part may be new, it is no guarantee that the part is functioning properly.

Safety Precautions

The refrigerant used in the air conditioning system is Refrigerant-12. Refrigerant-12 is non-explosive, non-flammable, noncorrosive, has practically no odor, and is heavier than air. Although it is classified as a safe refrigerant, certain precautions must be observed to protect the parts involved and the person who is working on the unit.

CAUTION: Use only Refrigerant-12. Do not use refrigerant that is canned for pressure-operated accessories (such as boat air horns). This type is not pure Refrigerant-12 and will cause a malfunction.

WARNING: AVOID CONTACT OF LIQUID REFRIGERANT-12 WITH SKIN AND EYES. AT NORMAL ATMOSPHERIC PRESSURES AND TEMPERATURES, REFRIGERANT-12 EVAPORATES SO QUICKLY THAT IT HAS THE TENDENCY TO FREEZE ANYTHING IT CONTACTS. SHOULD LIQUID REFRIGERANT COME IN CONTACT WITH THE EYES, IMMEDIATELY WASH WITH A FEW DROPS OF MINERAL OIL FOLLOWED BY A WEAK BORIC ACID SOLUTION. CONTACT A PHYSICIAN IMMEDIATELY.

WARNING: ALWAYS WEAR SAFETY GOGGLES WHEN SERVICING ANY PART OF THE REFRIGERANT SYSTEM. REFRIGERANT-12 IS ALWAYS UNDER PRESSURE. BECAUSE THE SYSTEM IS TIGHTLY SEALED, HEAT APPLIED TO ANY PART OF THE SYSTEM WILL CAUSE EXCESSIVE PRESSURE BUILDUP. TO AVOID A DANGEROUS EXPLOSION, NEVER WELD, USE A BLOW TORCH, SOLDER, STEAM CLEAN, BAKE BODY FINISHES OR USE AN EXCESSIVE AMOUNT OF HEAT ON OR IN THE IMMEDIATE AREA OF ANY PART OF THE AIR COOLING SYSTEM OR REFRIGERANT SUPPLY TANK, WHILE CLOSED TO ATMOSPHERE, WHETHER FILLED WITH REFRIGERANT OR NOT.

WARNING: LIQUID REFRIGERANT EVAPORATES RAPIDLY, DISPLACING AIR WHERE THE REFRIGERANT IS RELEASED. TO PREVENT POSSIBLE SUFFOCATION IN ENCLOSED AREAS, DISCHARGE THE REFRIGERANT FROM AN AIR COOLING SYSTEM INTO THE GARAGE EXHAUST COLLECTOR. MAINTAIN GOOD VENTILATION SURROUNDING THE WORK AREA.

WARNING: ALTHOUGH REFRIGERANT-12 GAS, UNDER NORMAL CONDITIONS, IS NON-POISONOUS, THE DISCHARGE OR REFRIGERANT GAS NEAR AN OPEN FLAME CAN PRODUCE A VERY POISONOUS GAS. IT IS GENERATED WHEN THE FLAME-TYPE LEAK DETECTOR IS USED. AVOID INHALING FUMES FROM THE LEAK DETECTOR. MAKE CERTAIN THAT REFRIGERANT-12 IS STORED AND INSTALLED IN ACCORDANCE WITH ALL STATE AND LOCAL ORDINANCES.

DIAGNOSIS AND TESTING (Continued)

CAUTION: When admitting Refrigerant-12 gas into the cooling unit, keep the tank in an upright position. If the tank is on its side or upside down, liquid Refrigerant-12 will enter the system and damage the compressor.

CAUTION: A number of manufacturers are producing refrigerant products which are described as being direct replacements for Refrigerant-12. The use of any unauthorized substitute refrigerant may severely damage the A/C components. If service is required, use only **NEW** or **RECYCLED** Refrigerant-12.

Service Precautions

Observe the following service precautions.

1. Never open or loosen a connection before discharging the system.
2. When loosening a connection, if any residual pressure is evident, allow it to leak off before opening the fitting.
3. Evacuate a system which has been opened to replace a component or one which has discharged through leakage before charging.
4. Seal open fittings with a cap or plug immediately after disconnecting a component from the system.
5. Clean the outside of the fittings thoroughly before disconnecting a component from the system.
6. Do not remove the sealing caps from a replacement component until ready to install.
7. Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use and install the cap immediately after using. Store the oil only in a clean, moisture-free container.
8. Install a new seal ring before connecting an open fitting. Coat the fitting and seal with refrigerant oil before connecting.
9. When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges which may chafe the line.
10. Tighten fittings only to specifications. The steel and aluminum fittings used in the refrigeration system will not tolerate over-tightening.
11. When disconnecting a fitting, use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.
12. Do not open a refrigerant system or uncap a replacement component unless it is as close as possible to room temperature. This will prevent condensation from forming inside a component which is cooler than the surrounding air.
13. Keep service tools and the work area clean to avoid contamination of a refrigerant system.

System Visual Inspection

It is possible to detect problem causes by a careful visual inspection of the air conditioner refrigerant system. This includes broken belts, obstructed condenser air passages, a loose clutch, loose or broken mounting brackets, disconnected or broken wires and many refrigerant leaks.

A refrigerant leak will usually appear as an oily residue at the leakage point in the system. The oily residue soon picks up dust or dirt particles from the surrounding air and appears greasy. Through time, this will build up and appear to be a heavy dirt-impregnated grease.

Most common leaks are caused by damaged or missing O-ring seals at the various hose and component connections. When these O-rings are replaced, lubricate the new O-rings with refrigerant oil. Be careful to keep shop towel lint from contaminating the internal surfaces of the connection. Leakage may occur at a spring lock coupling if the wrong O-rings are used at the coupling. Use **only** the O-rings listed in the Ford Master Parts Catalog for the spring lock coupling.

If the system contains no refrigerant or is extremely low on refrigerant, the clutch will not engage for compressor operation. A rapid cycling compressor clutch is usually an indication that the system is low on refrigerant. Also, clutch cycling will normally not occur when the engine is operating at curb idle speed.

Suction Accumulator / Drier Replacement

Replacement of the suction accumulator / drier is necessary anytime a major component of the refrigerant system is replaced. A major component includes condenser, compressor, evaporator core or a refrigerant hose / line. An orifice tube or O-ring is not considered a major component but the orifice tube should be replaced whenever the compressor is replaced for lack of performance.

In addition to the preceding condition, the accumulator / drier should also be replaced if one of the following conditions exist.

1. The accumulator / drier is perforated.
2. The refrigerant system has been opened to the atmosphere for a period of time longer than required to make a minor repair.
3. There is evidence of moisture in the system such as internal corrosion of metal refrigerant lines or the refrigerant oil is thick and dark.

When replacing the suction accumulator / drier, the procedure given here must be followed to make sure that the total oil charge in the system is correct after the new accumulator / drier is installed.

- Drain the oil from the removed accumulator / drier into a suitable measuring container. It may be necessary to drill one or two 12.7mm (1/2 inch) holes in the bottom of the old accumulator / drier to make sure that all the oil has drained out.

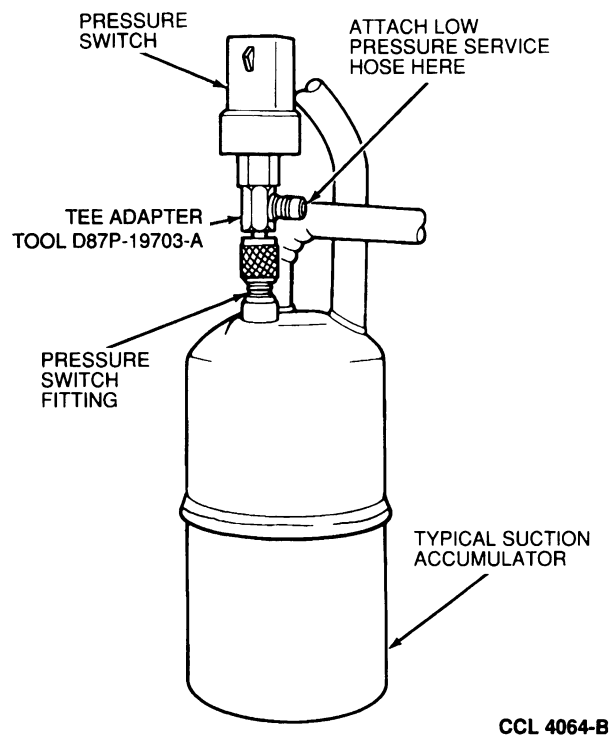
DIAGNOSIS AND TESTING (Continued)

- Add the same amount of clean new refrigerant oil plus one fluid ounce (two fluid ounces on 1989 and later models) to the new accumulator / drier. Use only the oil specified for the specific vehicle being serviced.

Tee Adapter Tool

A tee-type service adapter, tool D87P-19703-A or equivalent, may be used to diagnose the low pressure side of the refrigerant system. The tool is shown installed.

1. Disconnect electrical connector at clutch cycling pressure switch and remove switch from switch fitting.
2. Install a new clutch cycling pressure switch and O-ring on adapter tool, and plan to leave it on adapter as a permanent part of tool. Lubricate O-ring before installation.
3. Install tee adapter tool on clutch cycling pressure switch fitting and tighten it securely.
4. Connect low pressure hose of manifold gauge set to side fitting of tee adapter tool.
5. Connect electrical connector to clutch cycling pressure switch on tee adapter tool.



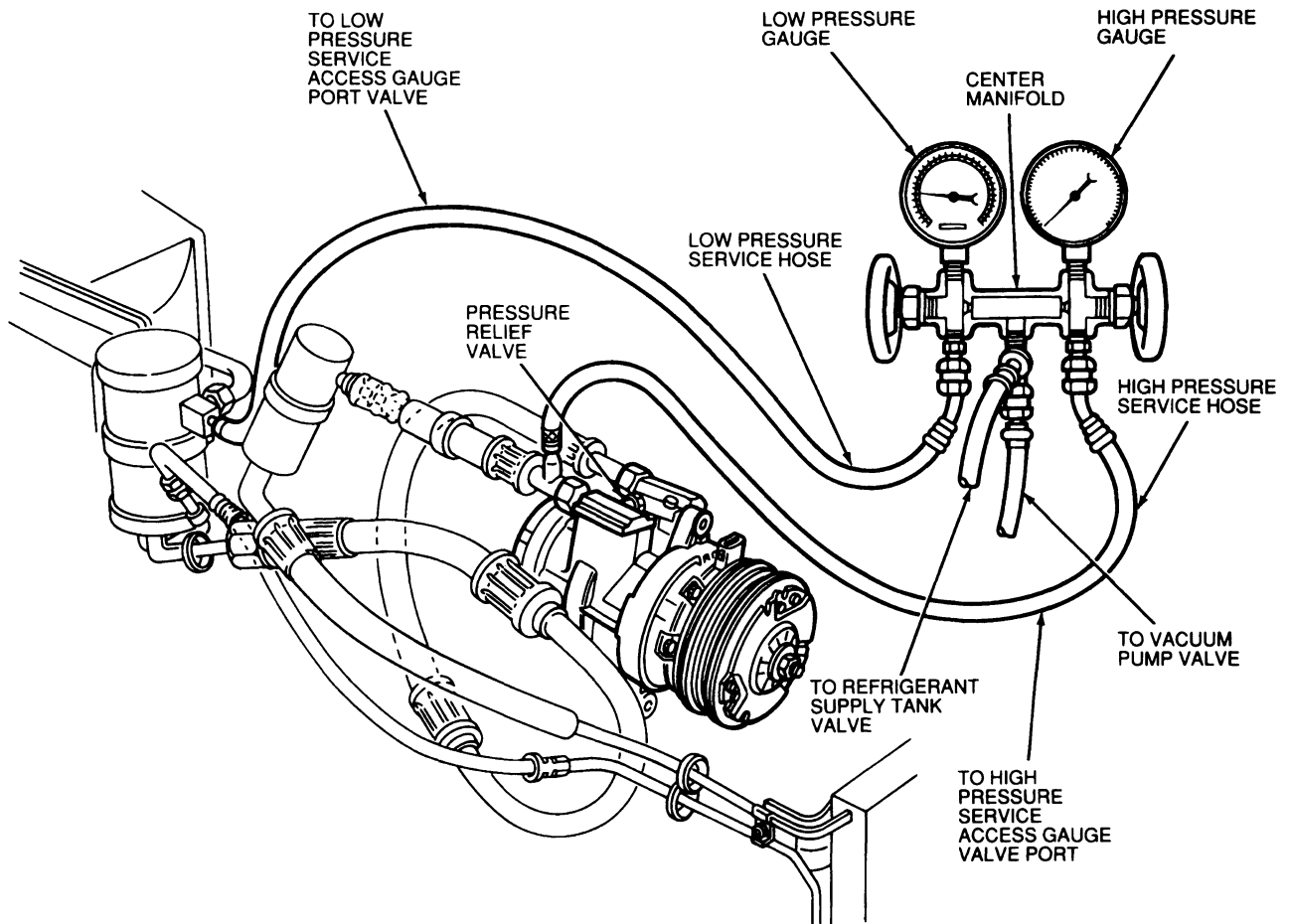
With the tee adapter tool installed in this manner, the refrigerant system can be operated under normal conditions with clutch cycling pressure switch control and evaporator (suction) pressure may be observed. This provides a more accurate low pressure reading than can be obtained from a low pressure gauge port located in the suction line or near the compressor.

After completing the repair, disconnect the manifold gauge set from the adapter tool. Disconnect the electrical connector from the clutch cycling pressure switch on the tool and remove the tool from the pressure switch fitting. Install the removed clutch cycling pressure switch and connect the electrical connector.

SERVICE PROCEDURES**Attaching a Manifold Gauge Set**

When performing any of the various tests, test equipment must be connected to the refrigerant system. If charge station-type equipment is used, follow the instructions of the manufacturer.

To attach a manifold gauge set (part of Rotunda Manifold Gauge Set 063-00010 or equivalent) to the service access gauge port valves, proceed as follows:

SERVICE PROCEDURES (Continued)**Manifold Gauge Set Connections**

CCL 4067-A

1. Turn both manifold gauge set valves fully clockwise to close high and low pressure hoses at gauge.
2. Remove caps from low and high pressure service (Schrader) access gauge port valves in high and low pressure lines.
3. If refrigerant hoses do not have valve depressing pins in them, install Straight Adapter T7 1P-19703-S or Curved Adapter T7 1P-19703-R (containing valve depressing pins) on manifold gauge set low and high pressure hoses.
4. Connect high and low pressure refrigerant hoses with depressing pins or adapters containing depressing pins to respective high and low pressure service access gauge port valves. The special adapter must be used on high pressure service access gauge port valve.
5. Connect hoses attached to manifold center fitting to refrigerant supply tank and vacuum pump valves.

Discharging the System

Discharge the refrigerant from the system into an approved recovery unit (with the exception of the clutch cycling pressure switch). Be sure to discharge the system before removing any other part.

1. Remove caps from high and low pressure service gauge port valves in high and low pressure lines.
2. Turn both manifold gauge valves fully clockwise to close gauge set to center outlet hoses.
3. If gauge set hoses do not have service valve actuating pins, install Straight Adapter T7 1P-19703-S and Curved Adapter T7 1P-19703-R on manifold gauge low pressure hose. Install a special adapter coupler on high pressure hose.
4. Connect high and low pressure gauge hoses with adapters to respective high and low pressure service gauge port valves.

SERVICE PROCEDURES (Continued)

5. Slowly de-pressurize refrigeration system by opening low pressure gauge valve a slight amount and allowing refrigerant to discharge slowly from system.
6. After system is nearly discharged, open the high pressure gauge valve very slowly to avoid losing an excessive amount of refrigerant oil while still allowing any refrigerant remaining in compressor and high pressure line to discharge.

4. Allow the vehicle air conditioning system to remain closed for about two minutes. Observe system vacuum level as shown on the gauge. If the pressure does not rise, disconnect the recycling station hose(s).
5. If the system pressure rises, repeat Steps 2, 3, and 4 until the vacuum level remains stable for two minutes.
6. Perform required service operations, evacuate and recharge the air conditioning system.

Refrigerant Recovery / Recycling

In order to minimize the discharge of ozone depleting chlorofluorocarbons into the atmosphere, the Ford Motor Co. supports the efficient usage, recovery, and recycling of R-12 used in car and truck air conditioners. Ford Motor Co. recommends the use of an U.L. approved recovery / recycling device such as Rotunda Model No. 158-00001 or 158-00002 (or other device which meets SAE Standard J1991) during any air conditioning system repair and recharge procedure which requires the air conditioning system to be discharged.

Additional information and a typical procedure for operating a refrigerant recovery device follows:

Refrigerant recovery systems and recycling stations are in use in an increasing number of automotive air conditioning service facilities. The use of such equipment makes possible the recovery and use of air conditioning system refrigerant after contaminants and moisture have been removed.

If a refrigerant recovery or recycling station is used, the following general procedures should be observed, in addition to the operating instructions provided by the equipment manufacturer.

CAUTION: Use extreme care and observe all safety and service precautions related to the use of refrigerants.

1. Connect the refrigerant recycling station hose(s) to the vehicle air conditioning service ports and the recovery station inlet fitting.

NOTE: Hoses should have shut off devices or check valves within 12 inches of the hose end to minimize the introduction of non-condensable gases (air) into the recycling station and to minimize the amount of refrigerant released when the hose(s) is disconnected.
2. Turn the power to the recycling station on to start the recovery process. Allow the recycling station to pump the refrigerant from the system until the station pressure goes into a vacuum. On some stations the pump will be shut off automatically by a low pressure switch in the electrical system. On other units it may be necessary to manually turn off the pump.
3. Once the recycling station has evacuated the vehicle air conditioning system, close the station inlet valve (if so equipped). Then, switch off the electrical power.

Evacuating the System

1. Discharge refrigerant system as outlined.
2. Be certain that the manifold gauge set is connected as follows:
 - a. Low pressure hose connected to low pressure service gauge port on top center of the accumulator / drier assembly.
 - b. High pressure hose to high pressure gauge port on compressor discharge line at condenser connection. An adapter is necessary at this service gauge port.
 - c. Connect manifold gauge set center hose to a vacuum pump.
3. Open manifold gauge set valves and start vacuum pump.
4. Evacuate system with vacuum pump until low pressure gauge reads at least 84 kPa (25 in. Hg) (vacuum) and as close to 101 kPa (30 in. Hg) as possible. Continue vacuum pump operation for 15 minutes. If part of system has been replaced, continue vacuum pump operation for an additional 20-30 minutes.
5. When evacuation of system is complete, close manifold gauge set valves and turn vacuum pump off.
6. Observe low side gauge to make sure system holds vacuum for five minutes. If vacuum is held for five minutes, proceed to charging the system. If vacuum is not held for five minutes, leak test system, repair leak(s) and again evacuate system.

Charging the System

1. With manifold gauge set valve closed to center hose, disconnect vacuum pump from manifold gauge set.
2. Connect center hose of manifold gauge set to a charging cylinder or refrigerant drum.
3. Loosen center hose at manifold gauge set and open the charging cylinder refrigerant drum valve. Allow refrigerant to escape to purge air and moisture from center hose. Then, tighten center hose connection at manifold gauge set.

SERVICE PROCEDURES (Continued)

4. Open manifold gauge set low side valve to allow refrigerant to enter system. Keep refrigerant can in an upright position if vehicle low pressure service gauge port is not on suction accumulator / drier or suction accumulator fitting.
5. When no more refrigerant is being drawn into system, start engine, move blower switch to HI and move function selector lever to MAX A/C. Continue to add refrigerant to system until specified weight of Refrigerant-12 is in system. Then, close manifold gauge set low pressure valve and refrigerant supply valve.
6. Operate system until the pressures stabilize to verify normal operation and system pressures.
7. In high ambient temperatures, it may be necessary to operate a high volume fan positioned to blow air through radiator and condenser to aid in cooling the engine and prevent excessive refrigerant system pressures.
8. When charging is completed and system operating pressures are normal, disconnect manifold gauge set from vehicle. Install protective caps on service gauge port valves.

Recommendation to Avoid the Use of Small Containers for Charging

It is repeated that the refrigerant charge level of air conditioning systems currently being used is critical to optimum performance. Either an under-charge or an over-charge will adversely affect performance. Using small cans to charge these systems is not recommended because the charge level cannot be accurately controlled. A Charging Cylinder or Charging Station is the only recommended method.

Compressor Oil Level Check

The only method for checking the amount of oil in a compressor is to remove the compressor and pour the oil from its manifold openings into a clean calibrated container.

Purging the Refrigerant System to Remove Air and Moisture Vapor

The triple evacuation procedure should be employed when there are definite indications of moisture in the system. This procedure is effective in removing small amounts of moisture from the refrigerant system. However, if the system is contaminated with a large quantity of water, complete system flushing will be required. In any case, use approved refrigerant recovery equipment.

The principle of the three evacuations is simple. The first pull-down removes approximately 90 percent of the air and moisture vapors.

The first purge with new, dry Refrigerant-12 mixes with the remaining 10 percent.

With the next evacuation, this mixture will be drawn out so that only approximately one percent of the initial air and moisture vapors remain.

The second purge with new, dry Refrigerant-12 will mix with this one percent, and the third evacuation will finish the job by drawing out practically all the remaining vapors.

But, if any water was present in the system at the start of this procedure, most of it will still be there, because a short period of vacuum is not long enough to boil and vaporize the water. The Refrigerant-12 purges, in passing over the liquid, will absorb only a relatively small amount of water.

This procedure is effective only when no water is in the system. It should not be used if there is any indication of water in the system.

Cleaning a Badly Contaminated Refrigerant System

A refrigerant system can become badly contaminated for a number of reasons.

- The compressor may have failed due to damage or wear.
- The compressor may have been run for some time with a bad leak or any opening in the system.
- The system may have been damaged by a collision and left open for a long time.
- The system may not have been cleaned properly after a previous failure.
- The system may have been operated for a time with water or moisture in it.
- Clutch cycle rate is fast.
- Clutch ON time is short.
- Clutch OFF time is short.

The evaporator core is causing the problem. Airflow is restricted, indicating leaves or debris entering through the cowl air inlet and plugging the core.

This condition can also be detected by checking the center register discharge temperature. An abnormally low temperature indicates air is spending more time in the evaporator and is very cold when discharged, although the volume is not enough to cool the car properly.

Additional cause components are listed at the bottom of the chart for poor compressor operation or a damaged compressor condition.

These diagnosis charts provide the most direct and sure way to determine the cause of any problem in a poorly performing refrigerant system.

After servicing and correcting a refrigerant system problem, take additional pressure readings and observe the clutch cycle rate while meeting the conditional requirements to be sure the problem has been corrected.

SERVICE PROCEDURES (Continued)

In ambient temperatures above 38°C (100°F), the compressor clutch will not normally cycle off and in many instances, the clutch will not cycle off when temperatures are above 32°C (90°F).

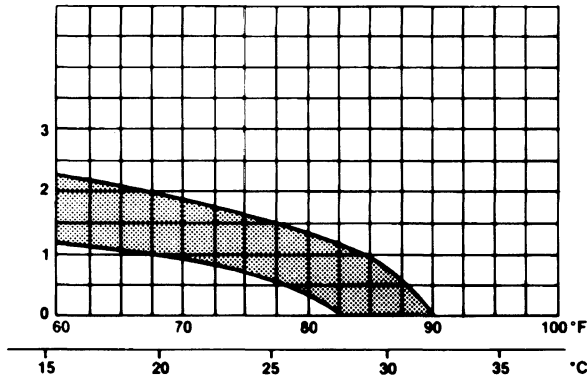
Another type of leak may appear at the internal Schrader-type air conditioner charging valve core in the service gauge port valve fittings. If tightening the valve core does not stop the leak, replace it with a new air conditioner charging valve core (part number 19D701) or equivalent.

Missing service gauge port valve caps (19D702 or equivalent) can also cause a refrigerant leak. If this important primary seal (the valve cap) is missing, dirt will enter the area of the air conditioner charging valve core. When the service hose is attached, the valve compressor in the end of the service hose forces the dirt into the valve seat area and the dirt will destroy the sealing surface of the air conditioner charging valve core. When a service gauge port valve cap is missing, clean the protected area of the air conditioner charging valve core and install a new 19D702 service gauge port valve cap.

CAUTION: Service gauge port valve caps must be installed finger-tight. If tightened with pliers, the sealing surface of the service gauge port valve may be damaged.

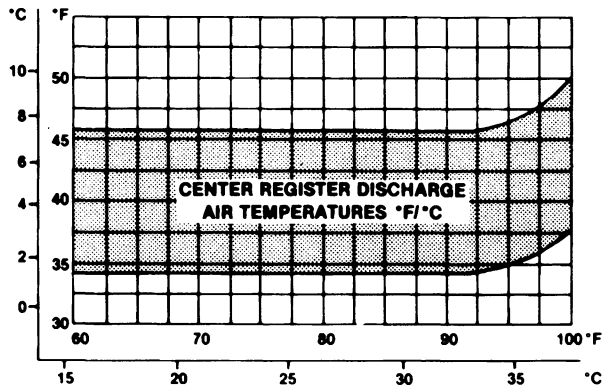
SERVICE PROCEDURES (Continued)

NORMAL CLUTCH CYCLE RATE PER MINUTE CYCLES/MINUTE



AMBIENT TEMPERATURES

NORMAL CENTER REGISTER DISCHARGE TEMPERATURES

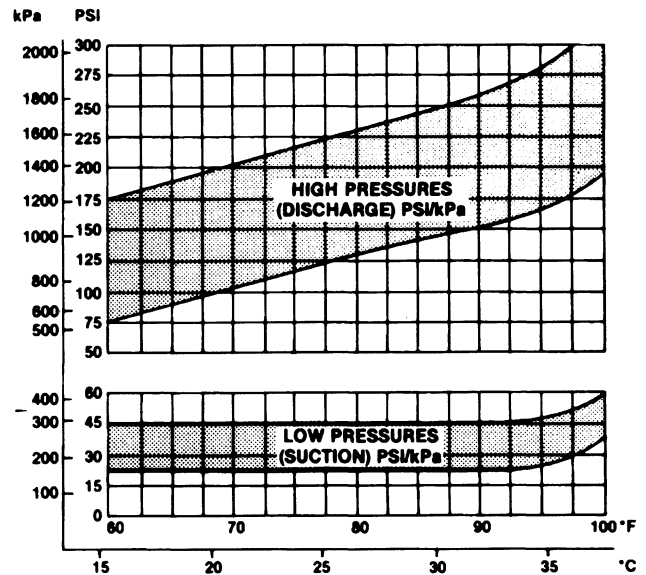


AMBIENT TEMPERATURES

THESE CONDITIONAL REQUIREMENTS FOR THE FIXED ORIFICE TUBE CYCLING CLUTCH SYSTEM TESTS MUST BE SATISFIED TO OBTAIN ACCURATE PRESSURE READINGS.

- Stabilized in Car Temperatures @ 70°F to 80°F (21°C to 27°C)
- Maximum A/C (Recirculating Air)
- Maximum Blower Speed
- 1500 Engine RPM For 10 Minutes

NORMAL FIXED ORIFICE TUBE CYCLING CLUTCH REFRIGERANT SYSTEM PRESSURES

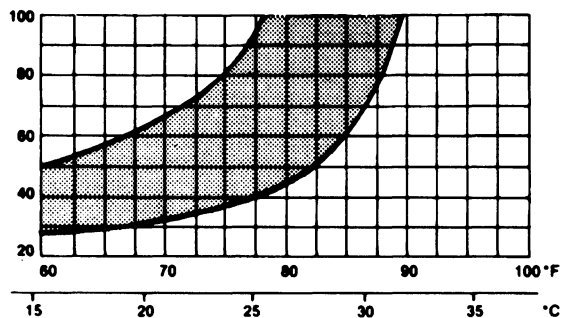


AMBIENT TEMPERATURES

CCL 1939-B

SERVICE PROCEDURES (Continued)

SECONDS **TOTAL CLUTCH
CYCLE TIME — SECONDS**

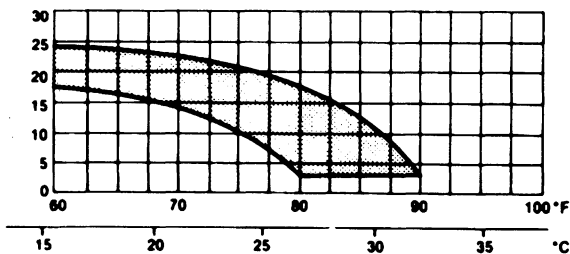


AMBIENT TEMPERATURES

THESE CONDITIONAL REQUIREMENTS FOR THE
FIXED ORIFICE TUBE CYCLING CLUTCH SYSTEM
TESTS MUST BE SATISFIED TO OBTAIN
ACCURATE CLUTCH CYCLE TIMING

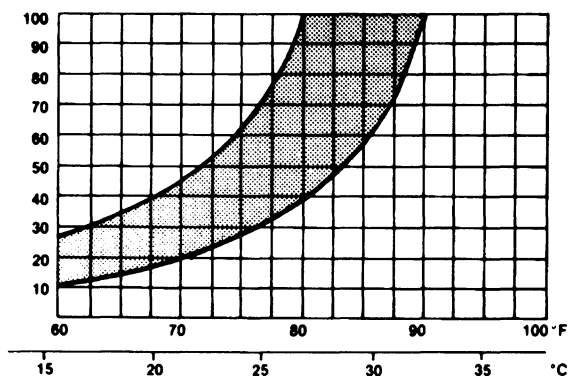
- Stabilized in Car Temperatures @ 70°F to 80°F (21°C to 27°C)
- Maximum A/C (Recirculating Air)
- Maximum Blower Speed
- 1500 Engine RPM For 10 Minutes

SECONDS **NORMAL CLUTCH
OFF TIME — SECONDS**



AMBIENT TEMPERATURES

SECONDS **NORMAL CLUTCH
ON TIME — SECONDS**



AMBIENT TEMPERATURES

CCL 1940-A

SERVICE PROCEDURES (Continued)

REFRIGERANT SYSTEM PRESSURE AND CLUTCH CYCLE TIMING EVALUATION CHART
FOR FIXED ORIFICE TUBE CYCLING CLUTCH SYSTEMS

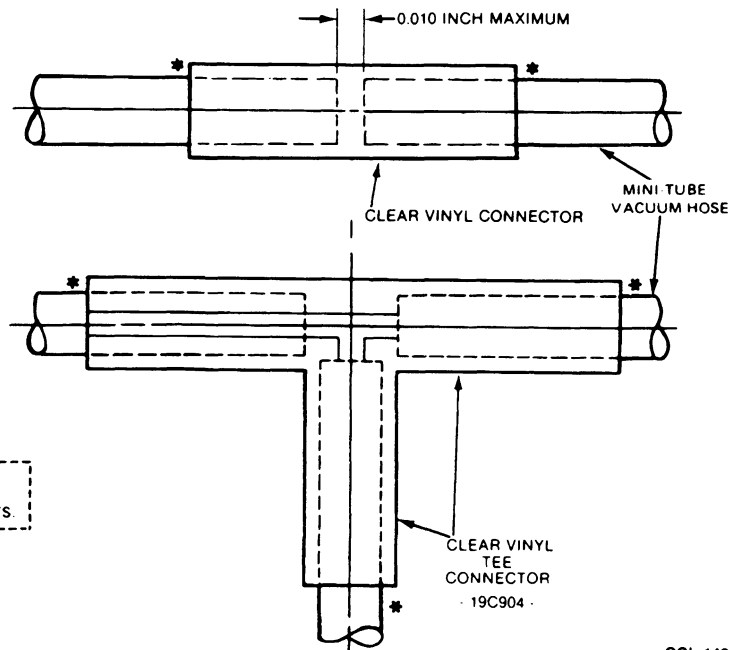
NOTE: Normal system conditional requirements must be maintained to properly evaluate refrigerant system pressures.
Refer to charts applicable to system under test.

HIGH (DISCHARGE) PRESSURE	LOW (SUCTION) PRESSURE	CLUTCH CYCLE TIME			COMPONENT — CAUSES
		RATE	ON	OFF	
HIGH	HIGH	CONTINUOUS RUN			CONDENSER — Inadequate Airflow
HIGH	NORMAL TO HIGH				ENGINE OVERHEATING
NORMAL TO HIGH	NORMAL				AIR IN REFRIGERANT. REFRIGERANT OVERCHARGE (a) HUMIDITY OR AMBIENT TEMP. VERY HIGH (b).
NORMAL	HIGH				FIXED ORIFICE TUBE — Missing. O-Rings Leaking/Missing
NORMAL	HIGH	SLOW	LONG	LONG	CLUTCH CYCLING SWITCH — High Cut-In
NORMAL	NORMAL	SLOW OR NO CYCLE	LONG OR CONTINUOUS	NORMAL OR NO CYCLE	MOISTURE IN REFRIGERANT SYSTEM. EXCESSIVE REFRIGERANT OIL
		FAST	SHORT	SHORT	CLUTCH CYCLING SWITCH — Low Cut-In or High Cut-Out
NORMAL	LOW	SLOW	LONG	LONG	CLUTCH CYCLING SWITCH — Low Cut-Out
NORMAL TO LOW	HIGH	CONTINUOUS RUN			Compressor — Low Performance
NORMAL TO LOW	NORMAL TO HIGH				A/C SUCTION LINE — Partially Restricted or Plugged (c)
NORMAL TO LOW	NORMAL	FAST	SHORT	NORMAL	EVAPORATOR — Low Airflow
			SHORT TO VERY SHORT	NORMAL TO LONG	CONDENSER, FIXED ORIFICE TUBE, OR A/C LIQUID LINE — Partially Restricted or Plugged
			SHORT TO VERY SHORT	SHORT TO VERY SHORT	LOW REFRIGERANT CHARGE
			SHORT TO VERY SHORT	LONG	EVAPORATOR CORE — Partially Restricted or Plugged
NORMAL TO LOW	LOW	CONTINUOUS RUN			A/C SUCTION LINE — Partially Restricted or Plugged. (d) CLUTCH CYCLING SWITCH — Sticking Closed
LOW	NORMAL	VERY FAST	VERY SHORT	VERY SHORT	CLUTCH CYCLING SWITCH — Cycling Range Too Close
ERRATIC OPERATION OR COMPRESSOR NOT RUNNING		—	—	—	CLUTCH CYCLING SWITCH — Dirty Contacts or Sticking Open. POOR CONNECTION AT A/C CLUTCH CONNECTOR OR CLUTCH CYCLING SWITCH CONNECTOR. A/C ELECTRICAL CIRCUIT ERRATIC — See A/C Electrical Circuit Wiring Diagram
ADDITIONAL POSSIBLE CAUSE COMPONENTS ASSOCIATED WITH INADEQUATE COMPRESSOR OPERATION					
<ul style="list-style-type: none"> • COMPRESSOR CLUTCH Slipping • LOOSE DRIVE BELT • CLUTCH COIL Open — Shorted, or Loose Mounting • CONTROL ASSEMBLY SWITCH — Dirty Contacts or Sticking Open • CLUTCH WIRING CIRCUIT — High Resistance, Open or Blown Fuse • A/C HIGH PRESSURE CUT-OUT SWITCH — Dirty Contacts or Sticking Open (If So Equipped) 					
ADDITIONAL POSSIBLE CAUSE COMPONENTS ASSOCIATED WITH A DAMAGED COMPRESSOR					
<ul style="list-style-type: none"> • CLUTCH CYCLING SWITCH — Sticking Closed or Compressor Clutch Seized • SUCTION ACCUMULATOR DRIER — Refrigerant Oil Bleed Hole Plugged • REFRIGERANT LEAKS 					
(a) Compressor may make noise on initial run. This is slugging condition caused by excessive liquid refrigerant.					
(b) Compressor clutch may not cycle in ambient temperatures above 80°F depending on humidity conditions.					
(c) Low pressure reading will be normal to high if pressure is taken at accumulator and if restriction is downstream of service access valve.					
(d) Low pressure reading will be low if pressure is taken near the compressor and restriction is upstream of service access valve.					

CCL 1941-B

SERVICE PROCEDURES (Continued)**Installing a Mini-Tube Vacuum Hose**

1. Measure the length of the damaged area of the mini-tube vacuum hose.
2. Cut a piece of standard 3mm (1/8 inch) ID vacuum hose approximately 25mm (1 inch) longer than the damaged area of the mini-tube vacuum hose.
3. Cut off the mini-tube vacuum hose on each side of the damaged area.
4. Dip the mini-tube hose ends in Tetra Hydro Furan (THF) or Methyl Ethyl Ketone (MEK). This solvent will seal the mini-tube in the vacuum hose.
5. Insert the ends of the mini-tube vacuum hose approximately 9mm (3/8 inch) into the ends of the standard 3mm (1/8 inch) service vacuum hose section.
6. Shake the service joint after assembly to make sure the solvent is dispersed and the vacuum line is not plugged.
7. Test the system for a vacuum leak in the service area.



*DIP THE MINI-TUBE HOSE ENDS IN TETRA HYDRO FURAN (THF) OR METHYL ETHYL KETONE (MEK) TO ACT AS SOLVENT AND SEAL THE REPAIR JOINTS.

ALL PASSAGES MUST BE CLEAN AND FREE OF OBSTRUCTION

CCL 1435-C

Checking For Leaks

NOTE: When checking for freon leaks with either a propane flame-type tester or an electronic beeper-type tester the technician should be aware of whatever chemicals are present in the testing area which might affect test results. Some of these chemical compounds which might alter test results are disc brake cleaner, diesel fuel, antifreeze, etc.

Attach the manifold gauge set. Leave both manifold gauge set valves at the maximum clockwise position. Both gauges should show approximately 414-551 kPa (60-80 psi) at 23.9°C (75°F) with the engine not running. If very little or no pressure is indicated, leave the vacuum pump valve closed, open the Refrigerant-12 tank valve, and turn the low pressure (suction) manifold gauge set valve to the counterclockwise position. This opens the system to tank pressure. Check all connections, and the compressor head gasket, oil filter plug, and the shaft seal for leaks using Rotunda Fluoro-Lite 112-00027 or equivalent.

NOTE: Use compressed air to blow off excessive oil from the shaft seal area to reduce the possibility of an erroneous detection of freon retained in the refrigerant oil.

SERVICE PROCEDURES (Continued)**Electronic Leak Detector**

The battery operated Rotunda Electronic Refrigerant Leak Detector 055-00014 is an electronic instrument that will locate a much smaller type of refrigerant leak than can be detected by the flame-type leak detector. Follow the directions with the leak detector to obtain absolute accuracy.

When the instrument is set to the ON position, it automatically calibrates itself and is ready for detecting. The Geiger counter ticking / beeping signal will speed up as the flexible probe head comes closer to the refrigerant leak.



CCL4004-A

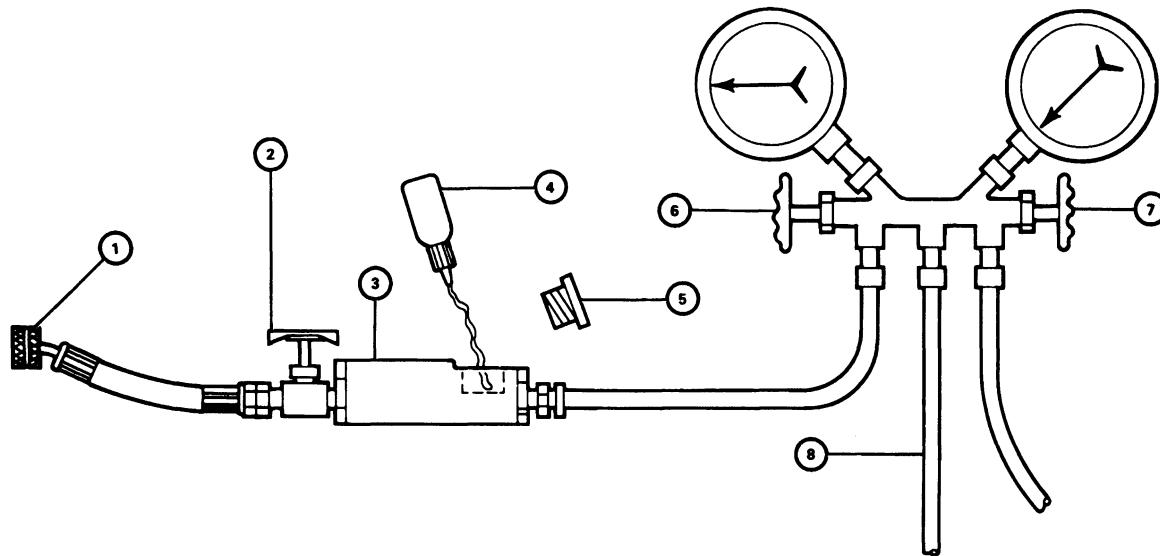
Rotunda Fluoro-Lite

Rotunda Fluoro-Lite leak tracer dye 112-00027 may also be used to detect refrigerant leaks. With the tracer dye in the system, use Rotunda Ultraviolet Lamp 112-00021 to find the leak or leaks. The tracer dye will glow a bright yellow / green color at the point of refrigerant leakage when the light is directed toward the leak. If the system pressure is above 60 psi, there is no need to add refrigerant to the system for this operation. Rotunda Ultraviolet Lamp and Tracer Dye Kit 112-00032 is available through the Rotunda Tool Catalog.

Rotunda Fluoro-Lite tracer dye may be introduced into the air conditioning system using Rotunda Tracer Dye Injector 112-00028. Inject the dye and check for leaks as follows:

1. Close the valve on the dye injector.
2. Connect the hose end of the dye injector to the system low pressure gauge port valve and tighten it securely.
3. Close both valves on the gauge manifold set and connect the center hose to a charging cylinder. Leave the center hose loose at the gauge manifold. Momentarily open the charging cylinder valve to purge air out of the center hose, then tighten the center hose at the gauge manifold connection. Close the valve on the charging cylinder.
4. Connect the gauge manifold low pressure hose to the dye injector, leaving the connection at the gauge manifold loose.
5. Open the dye injector valve to allow air conditioning system pressure to purge air from the dye injector reservoir and the low pressure hose to the gauge manifold. Tighten the hose connection at the gauge manifold. Close the valve on the dye injector.
6. Remove the reservoir cap from the top of the dye injector and fill the reservoir with 1 / 4 ounce of Fluoro-Lite tracer dye.

CAUTION: Do not overfill.

SERVICE PROCEDURES (Continued)**Rotunda 112-00028 Tracer Dye Injector**

CCL 3694-A

ITEM DESCRIPTION

1. TO LOW PRESSURE SERVICE PORT
2. RESERVOIR VALVE
3. TRACER DYE RESERVOIR (1/4 OZ. CAPACITY)
4. FLUORO-LITE TRACER DYE

ITEM DESCRIPTION

5. RESERVOIR CAP
6. LOW PRESSURE VALVE
7. HIGH PRESSURE VALVE
8. TO R-12 CYLINDER

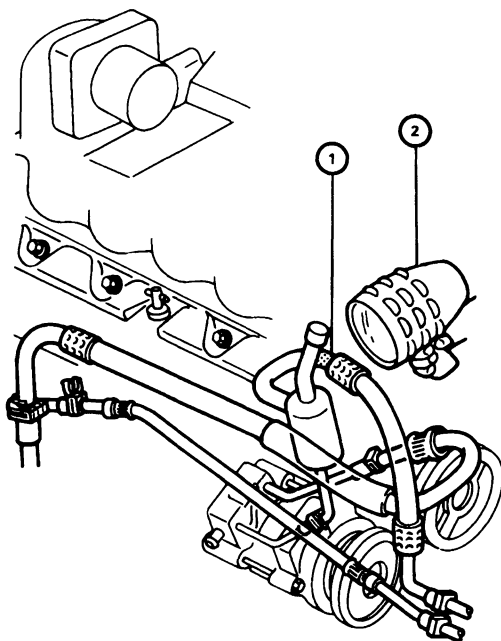
7. Replace the reservoir cap and tighten it securely.
8. Open the valve on the charging cylinder, then open the manifold gauge low pressure valve. Open the valve on the dye injector for 5 to 10 seconds to allow the dye to be forced into the air conditioning system. Close the dye injector valve. Close the manifold gauge low pressure valve and the valve on the charging cylinder.
9. Start the engine and operate the air conditioning system at MAX to stabilize the system (approximately 10-15 minutes).

10. Shut off the engine.
11. Disconnect all hoses slowly to dissipate any residual refrigerant pressure that may be present.
12. Using Rotunda 112-00021 Ultraviolet Lamp, check the system for leaks. The tracer dye will glow a bright yellow / green when the ultraviolet light hits it.

NOTE: Periodically lubricate the reservoir valve stem with refrigerant oil.

SERVICE PROCEDURES (Continued)

Rotunda 112-00021 Ultraviolet Lamp



CCL 3695-A

ITEM DESCRIPTION

1. PRESENCE OF DYE INDICATES LEAK HERE
2. ULTRAVIOLET LIGHT ROTUNDA NO. 112-00021

Evaluating Refrigerant System Performance

To diagnose a problem in the refrigerant system, note the system pressure (shown by the manifold gauges) and the clutch cycle rate. Then compare readings with the charts.

- The system pressures are low (compressor suction) and high (compressor discharge).
- A clutch cycle is the time the clutch is engaged plus the time it is disengaged (time on plus time off).
- Clutch cycle times are the lengths of time (in seconds) that the clutch is on or off.

To achieve accurate diagnosis results in the least amount of time use the following procedure and refer to the charts.

NOTE: The test conditions specified at the top of each of the charts must be met to obtain accurate test results.

1. Connect a manifold gauge set to the system.
2. When system has stabilized, record high and low pressures as shown by manifold gauges.
3. Determine clutch cycle rate per minute (clutch ON time plus OFF time is a cycle).
4. Record clutch OFF time in seconds.
5. Record clutch ON time in seconds.
6. Note center register discharge temperature.

7. Determine and record ambient temperature.
8. Compare test readings and appropriate chart.

- Plot a vertical line for recorded ambient temperature from scale at bottom of each chart to top of chart.
- Plot a horizontal line for other test readings from scale at left side of appropriate chart.

If the point where the two lines cross on each chart falls within the dark band, the system is operating normally. If the lines cross outside the dark band on one or more of the charts, there is a problem and the specific cause must be determined. Refer to the Refrigerant System and Clutch Cycle Timing Evaluation chart.

NOTE: The following five system operating conditions are indicated by where the lines cross on the chart:

- System high (discharge) — pressure is high, low or normal.
- System low (suction) — pressure is high, low or normal.
- Clutch cycle rate is fast, slow or clutch runs continuously.
- Clutch ON time is long or short.
- Clutch OFF time is long or short.

Match these conditions to the conditions shown in the five columns toward the left in the System Pressure and Clutch Cycle Timing Evaluation chart. All five system conditions will be indicated on one line. The most likely component or components causing the problem are listed in the right column.

A badly contaminated system contains water, carbon and other decomposition products. Where such a condition exists, the system must be flushed with a special flushing agent using equipment designed especially for this purpose. Follow the suggestions and procedures outlined for a proper cleaning job.

Flushing a Refrigerant System

In order to minimize the discharge of ozone depleting chlorofluorocarbons into the atmosphere, the Ford Motor Company supports the efficient usage, recovery, and recycling of the R-12 used in passenger car, compact truck, and light truck air conditioners. Ford Motor Company recommends the use of an U.I.-approved recovery / recycling device such as Rotunda Model Numbers 158-00001 or 158-00002 (or other device which meets SAE Standard J1991) during any air conditioning system repair and recharge procedure which requires that the system be discharged.

Although the company endorses the recovery and recycling of refrigerant with approved equipment, it does not, at this time, support existing procedures for flushing a system. A new procedure is being developed which will cover the proper equipment, flushing agents, and procedures to follow when the flushing of a system is involved.

PERFORMANCE TESTING

Refer to the following charts for performance testing procedures.

INSUFFICIENT OR NO AIR CONDITIONER COOLING, FIXED ORIFICE TUBE, CLUTCH CYCLING SYSTEM — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Verify the condition. 	System cooling properly System not cooling properly	Instruct driver on how to use system. GO to A2.
A2	CHECK A / C COMPRESSOR CLUTCH		
	<ul style="list-style-type: none"> Does the A / C compressor clutch engage? 	Yes No	GO to A3. REFER to clutch circuit diagnosis in this section.
A3	CHECK UNDER HOOD		
	Under-hood check for: <ul style="list-style-type: none"> Loose, missing or damaged compressor drive belt. Loose or disconnected A / C clutch or clutch cycling pressure switch wires or connectors. Damaged clutch assembly. Low engine speed. Fan shroud misalignment. Fan clutch damage. Engine cooling fan damage. Airflow obstructions in front of grille or between the fins of the condenser or radiator. In-car check for: <ul style="list-style-type: none"> Blown fuse / proper blower motor operation. Control assembly electrical connections. 	OK but still not cooling Not OK	GO to A5. REPAIR and GO to A4.
A4	CHECK SYSTEM OPERATION		
	<ul style="list-style-type: none"> Check system operation. 	System cooling OK System not cooling OK	Condition corrected. GO to A1. GO to A5.
A5	CHECK PRESSURE / CLUTCH CYCLE RATE		
	<ul style="list-style-type: none"> Use refrigerant system pressure / clutch cycle rate and timing evaluation charts. <ul style="list-style-type: none"> Hook up manifold gauge set. Set function lever at MAX A / C. Set blower switch on HIGH. Set temp lever full cool. Close doors and windows. Use a thermometer to check temperature at center discharge register. Record outside temperature. Run engine at approximately 1500 rpm with compressor clutch engaged. Stabilize with above conditions for 10-15 minutes. Check compressor clutch OFF / ON; time with watch. See charts for normal clutch cycle and timing rates. 	Compressor cycles very rapidly: 5 seconds ON 5 seconds OFF Compressor runs continuously (Normal operation in ambient temp above 26.6° (80°F) depending on humidity conditions)	GO to A7. GO to A6.

PERFORMANCE TESTING (Continued)

INSUFFICIENT OR NO AIR CONDITIONER COOLING, FIXED ORIFICE TUBE, CLUTCH CYCLING SYSTEM — TEST A
(Continued)

TEST STEP		RESULT	ACTION TO TAKE
A6	CHECK PRESSURES		
	Check system pressures. ● Compare readings with normal system pressure ranges.	Clutch cycles within limits System pressures not within limits Compressor cycles high or low: ON above 259 kPa (52 psi) OFF below 144 kPa (21 psi)	System OK. GO to A1. GO to Evaluation Chart and compare observed pressures with chart. REPAIR as required and GO to A4. System OK. GO to A1. Not OK. GO to A7.
A7	CHECK FOR LEAKS		
	● Leak check system.	Leak found No leak found	SERVICE, leak test evacuate and charge system. System OK. GO to A1. Low refrigerant charge or moisture in system. Discharge, evacuate and charge system. GO to A4.

TL5363E

COMPRESSOR CLUTCH CIRCUIT DIAGNOSIS — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK SYSTEM OPERATION		
	● Turn blower switch on. ● Turn ignition switch to RUN position. ● Compressor clutch should engage.	Clutch operates Clutch does not operate	System OK. GO to B2.
B2	CHECK FOR VOLTAGE		
	● Check for voltage at circuit wire at the clutch cycling pressure switch connector or A / C control switch (E-150-250-350).	Voltage present No voltage	GO to B3. GO to B9.
B3	BY-PASS PRESSURE SWITCH		
	● Disconnect connector at clutch cycling pressure switch or control switch (E-150-250-350). ● Jumper connector pins or control switch. ● Clutch should engage.	OK Not OK	GO to B4. GO to B5.
B4	CHECK SYSTEM PRESSURE		
	● Connect manifold gauge set and check system pressure.	Pressure above 55 psi Pressure below 55 psi (ambient temperature above 50°F)	REPLACE clutch cycling pressure switch. Refer to Section 12-03A or 12-03B. GO to B1. CHECK refrigerant system for leaks. REPAIR and CHARGE system as necessary. GO to B1.
B5	CHECK VOLTAGE AT CLUTCH		
	● Check for voltage at clutch field coil.	Voltage present No voltage	GO to B8. GO to B7.

PERFORMANCE TESTING (Continued)

COMPRESSOR CLUTCH CIRCUIT DIAGNOSIS — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B6	CHECK CLUTCH GROUND		
	<ul style="list-style-type: none"> • Jumper ground terminal of clutch field coil to ground. • Clutch should engage. 	Clutch ground OK Clutch ground Not OK	SERVICE open in ground wire. GO to B1 . REPLACE clutch field coil. Refer to Section 12-03A or 12-03B. GO to B1 .
B7	CHECK FUSE		
	<ul style="list-style-type: none"> • Check Fuse 17 in fuse panel for continuity. 	Fuse OK Fuse Not OK	GO to B8 . CHECK for short. SERVICE as necessary. REPLACE fuse. GO to B1 .
B8	CHECK A/C CONTROLS		
	<ul style="list-style-type: none"> • Move Function selector lever to DEFROST position. • Check for voltage at circuit wire at the clutch cycling pressure switch connector. 	Voltage present No voltage	GO to B10 . GO to B9 .
B9	CHECK CIRCUIT 294		
	<ul style="list-style-type: none"> • Remove connector from A/C pushbutton switch. • Check for voltage at circuit. 	Voltage present No voltage	GO to B9 . CHECK for open in Circuit 294. SERVICE as necessary. GO to B1 .
B10	CHECK A/C CONTROLS		
	<ul style="list-style-type: none"> • Check A/C pushbutton switch and Function switch for continuity. <p>NOTE: A/C pushbutton switch must be depressed. Function switch must be in DEFROST position.</p>	Continuity through Function switch only Continuity through A/C pushbutton switch only Continuity through both switches	REPLACE A/C pushbutton switch. Refer to Section 12-03A or 12-03B. GO to B1 . REPLACE Function switch. Refer to Section 12-03A or 12-03B. GO to B1 . CHECK for open in circuit between control assembly and clutch cycling pressure switch. SERVICE as necessary. GO to B1 .

TL5367D

SPECIFICATIONS




REFRIGERANT CAPACITIES (REFRIGERANT-12)

Vehicle	Capacity (Pounds)
F-150 — F-350 and Bronco	2.75 ± 0.0625
E-150 — E-350	3-1/2 + .25-0 Front A/C Only
E-150 — E-350	4-1/4 + .25-0 Front and Auxiliary A/C

REFRIGERANT SPECIFICATION

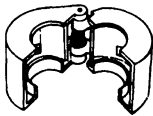
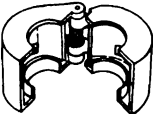

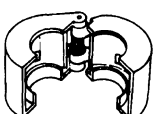
Type	Specification	Part No.
Refrigerant-12 (R-12) Dichlorodifluoromethane CCL ₂ F ₂	ESA-M17B2-A or equivalent	D3AZ-19B519-A or equivalent

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number / Description	Illustration
T63L-8620-A Belt Tension Gauge	 T63L-8620-A
T71P-19703-S Straight Adapter	 T71P-19703-S
T71P-19703-R Curved Adapter	 T71P-19703-R

(Continued)

SPECIAL SERVICE TOOLS / EQUIPMENT (Continued)

Tool Number / Description	Illustration
T81P-19623-G1 Spring Lock Coupling Tool: 3 / 8 Inch	 T81P-19623-G1
T81P-19623-G2 Spring Lock Coupling Tool: 1 / 2 Inch	 T81P-19623-G2
T83P-19623-C Spring Lock Coupling Tool: 5 / 8 Inch	 T83P-19623-C
T85L-19623-A Spring Lock Coupling Tool: 3 / 4 Inch	 T85L-19623-A

Tool Number	Description
D81L-19703-A	Service Port Adapter
D80L-19990-A	Orifice Tube Remover and Installer
D80L-19990-B	Broken Orifice Tube Extractor
D81L-19703-C	Flexible Adapter

(Continued)

Tool Number	Description
D81L-19703-D	Straight Adapter
D81L-19703-B	90 Degree Adapter
D81L-19703-E	45 Degree Adapter
D87P-19703-A	Tee Adapter

MOTORCRAFT TOOLS

Tool Number	Description
YT-371	Belt Tension Gauge
YT-1123	Back Flushing Adapter — E-150 — E-350, F-150 — F-350, Bronco
YT-1008	Orifice Tube Remover and Installer
YT-1009	Broken Orifice Tube Extractor
TY-355	Flexible Adapter
YT-357	Straight Adapter
YT-354	90 Degree Adapter
YT-924	45 Degree Adapter

NOTE: Tee Adapter also available from: Four Seasons P.N. 59655 and Robinair P.N. 40387.

ROTUNDA EQUIPMENT

Tool Number	Description
023-00006	Flame Type Leak Detector (Motorcraft YT-202)
023-00007	Dial Thermometer (Motorcraft YT-227)
023-00009	Small Can Adapter (Motorcraft YT-280)
063-00010	Manifold Gauge Set (Motorcraft YT-201)
112-00021	Ultraviolet Lamp
112-00028	Tracer Dye Injector
112-00032	Ultraviolet Lamp and Tracer Dye Kit

SECTION 12-03A Air Conditioning, Heater System, F-Series and Bronco, Manual

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Compressor Drive Belt Tension.....	12-03A-63	Evaporator Case	12-03A-39
Vacuum Controls and Temperature Control Cables	12-03A-62	Evaporator Core	12-03A-42
DESCRIPTION AND OPERATION		Fixed Orifice Tube	12-03A-45
Air Flow	12-03A-4	Floor Duct	12-03A-32
Clutch Cycling Pressure Switch	12-03A-26	Heater Core	12-03A-33
Control Assembly	12-03A-9	Heater Hoses	12-03A-49
Refrigerant Flow.....	12-03A-7	Instrument Panel	12-03A-31
Service Access Gauge Port Valves.....	12-03A-26	Mix Door Motor	12-03A-39
Suction Accumulator/Drier	12-03A-25	Outside Air/Recirculated Air Door, Vacuum Motor or Door Crank.....	12-03A-37
System Components	12-03A-12	Panel/Defrost Door Vacuum Motor	12-03A-39
DIAGNOSIS AND TESTING	12-03A-28	Plenum Door Vacuum Motors	12-03A-38
REMOVAL AND INSTALLATION		Plenum Doors	12-03A-38
A/C-Heater Tubes and Hoses.....	12-03A-50	Refrigerant Lines.....	12-03A-49
Blower Motor and/or Wheel.....	12-03A-44	Register and Louver Assembly.....	12-03A-36
Blower Motor Resistor	12-03A-44	Register Ducts.....	12-03A-34
Blower Speed Control Switch	12-03A-29	Suction Accumulator/Drier	12-03A-46
Clutch Cycling Pressure Switch	12-03A-46	Temperature Control Cable	12-03A-30
Condenser	12-03A-47	Temperature Control Cam	12-03A-31
Control Assembly	12-03A-28	Vacuum Selector Valve	12-03A-30
Cross References.....	12-03A-56	SPECIAL SERVICE TOOLS/EQUIPMENT	12-03A-64
Defroster Duct and Ventilation Ducts	12-03A-31	SPECIFICATIONS	12-03A-63
Demister Hoses and Nozzles.....	12-03A-31	VEHICLE APPLICATION	12-03A-1

VEHICLE APPLICATION

F-150-250-350, F-Super Duty and Bronco Vehicles

DESCRIPTION AND OPERATION

Most of the major components of the manual air conditioning / heater system used in the F-Series and Bronco vehicles are identified in the first two illustrations. The first is a diagram of a typical refrigerant circuit; the second is a disassembled view showing an evaporator case assembly and a plenum assembly positioned on opposite sides of the dash panel.

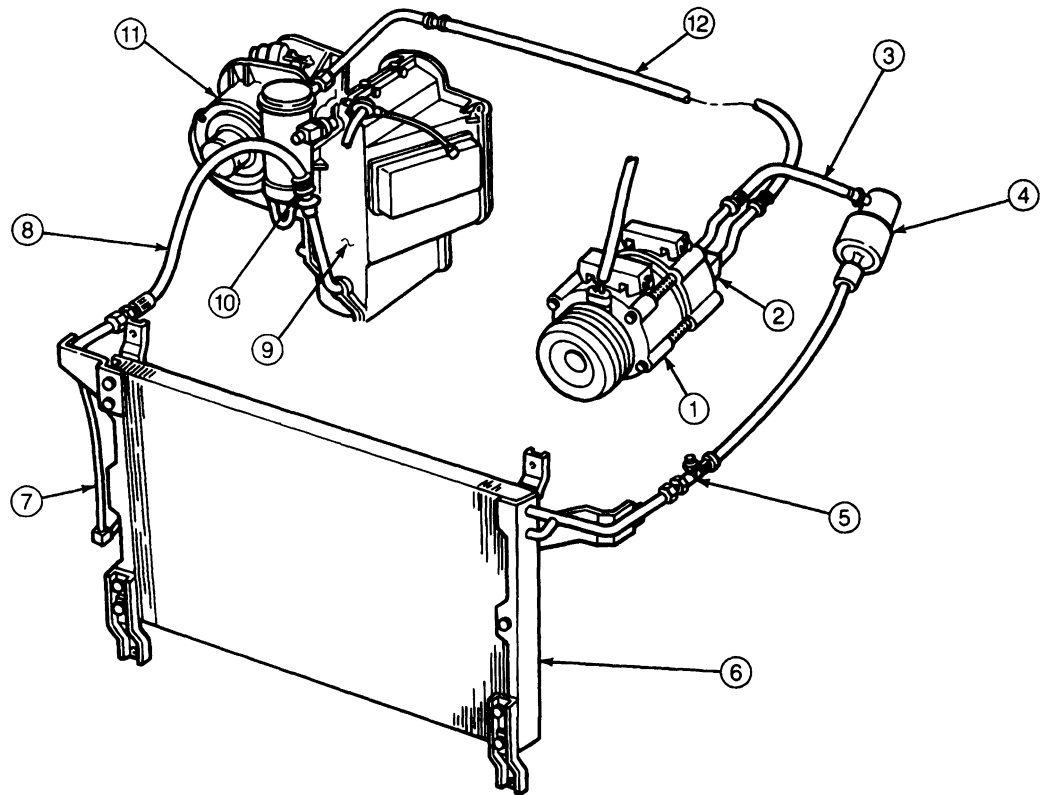
The system is equipped with:

- A plate-fin evaporator core and attached suction accumulator / drier
- A fixed orifice tube for control of refrigerant flow
- A clutch cycling pressure switch

Two Schrader-type service access gauge port valves are used in the manual air conditioning / heater system. The high pressure valve is located near the condenser in the discharge line and has a quick disconnect-type valve body. This requires a special high pressure service access valve adapter to connect a manifold gauge set or a charging station to the valve. The other service access gauge port valve is located on the inlet to the suction accumulator and is used to measure evaporator pressure.

DESCRIPTION AND OPERATION (Continued)

Air Conditioning System

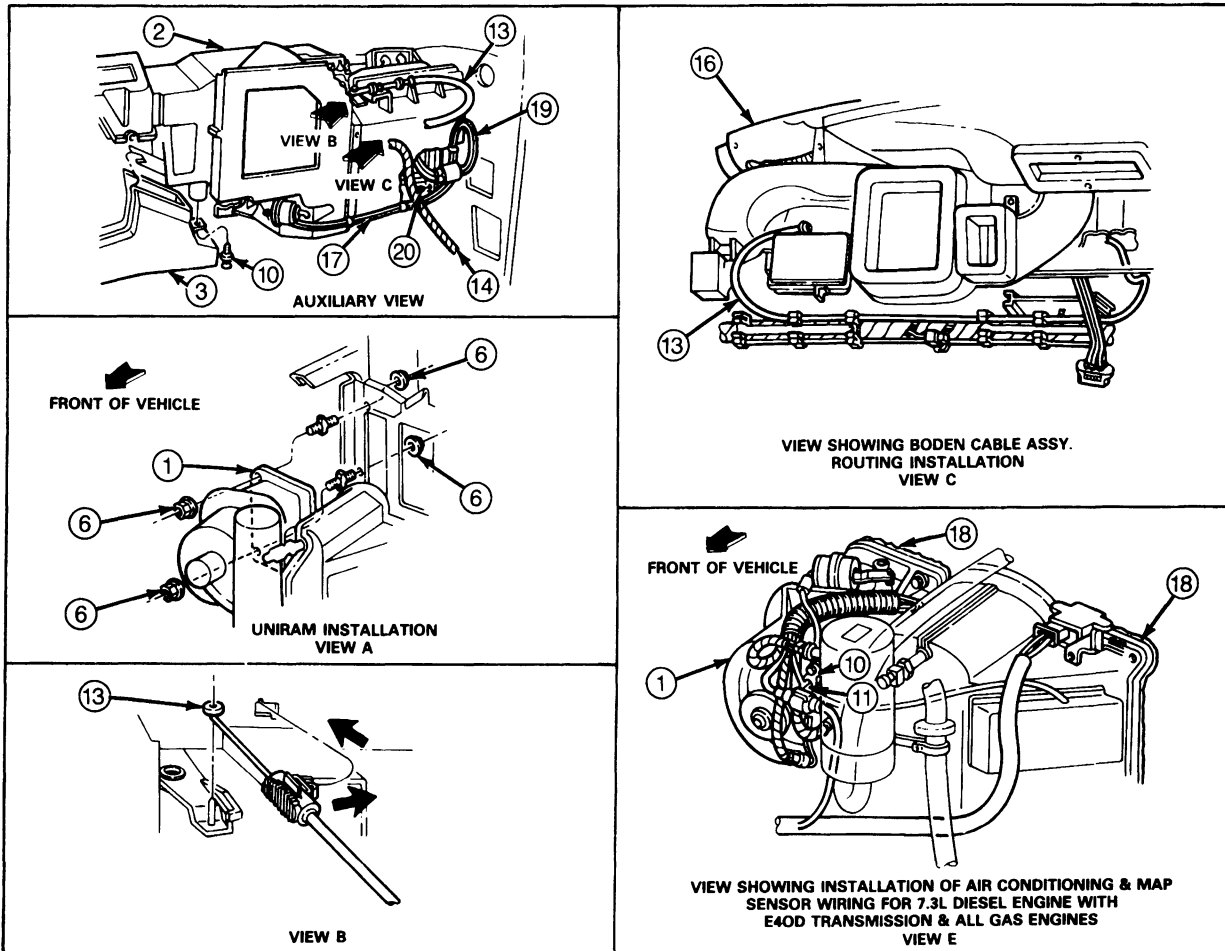
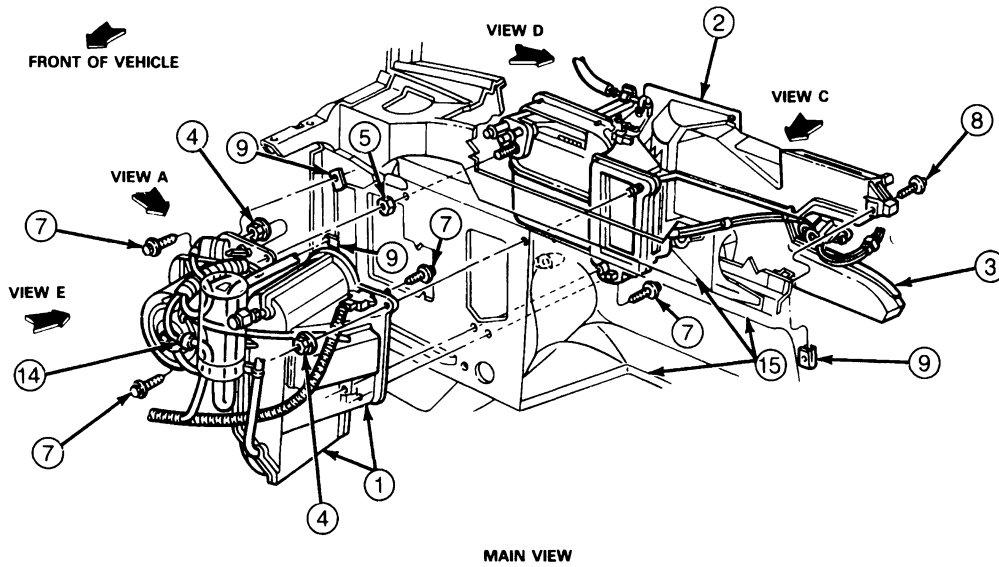


ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	COMPRESSOR ASSEMBLY	7.	HIGH PRESSURE LIQUID LINE
2.	COMPRESSOR MANIFOLD	8.	LOW PRESSURE LIQUID LINE
3.	DISCHARGE LINE	9.	EVAPORATOR CASE ASSY.
4.	MUFFLER ASSY.	10.	SUCTION ACCUMULATOR DRIER
5.	HIGH PRESSURE SERVICE VALVE	11.	BLOWER MOTOR
6.	CONDENSER ASSY.	12.	SUCTION LINE TO COMPRESSOR

CCL 4208-B

DESCRIPTION AND OPERATION (Continued)

Evaporator Case, Plenum Assembly



CCL 4206-A

DESCRIPTION AND OPERATION (Continued)

LEGEND FOR CCL 4206-A

ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1	18456	HEATER - BLOWER ASSY.	11	N801696-S2	NUT
2	18471	PLENUM CHAMBER ASSY.		(AS REQ'D. -	
3	18C433	FLOOR DUCT ASSY.		PLANT	
4	N621906-S2	NUT		OPTION)	
	(2 REQ'D.)		12	18D306	TEMPERATURE CABLE ASSY.
5	N803912-S2	STUD	13	18471-PIA*	VACUUM TUBES
	(2 REQ'D.)			PLENUM	
6	N612906-S2	NUT	14	INSTALL IN	LOCATOR
	(4 REQ'D.)			HOLE IN	
7	56956-S2	HEX - SCREW & WASHER ASSY.		BRACKET	
	(4 REQ'D.)		15	REF.	DASH PANEL
8	56950-S2 OR	HEX - SCREW & WASHER ASSY.	16	REF.	INSTRUMENT PANEL
	56952-S2		17	PART OF	CONTROL VACUUM HARNESS
9	45261-S2	J-NUT		18549	
	(3 REQ'D.)			CONTROL	
10	N803946-S	BLIND TRUSS HEAD RIVET	18	MUST BE	RETENTION TAB
				OVER CABLE	
			19	PIA* BLOWER	WIRING RETAINER
				ASSY.	
			20	PIA* BLOWER	WIRING
				ASSY.	

*PIA — PURCHASED IN ASSEMBLY

CCL 4207-A

The evaporator case assembly is attached to the engine side of the dash panel. It contains the:

- Evaporator core
- Accumulator / drier
- Blower motor and wheel
- Blower resistor
- Outside air / recirculated air door and its vacuum motor
- Vacuum reservoir
- Vacuum / electrical wiring harness assemblies

The suction accumulator / drier is clamped to the evaporator case with its inlet tube connected to the evaporator outlet tube. The air conditioner clutch cycling pressure switch is installed in a fitting on the side of the accumulator / drier. The inlet tube to the evaporator core houses the fixed orifice tube.

The plenum is located in the passenger compartment. It contains the:

- Mix door (for directing a mixture or total air to the floor and / or defroster / demister outlets)
- Temperature blend door
- Panel / Defrost door
- Cam / crank which operate the temperature door
- Heater core
- Vacuum motor assemblies which operate the mix and panel / defrost doors.

The defroster is a channel which is formed into the instrument panel with outlets to the windshield and hoses which attach to an adapter located in the center of the instrument panel.

The control assembly is installed in an opening in the instrument panel. It contains three knobs. One knob operates the four-position blower switch and one selects the function under which the system will perform (MAX A/C, NORM A/C, VENT, FLOOR, MIX or PANEL / DEFROST) by controlling vacuum motor operation. The third knob regulates temperature by means of a cable which controls the position of the temperature blend air door.

Air Flow

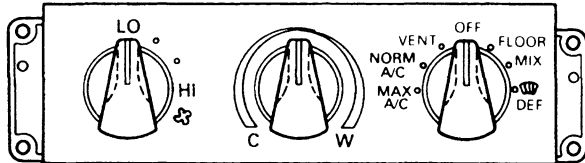
During operation, outside air is drawn into the system from the cowl air intake by a blower motor and wheel when the function knob is in NORM A/C, VENT, FLOOR, MIX or PANEL / DEFROST position. When the air door knob is in the MAX-A/C position, air flow is drawn from inside the vehicle through the recirculating air door opening. The air (outside or recirculated) is then forced by the blower through the evaporator core and, depending upon the setting of the temperature knob, is forced by the blower through and / or around the heater core into the plenum. Air is then directed to the floor and / or defrost nozzles or the instrument panel registers, depending upon the position of the function selector knob.

The two diagrams which follow illustrate air flow through the system when control knobs are moved from position-to-position.

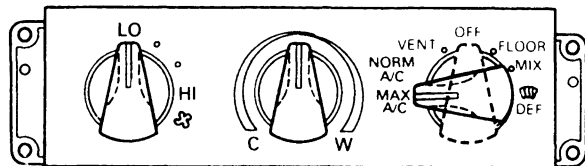
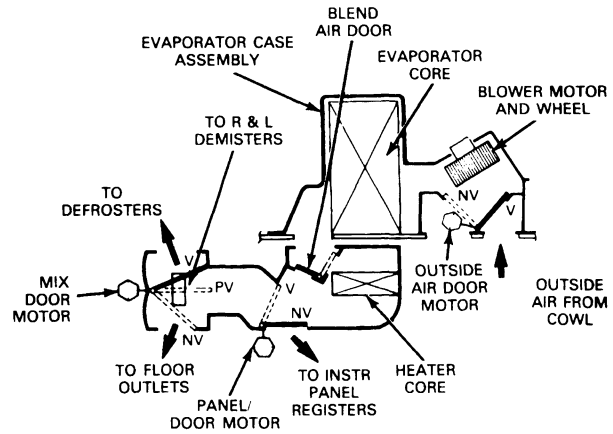
Air flow volume through the system is controlled by a five-position blower switch knob. The blower switch, used with a resistor assembly, provides four blower speeds to control air flow through the system. The blower can be shut off by rotating the function control knob to the OFF position.

DESCRIPTION AND OPERATION (Continued)

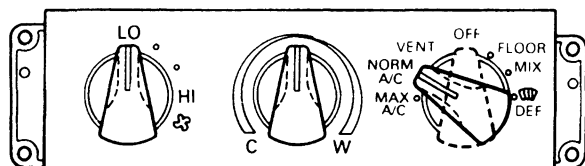
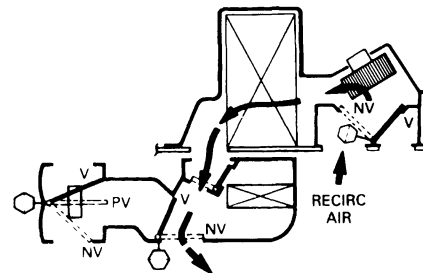
Air Flow Diagrams



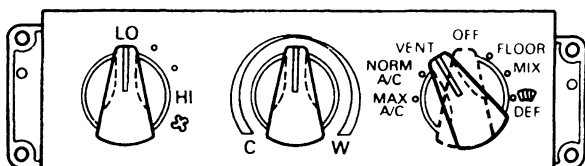
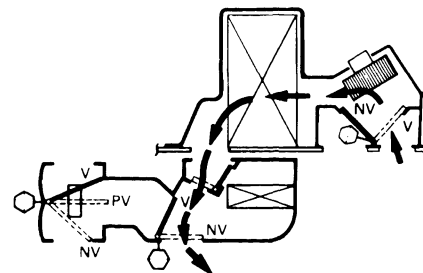
OFF



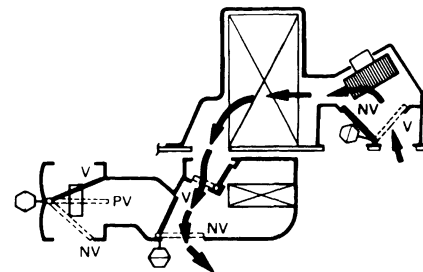
MAX A/C



NORM A/C



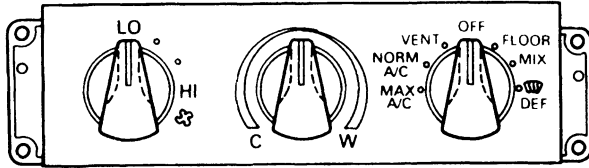
VENT



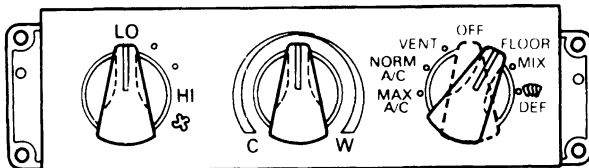
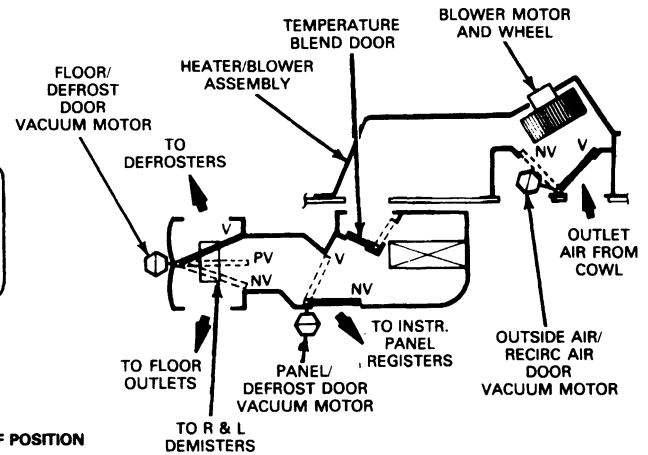
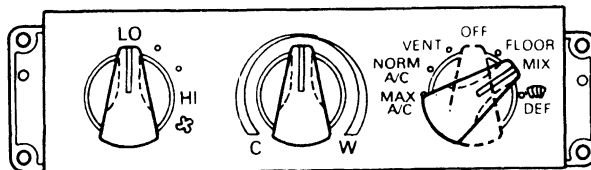
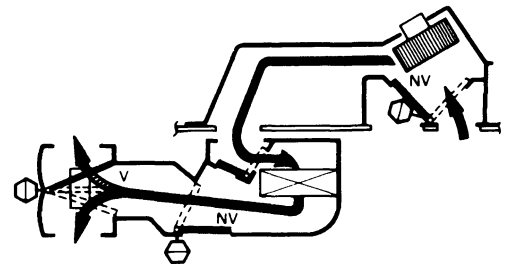
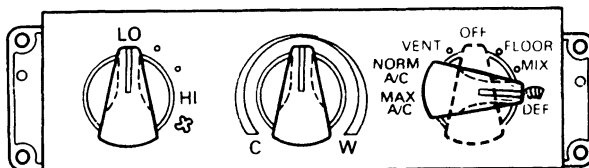
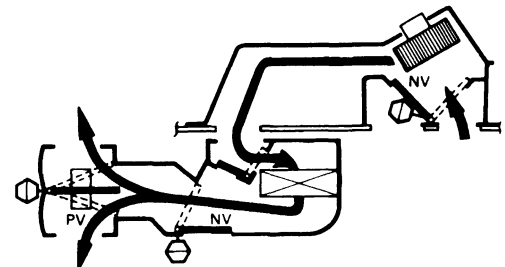
CCL 4209-A

DESCRIPTION AND OPERATION (Continued)

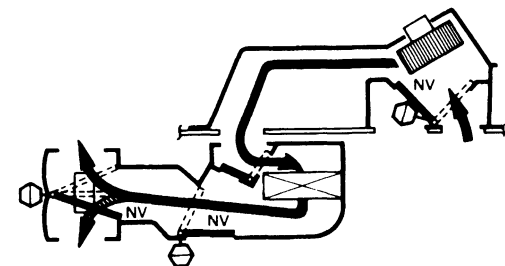
Air Flow Diagrams (Cont.)



OFF POSITION

FLOOR POSITION
(BLEED TO DEFROST)MIX POSITION
(EQUAL DISTRIBUTION TO FLOOR & DEFROST)

DEFROST POSITION (BLEED TO FLOOR)



CCL 4210-A

DESCRIPTION AND OPERATION (Continued)

Refrigerant Flow

The illustration shows a basic refrigerant circuit representing refrigerant changes as it passes through a cycle from compressor output to compressor input.

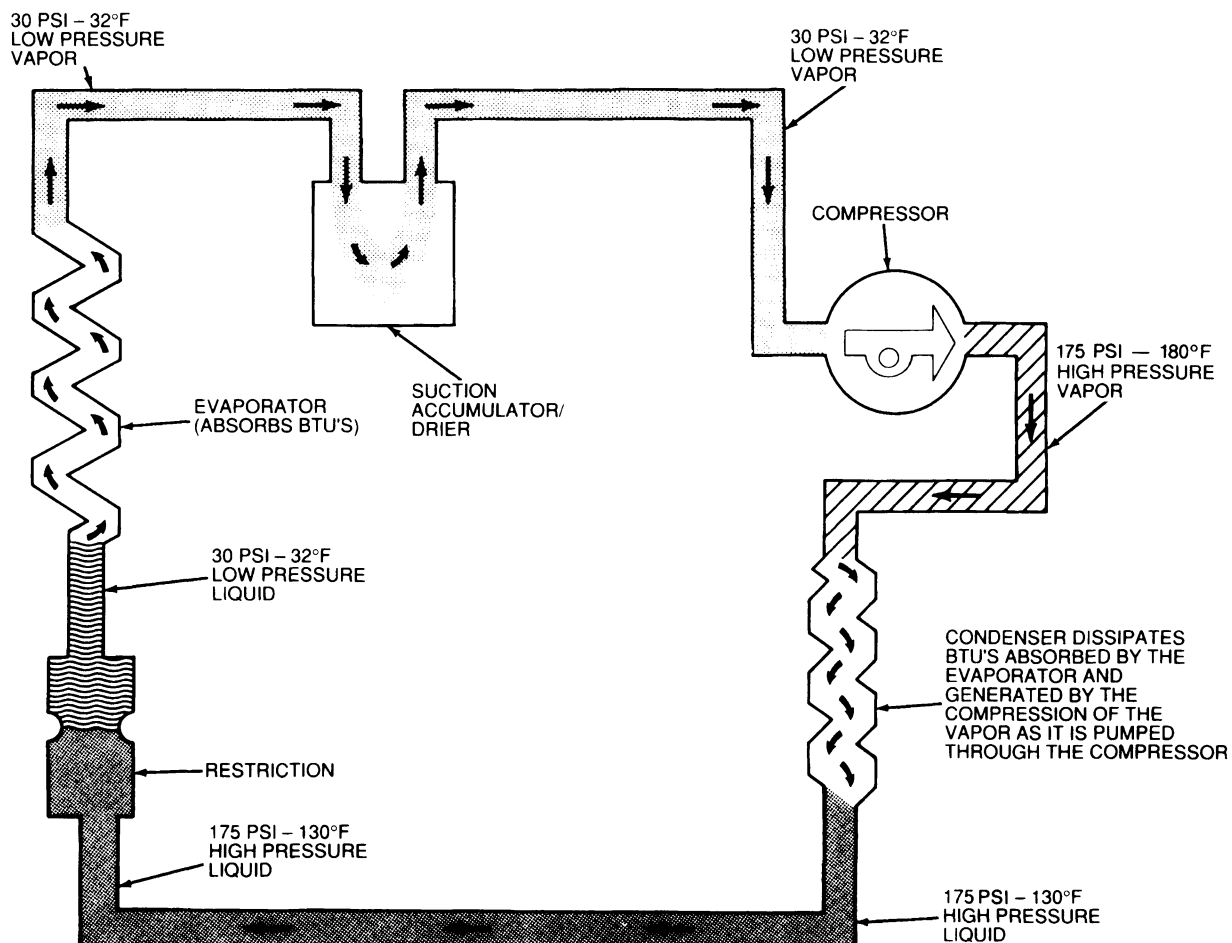
The illustration identifies four states in which refrigerant will exist in a closed circuit: (1) high pressure vapor, (2) high pressure liquid, (3) low pressure liquid and (4) low pressure vapor. Beginning with compressor output, refrigerant moves as a high pressure vapor to the condenser. As it passes through the condenser, the vapor condenses into a liquid.

In the course of this condensation process, the refrigerant gives up heat. This heat exchange does not alter the temperature of the refrigerant. Thus, the refrigerant continues its flow through the circuit as a high temperature, high pressure liquid.

The restriction called out in the illustration in F-150-250-350, F-Super Duty and Bronco applications is a fixed orifice tube which contains a 1.701mm (0.067-inch) orifice. (This tube is color-coded blue.) When the refrigerant passes through this tube and its orifice, it changes from a high to low pressure liquid, with a corresponding drop in temperature.

The refrigerant, upon leaving the orifice tube, is drawn through the circuit by compressor suction. Thus, it enters the evaporator as a low pressure / low temperature liquid.

Refrigerant Flow



CCL4001-A

DESCRIPTION AND OPERATION (Continued)

The cooling of the evaporator core creates a temperature differential between the core and the ambient air in the evaporator case. As a result of this difference, heat is absorbed from the air. Simultaneously, humidity is extracted from the air and drained onto the road surface under the vehicle. Again, the absorption of BTUs does not affect refrigerant temperature.

Refrigerant flow, after leaving the evaporator, continues through the suction accumulator / drier where water is absorbed into a desiccant bag and the more heavily oil-laden refrigerant is further vaporized as it is dispelled into the inlet line to the compressor.

The cooled, dehumidified air in the evaporator case is pushed by the blower through the case and out through ducting to the registers in the instrument panel.

Extending this basic coverage of a refrigerant circuit, the following traces refrigerant flow through actual circuit components.

When the air conditioning system is not on, refrigerant system pressures are equalized on both the high and low sides of the refrigerant system. In both cases, the refrigerant is in a vapor state.

When the function control knob is set on A / C (MAX or NORM), MIX or PANEL / DEFROST, the air conditioner compressor magnetic clutch field coil is energized and the clutch plate is pulled into contact with the clutch pulley. The clutch plate and hub assembly then rotates the compressor shaft.

When the compressor shaft is rotated, the double ended pistons move backward and forward in their respective cylinder bores. As each piston is moved backward in its cylinder bore, the pressure in the cylinder suddenly reduces to a pressure (or vacuum) considerably lower than the refrigerant vapor pressure on the suction side of the refrigerant system. The higher refrigerant system vapor pressure overcomes the suction reed valve spring pressure, forcing itself through the reed valve and into the lower pressure (or vacuum) area inside the compressor cylinder. The spring pressure on the reed valve closes the valve when the refrigerant system suction vapor pressure and the compressor cylinder vapor pressure are equalized.

As each piston is forced into its respective cylinder bore, the refrigerant vapors from the suction side of the refrigerant system are compressed into a decreasingly smaller area, thus increasing the refrigerant vapor pressure and also raising the refrigerant vapor temperature. The higher refrigerant vapor pressure now assists in sealing the suction reed valve closed and also opens the discharge (high pressure) reed valve as the cylinder pressure exceeds the higher pressure side of the refrigerant system. When the compressed higher pressure and temperature refrigerant vapor is discharged into the high pressure side of the refrigerant system, the discharge reed valve spring pressure and the high side refrigerant pressure closes and seals the reed valve, thus preventing the discharge pressure from re-entering the compressor cylinder. The compressor's refrigerant vapor compression cycle begins again as the pistons are again pulled from their respective compressor cylinder bores by the rotating compressor shaft.

The high pressure and high temperature compressor discharge refrigerant vapor is released into the top of the condenser assembly, via the compressor's discharge hose. The condenser, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant vapor by ambient air passing over the condenser fins and tubing.

Liquid refrigerant from the condenser outlet enters the high pressure liquid line and then the inlet side of the fixed orifice tube located in the evaporator inlet tube. The inlet filter screen of the fixed orifice tube assembly removes coarse contaminant particulates, which may be present in the liquid refrigerant, before the liquid refrigerant enters the calibrated opening of the fixed orifice tube. The outlet end of the orifice tube assembly has a fine mesh filter with four open side slots in the body of the tube assembly, upstream from the filter. This filter removes fine contaminants and allows some of the refrigerant to exit through the non-filtered side slots. The side slots and filter act as a refrigerant flow noise suppressor.

Evaporator pressure is reduced as a result of air conditioner compressor suction. As the evaporator pressure is lowered and the liquid line pressure increases, the liquid refrigerant passes through the fixed orifice tube and enters the evaporator at a low pressure and as a cold liquid. As air flow passes over the plate-fin sections of the evaporator core, the refrigerant inside absorbs the heat and changes into a vapor.

DESCRIPTION AND OPERATION (Continued)

Compressor suction draws the vaporized refrigerant and oil mixture into the suction accumulator / drier where the heavier, oil-laden vapors fall to the bottom and the lighter vapors and oil mixture continue their path to the compressor via the top of the vapor return tube. A desiccant bag, located inside the suction accumulator / drier, absorbs and retains moisture which may be circulating in the refrigerant system. The heavier, oil-laden refrigerant also returns to the compressor through a small liquid bleed hole near the bottom of the vapor return tube. The liquid bleed hole provides a controlled second opportunity for the accumulated refrigerant and oil mixture to revaporize as it passes through the opening to re-enter into the main vapor flow path to the suction side of the compressor.

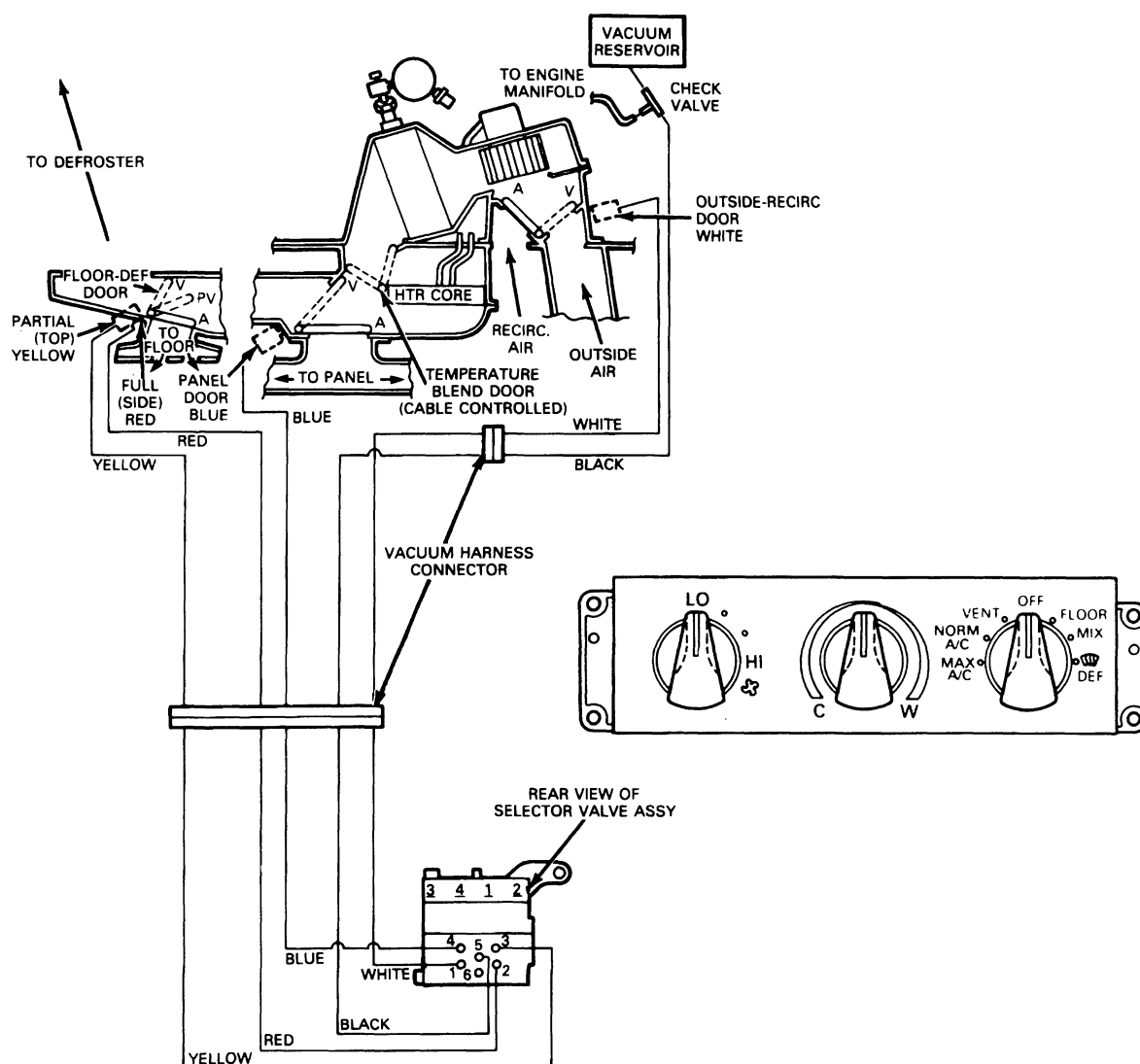
Control Assembly**Air flow**

Air can be distributed through the instrument panel registers, the floor outlets, and the defroster outlets depending upon the position of the function selector knob. Air flow to the side window demisters occurs in all control assembly knob settings except PANEL.

The following illustration is a diagram of the vacuum system and how it controls the PANEL / DEFROST, FLOOR, MIX and DEFROST doors.

DESCRIPTION AND OPERATION (Continued)

Vacuum System Diagram



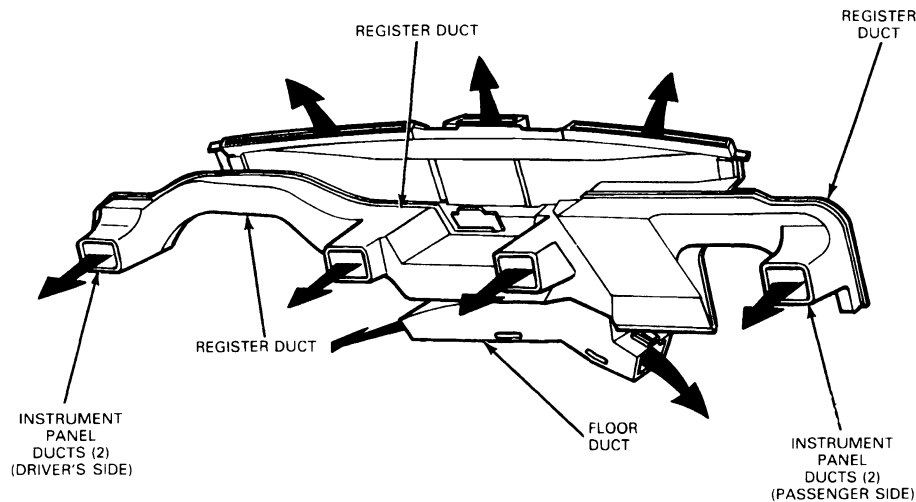
MODE SELECTOR VALVE DETENT POSITIONS								
PORT	FUNCTION	MAX A/C	NORM A/C	VENT	OFF	FLOOR	MIX	DEF
1	RECIRC — O/S AIR	V	A	A	V	A	A	A
2	FULL FLOOR	A	A	A	V	V	A	A
3	PANEL	A	A	A	V	V	V	A
4	MIX	V	V	V	V	A	A	A
5	SOURCE	V	V	V	V	V	V	V

V = VACUUM
A = ATMOSPHERE

CCL 4211-A

DESCRIPTION AND OPERATION (Continued)**Function Control**

When the function selector knob is in the A/C (MAX and NORM) and VENT positions, air flows out of the panel registers. Moving the function lever to the FLOOR position directs air flow to the floor outlets with a slight bleed to the defroster outlets. The MIX position splits the air between the floor outlets and the defroster outlets, and PANEL / DEFROST position directs air flow to the defroster outlets with a slight bleed to the floor outlets.

Air Flow Through Duct System

CCL 4191-B

The function knob actuates a vacuum switch which controls the movement of the door. A selector vacuum harness running between the switch and the vacuum motor transmits the power needed to position the door.

In the NORM A/C, VENT, FLOOR, MIX and PANEL / DEFROST positions, outside air is drawn into the system by the blower. In the OFF and MAX A/C positions, the recirc door is positioned so that outside air cannot pass into the evaporator case.

Temperature Control

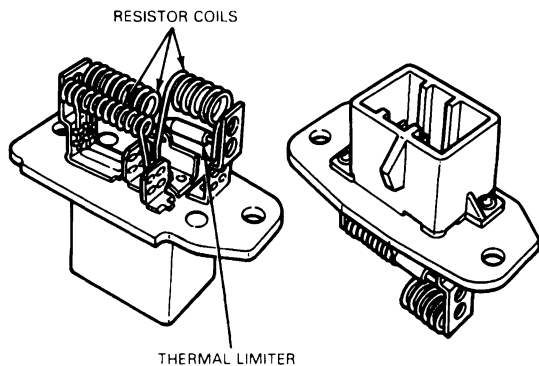
Temperature is controlled by a manually operated air blend door in the plenum assembly. When the temperature control knob is in the extreme COOL position (fully counterclockwise) all air is directed past the heater core.

When the temperature control lever is moved to the extreme WARM (fully clockwise) position, all air is directed through the heater core. When the temperature control knob is between COOL and WARM (between full counterclockwise and clockwise), air is directed through and around the heater core in proportion to the position of the temperature control knob between the extremes of its travel.

Blower Control

Blower speeds are controlled by a four-position blower switch and a resistor assembly located in the evaporator case upstream from the evaporator core.

The switch is used to select LO, two intermediate, or HI blower speed settings. The blower is turned off by rotating the function control knob to its OFF position.

DESCRIPTION AND OPERATION (Continued)**Blower Motor Resistor**

CCL 4394-A

A/C System Control

The air conditioning system is turned on and off by the function selector knob. When the knob is set in A/C (MAX or NORM) positions, electrical current flows through the pressure switch to the compressor clutch coil; the clutch engages and the air conditioning system is on. When the knob is rotated to other than air conditioning functions, current is stopped to the compressor clutch coil and the air conditioning system is off.

System Components**Evaporator Case Assembly**

The evaporator case assembly is attached to the engine side of the dash panel.

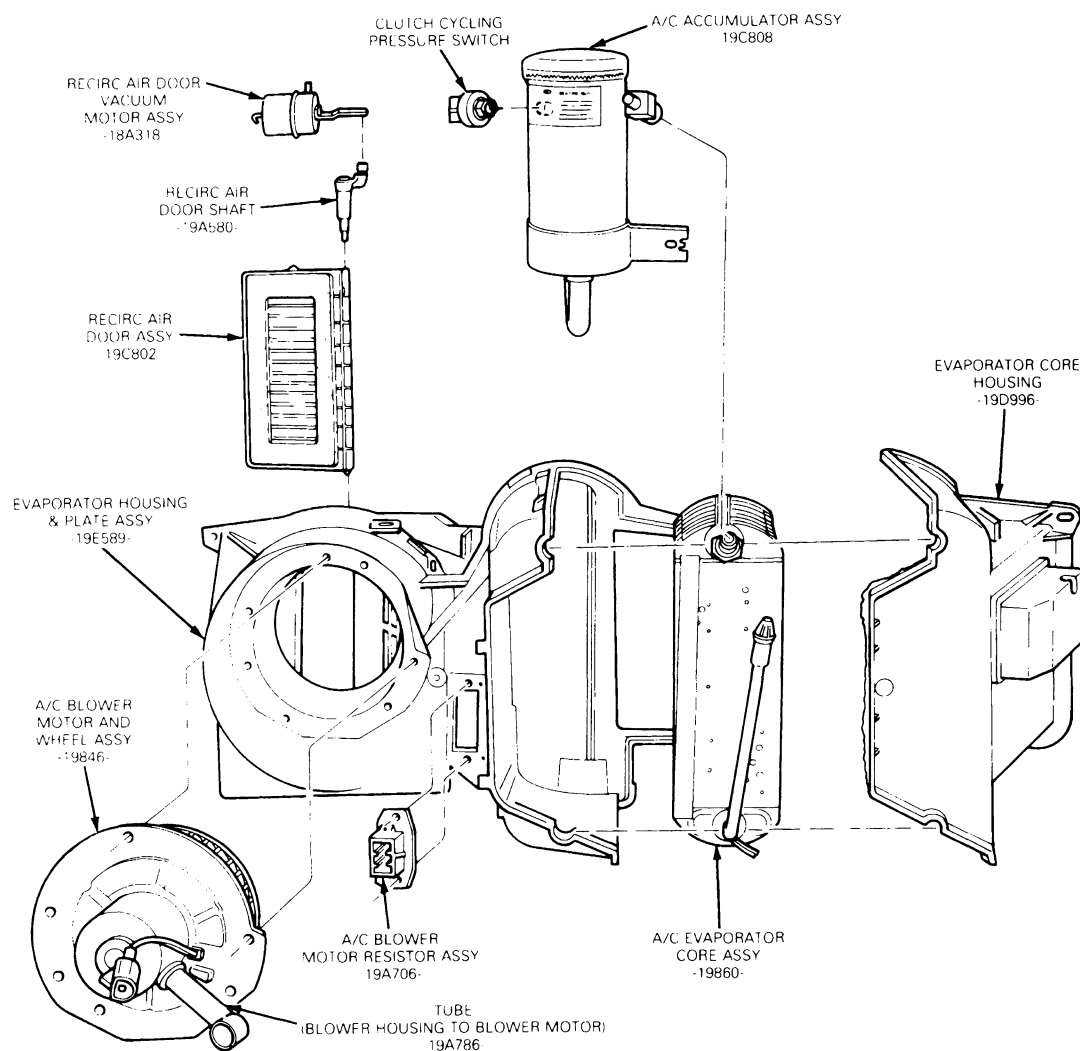
The case is a two-piece molded construction, one piece of which forms a cover over the evaporator core. An integral vacuum reservoir is part of the cover housing. This reservoir and the vacuum motor, which operates the outside/recirc air door, are linked through a check valve to a hose that supplies engine vacuum.

The blower housing is an integral part of the evaporator case. It houses the blower motor and wheel assembly which attaches to the case through a mounting flange on the blower motor.

The blower motor resistor assembly is attached to the case with its thermal elements extending into the air stream inside the evaporator case. The suction accumulator/drier is attached to the evaporator core by a support bracket.

DESCRIPTION AND OPERATION (Continued)

Evaporator Case Assembly, Disassembled View



CCL 3155-A

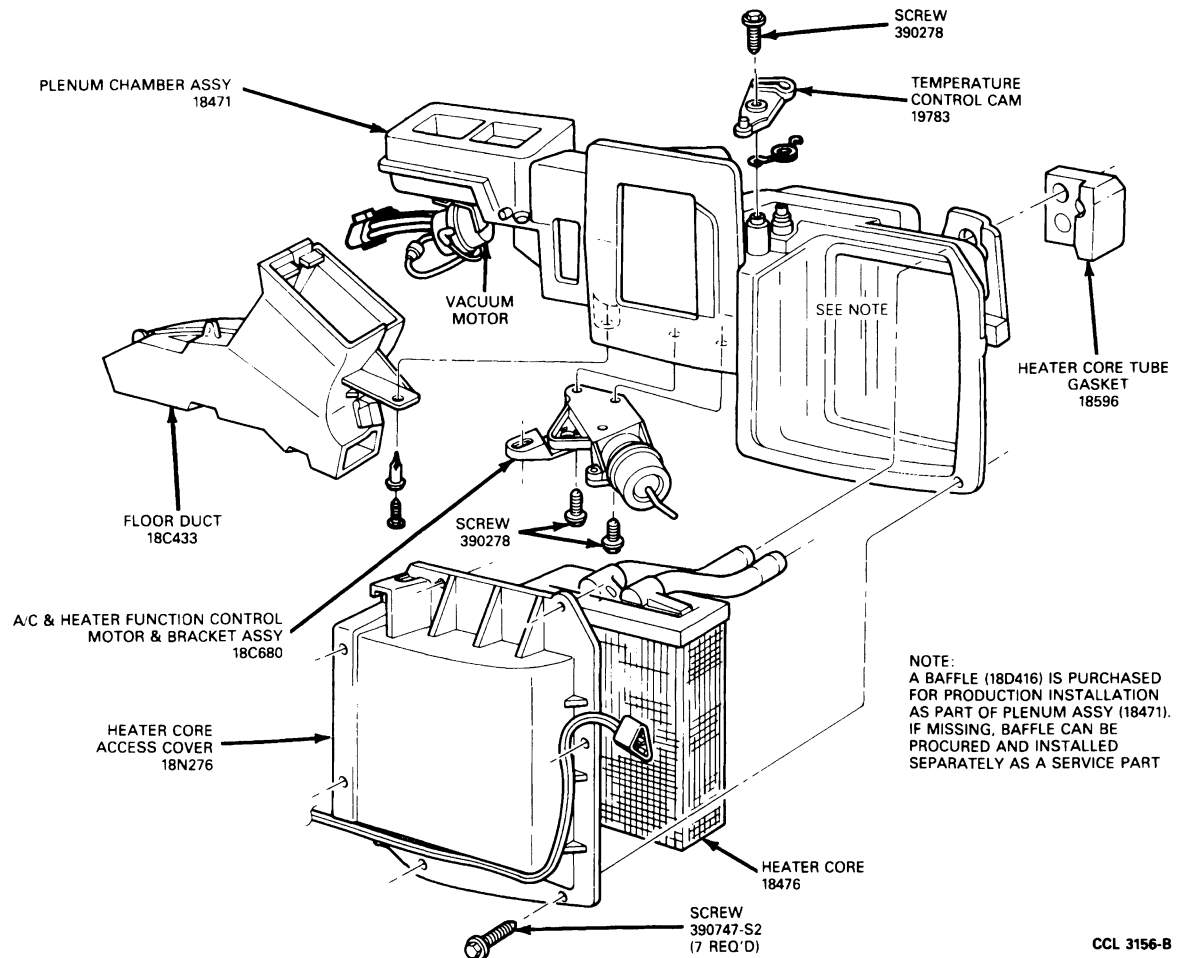
Plenum Assembly

The plenum assembly is mounted to the dash panel in the passenger compartment. It contains the heater core, temperature blend door, panel door and the floor / defrost door. The temperature blend door is cable-controlled through a cam located on top of the plenum. The panel and floor / defrost doors are both controlled by vacuum motors, located on the bottom of the plenum.

The heater core is located in the plenum behind the heater core cover. The cover allows the core to be removed without removing the plenum.

DESCRIPTION AND OPERATION (Continued)

Plenum Assembly



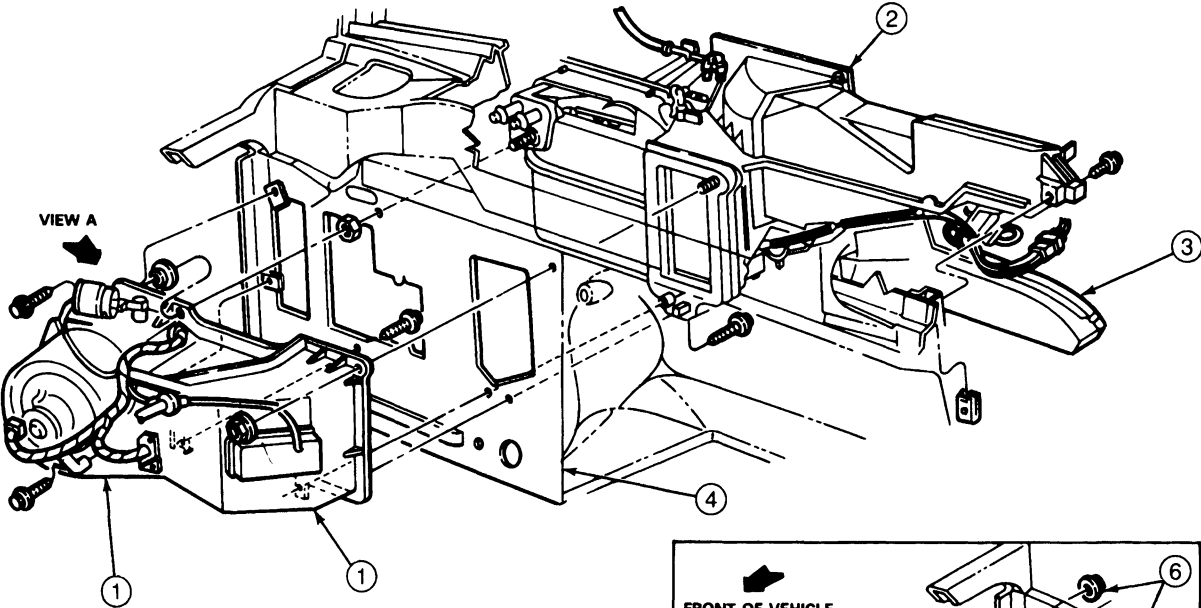
CCL 3156-B

Evaporator Case and Plenum Assemblies

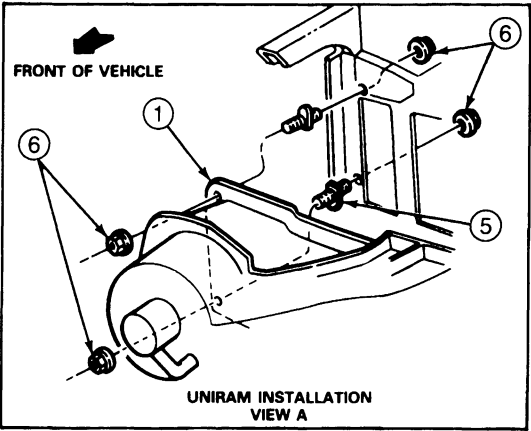
The following illustrates how the evaporator case and plenum assemblies attach on each side of the dash panel.

DESCRIPTION AND OPERATION (Continued)

Evaporator Case and Plenum Assembly, Installation



FRONT OF VEHICLE
➡

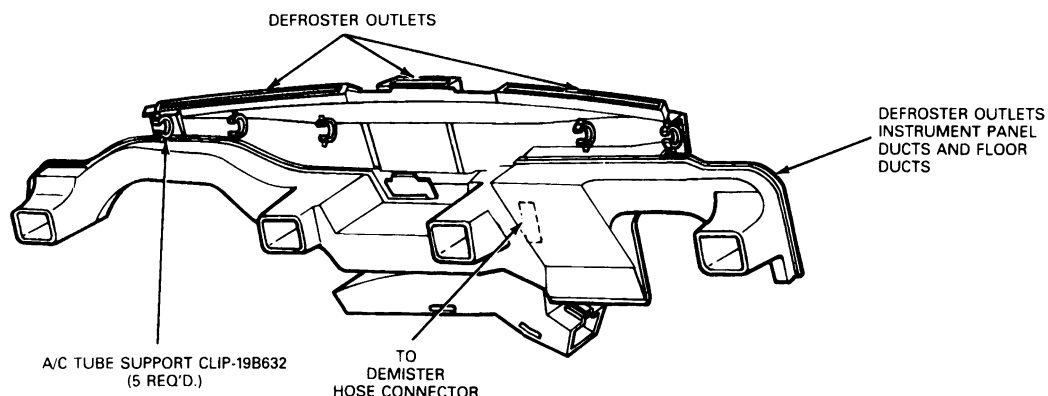


ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1.	18456	HEATER BLOWER ASSY.	4.	REF.	DASH PANEL
2.	18471	PLENUM CHAMBER ASSY.	5.	N803912-S2	STUD (2 REQ'D.)
3.	18C433	FLOOR DUCT	6.	N612906-S2	NUT (4 REQ'D.)

CCL 4201-A

Defroster and Ventilation Ducts

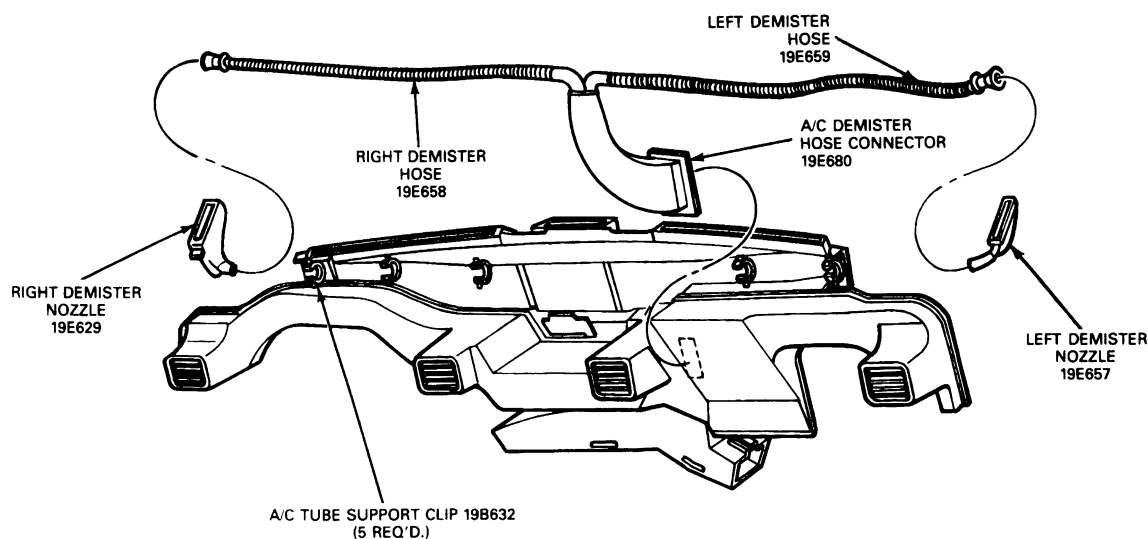
The defroster duct and ventilation ducts are a two-piece adhesively bonded construction attached as an assembly to the instrument panel. Refer to Section 01-12A, for details regarding instrument panel service.

DESCRIPTION AND OPERATION (Continued)**Defroster and Ventilation Ducts**

CCL 4374-A

Demister Nozzles and Hoses

The following illustration shows the parts which make up the side window demister system. A separate nozzle attaches to a register which is molded into each end of the instrument panel. A separate hose leads from each nozzle to a connector attached to the center air duct.

Demister Nozzles and Hoses

CCL 4199-A

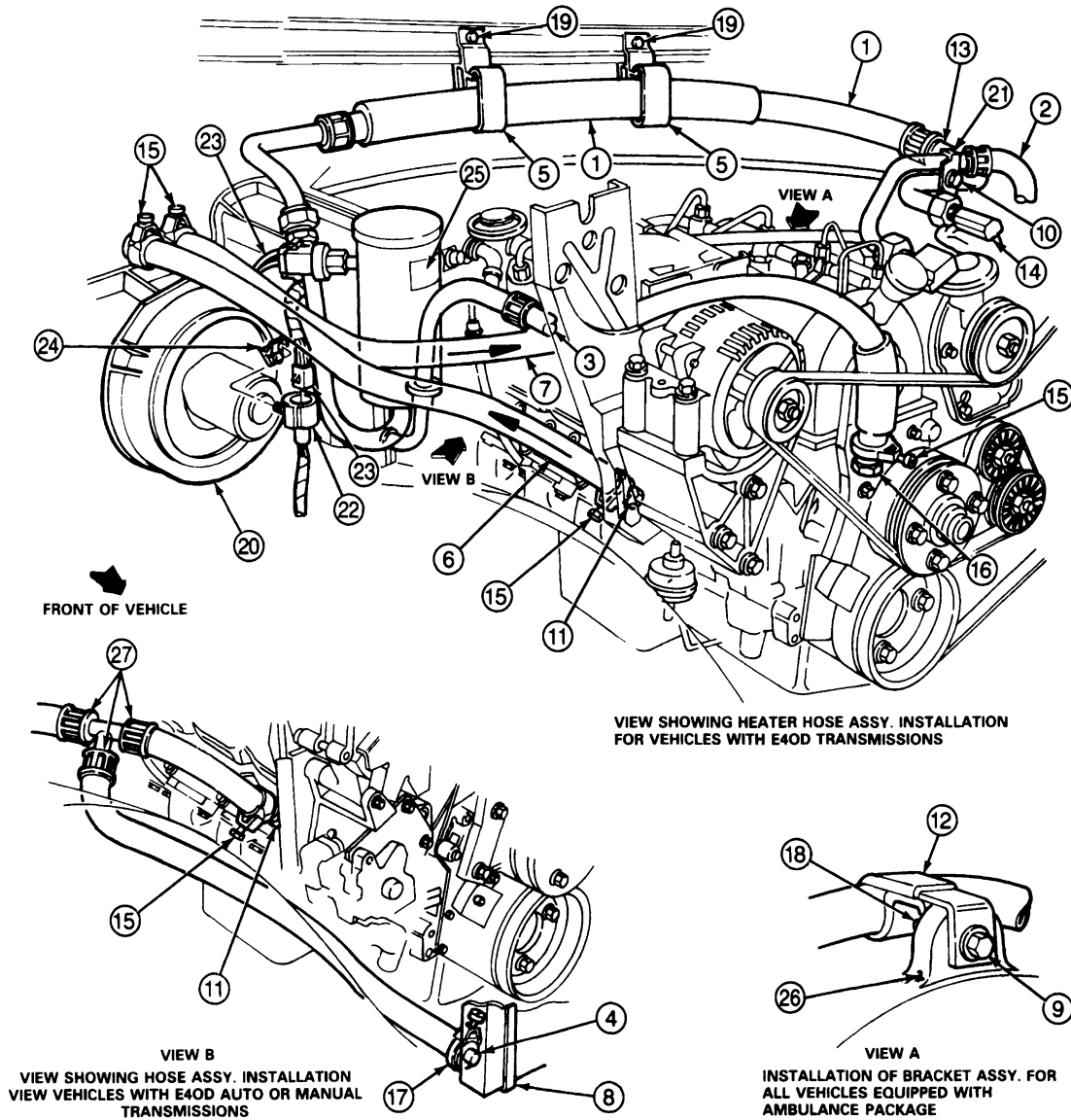
Register Ducts

The register ducts are three one-piece molded parts which attach to the underside of the instrument panel.

The ducts feed four registers in the instrument panel. One register is located on each side of the instrument cluster and one register is located immediately to the right and left of the glove compartment. The louver assemblies are serviceable from the passenger compartment.

DESCRIPTION AND OPERATION (Continued)

Register Locations



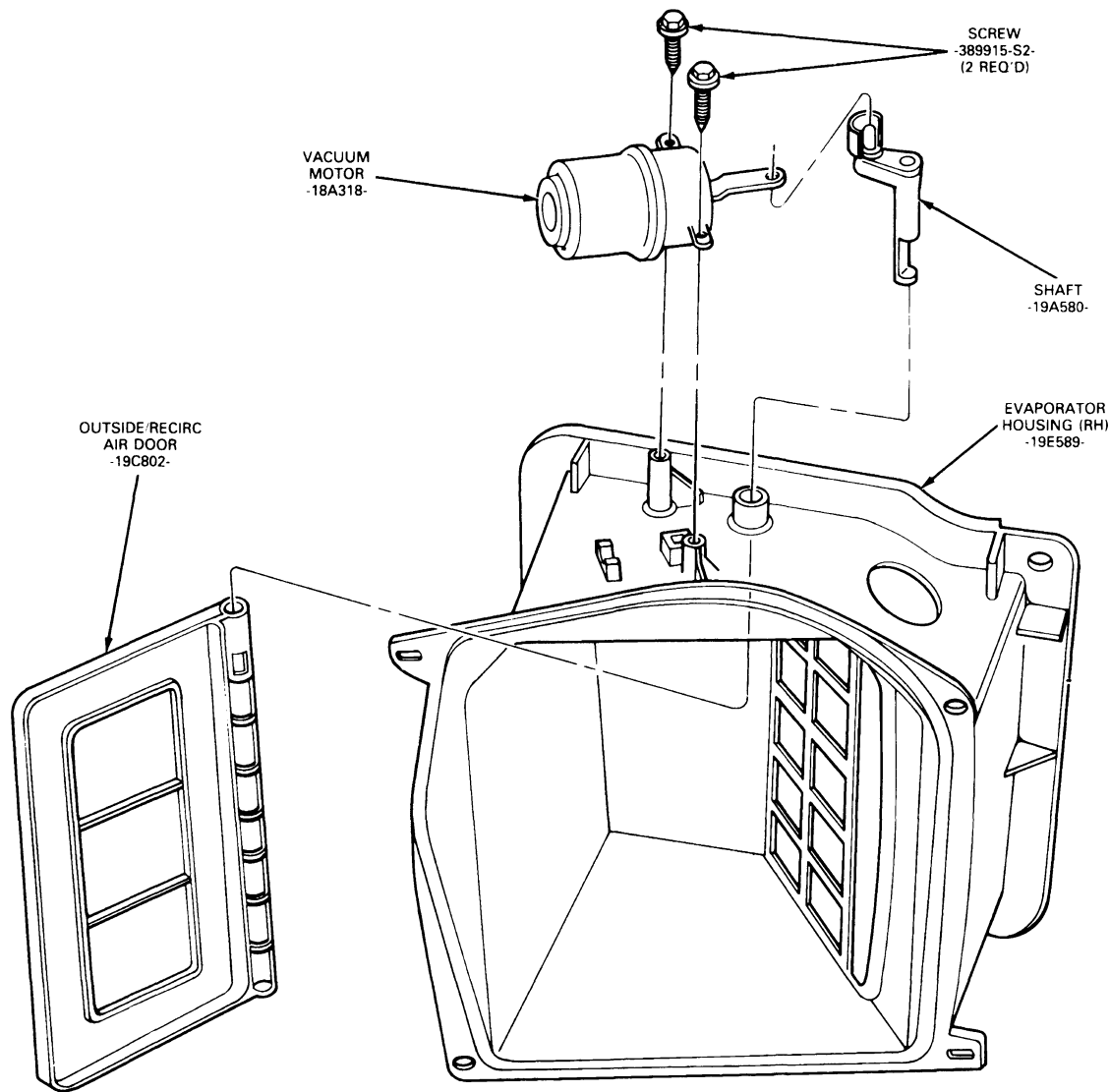
ITEM	BASE PART NUMBER	DESCRIPTION	ITEM	BASE PART NUMBER	DESCRIPTION
1.	19N617	HOSE ASSY. (SUCTION)	15.	390761-S100M	CLAMP (4-REQD.)
2.	19972	HOSE ASSY. (DISCHARGE)		389628-S100	HEATER HOSE CONNECTOR
3.	19N651	HOSE ASSY. (LIQUID LINE)	16.	389766-S100	HOSE CLAMP
4.	18C60	FITTING-HEATER HOSE (BYPASS)	17.	389772-S100	SPRING NUT, PART OF 18D331
5.	19N704	CLIP (2 REQ'D.)	18.	(REF.)	BRACKET ASSY.
6.	381260-S360A	HOSE	19.	(REF.)	EXISTING SCREW
7.	18C266	HOSE ASSY., FOR VEHICLES WITH C-6 AUTO OR MANUAL TRANSMISSIONS	20.	(REF.)	EVAPORATOR ASSY.
8.	(REF.)	RADIATOR	21.	(REF.)	SUPPORT BRACKET
9.	N606677-S2	SCREW & WASHER ASSY.	22.	(REF.)	INSTALL LOCATOR IN RETAINER
10.	N611058-S2	SCREW	23.	18A586	WIRING ASSY. (P.I.A. EVAPORATOR ASSY.)
11.	18D406	CONTROL ASSY. - HEATER COOL FLO	24.	(REF.)	EXISTING RETAINER
12.	18D331	BRACKET ASSY.	25.	19850	EVAPORATOR A/C SERVICE INSTRUCTIONS TAG
13.	19B632	CLIP-A/C TUBE SUPPORT	26.	(REF.)	ALTERNATOR EAR
14.	19D629	COMPRESSOR & CLUTCH ASSY.	27.	(REF.)	HEATER HOSE ASSY. CRIMPS

CCL 4375-A

DESCRIPTION AND OPERATION (Continued)**Outside Air / Recirculated Air Door**

The outside air / recirculated air door is located in the evaporator case assembly. It is operated by a vacuum motor in response to movement of the function air control knob.

When the lever is in the NORM, A/C, VENT, FLOOR, MIX and PANEL / DEFROST positions, the door is open to admit outside air; when the knob is in the OFF or MAX A/C position, the door is moved by vacuum to shut off outside air and open the passageway so that inside air can be recirculated through the system.

Outside Air / Recirculated Air Door and Vacuum Motor

CCL 3158-A

Control Assembly

The control assembly is installed in the center of the instrument panel.

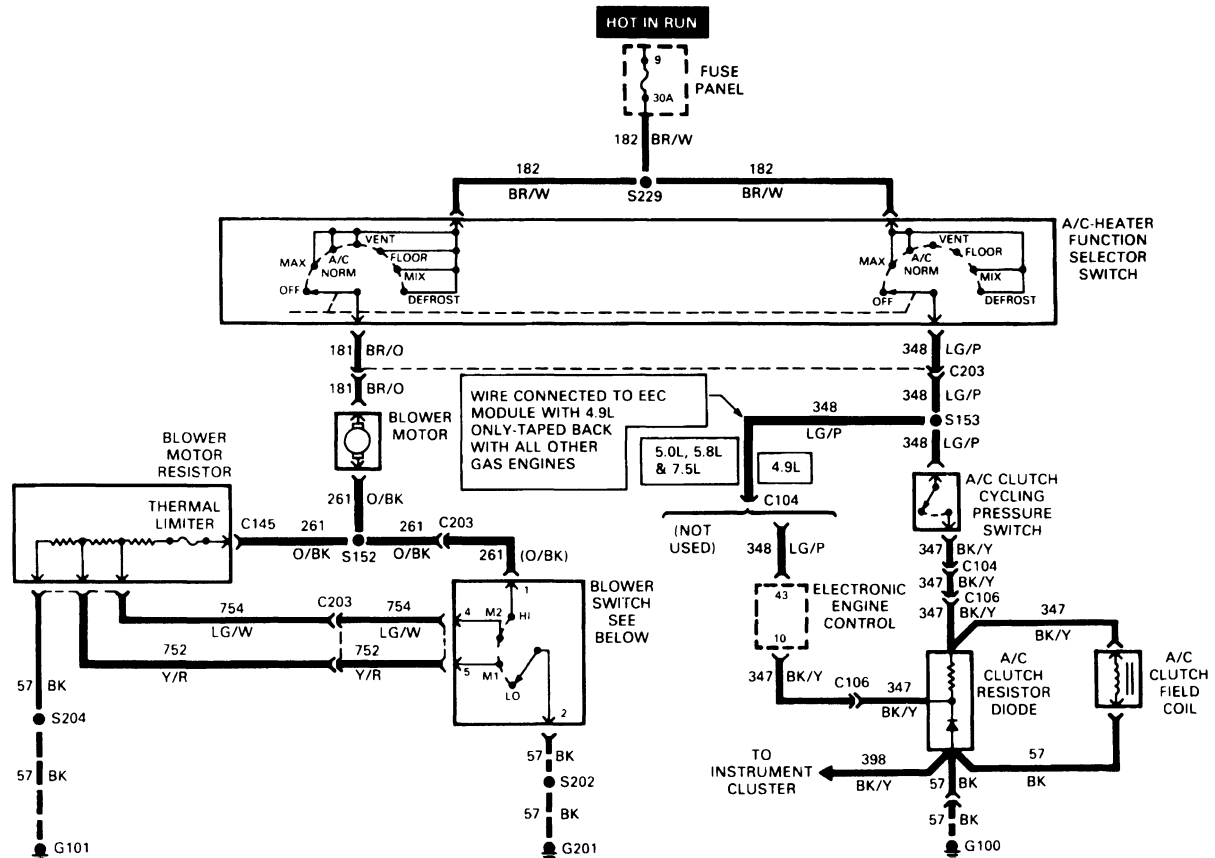
It includes the control head with one knob-operated cable for selecting temperature. A second knob moves a vacuum selector switch that activates the various function doors and air conditioner electrical contacts. A third knob moves electrical switch contacts so that they establish continuity for one of four available blower switch positions between LO and HI speed.

DESCRIPTION AND OPERATION (Continued)

Electrical System

The electrical system consists of the blower motor, blower speed switch, blower resistor with a thermal limiter, pressure switch, magnetic clutch and the fuse and wiring to complete the circuits.

Air Conditioning/Heater Electrical System Schematic



TERMINAL LOCATIONS	SCHEMATIC	COMPONENT TESTING PROCEDURE			
		TO TEST	Connect Self-Powered Test Lamp or Ohmmeter to Terminals	Move Switch to These Positions	A Good Switch Will Indicate
		Medium-Low Speed	57 (BK) 2 and 752 (Y/R) 5	Lo M1 M2 Hi	Open circuit Closed circuit Open circuit Open circuit
		Medium Speed	57 (BK) 2 and 754 (LG/W)	Lo M1 M2 Hi	Open circuit Open circuit Closed circuit Open circuit
		High Speed	57 (BK) 2 and 261 (O/BK) 1	Lo M1 M2 Hi	Open circuit Open circuit Open circuit Closed circuit

CCL 4100-A

The blower motor is installed in the blower housing which is part of the evaporator case. The motor is connected to the electrical circuit with one hardshell connector located near the motor.

The blower speed switch is installed on the control assembly and, with the blower resistor, provides the selection of four blower operating speeds.

DESCRIPTION AND OPERATION (Continued)

The blower motor resistor is installed in the evaporator case between the blower motor and the evaporator core.

The resistor assembly also contains a thermal limiter which is used as a temperature-protecting fuse. The thermal limiter is located a preset distance from the resistor coils. If the temperature of the thermal limiter reaches approximately 121°C (250°F), the limiter contacts will open, interrupting the blower motor circuit for all blower speeds except high speed. The thermal limiter will not reset so the resistor assembly must be replaced if the thermal limiter opens.

The pressure switch is located on the side of the suction accumulator and controls compressor clutch cycling. When the evaporator pressure increases to approximately 276-324 kPa (40-47 psi), the switch closes. When the pressure drops below approximately 169 kPa \pm 10 kPa (24.5 psi \pm 1.5 psi), the switch opens to stop compressor operation. In ambient temperatures below approximately 7.2°C (45°F), the pressure switch will not allow compressor operation because of low system pressures.

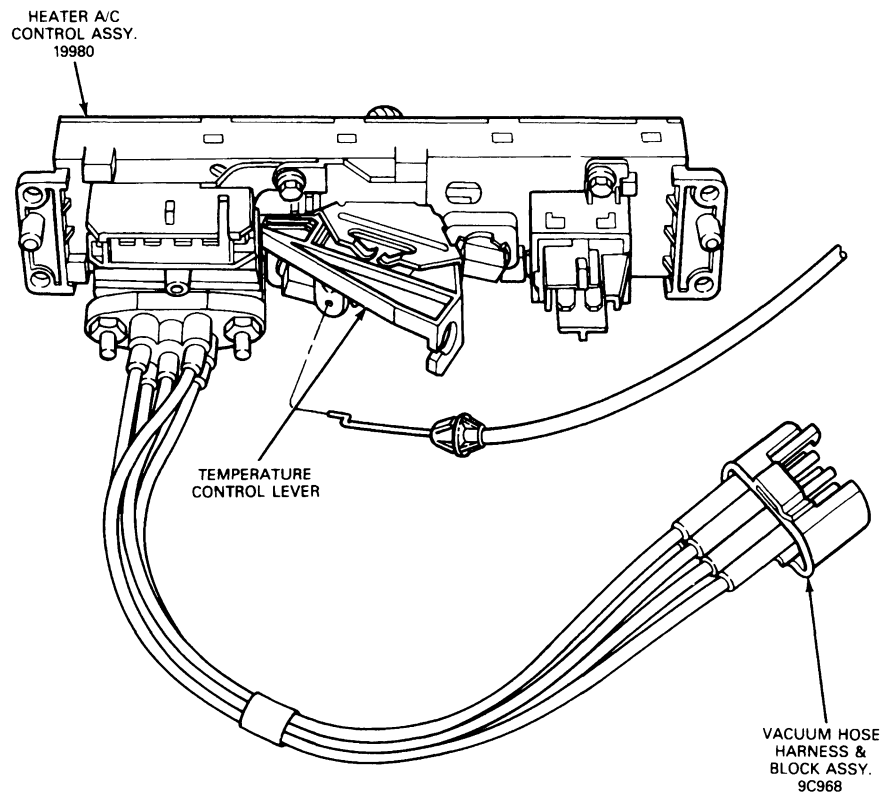
Vacuum System

The VENT/HEAT, MIX and OUTSIDE/RECIRC doors are vacuum operated. Refer to the vacuum logic diagram under Operation, Air flow for vacuum motor actuation sequence.

For maximum cooling, the temperature knob should be set in its fully counterclockwise position the function knob should be in the MAX A/C position; and the blower should be set for a desired rate of air flow.

Even though the function knob is on MAX A/C, the temperature knob, being manually controlled, may be set to modify the temperature of the air and the path through which the air flows. Another characteristic of the MAX A/C setting is the increased noise level of the blower. Blower speed does not change when the outside air/recirc door is moved to either of its two positions. The difference in noise level is that an open recirc door exposes the passenger compartment directly to the noise. When insulated against the noise with the recirc passageway closed, the blower speed appears to be less.

The control knob operates a vacuum valve which is attached to the backside of the control assembly by one screw and retainer tabs.

Vacuum Hose Harness

CCL 4195-A

DESCRIPTION AND OPERATION (Continued)

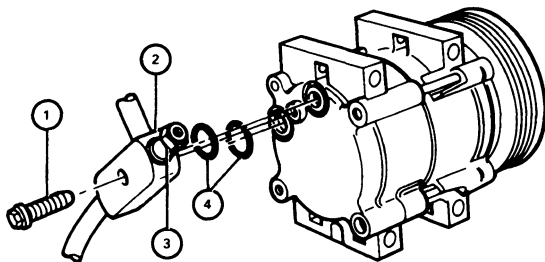
Two hoses extend from the valve to the vacuum motors and vacuum supply. The solid black hose goes to the vacuum supply through a tee shaped check valve, which attaches the vacuum reservoir and engine source. The white hose actuates the OUTSIDE / RECIRC air door two-position vacuum motor. The blue hose actuates the PANEL / DEFROST air door two-position vacuum motor. The red and yellow hoses actuate the MIX three-position air vacuum motor. Each end of each hose slides onto the nipple of the vacuum port to which it attaches.

Refrigerant System

The manual air conditioning / heater refrigerant system uses a ten-cylinder swash plate compressor, a condenser, an evaporator core with a fixed orifice in the evaporator inlet tube, a suction accumulator with an integral drier, a pressure switch, Schrader-type service access gauge port valves, and the necessary refrigerant lines.

Air Conditioner Compressor and Clutch Assembly

The air conditioner compressor is the 10-cylinder swash-plate type and is installed on the left side of the engine compartment. It is driven by the front end accessory drive poly-V belt. Belt tension adjustment is obtained by means of an automatic tensioner (on gasoline engines or by moving the compressor and braces on 7.3L diesel engines).



- | ITEM | DESCRIPTION |
|------|-----------------------|
| 1. | BOLT |
| 2. | MANIFOLD |
| 3. | PRESSURE RELIEF VALVE |
| 4. | O-RING |

CCL 4132-A

Pressure Relief Valve

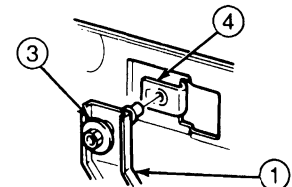
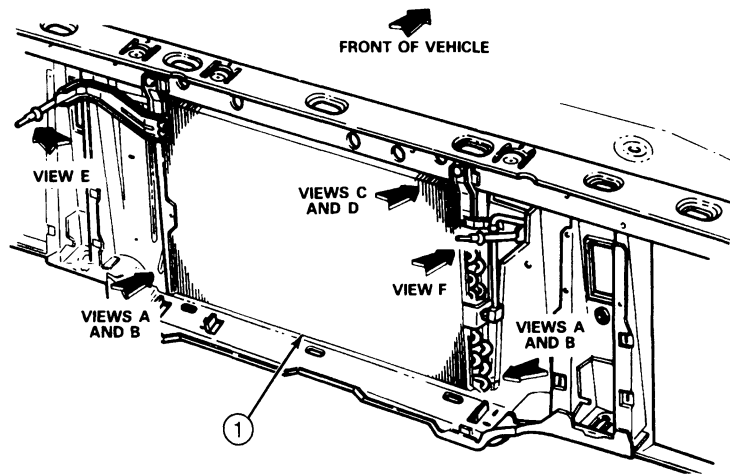
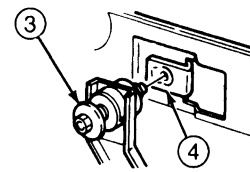
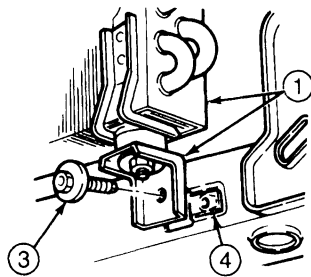
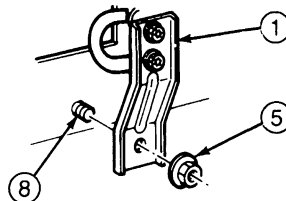
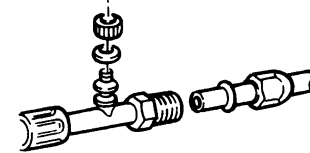
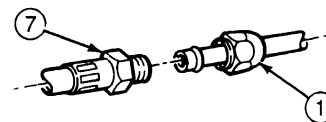
A pressure relief valve is installed on the compressor discharge manifold to relieve excess high pressure buildups (310 kPa or 450 psi and above) and prevent damage to the compressor and other air conditioner components.

Condenser Assembly

The condenser assembly is attached to the radiator support in front at the radiator with two mounting brackets at the top and bottom of the condenser. The top mounting brackets attach to the rear side of the radiator support and the lower brackets attach to the front side of the radiator support.

DESCRIPTION AND OPERATION (Continued)

Condenser Assembly Installation

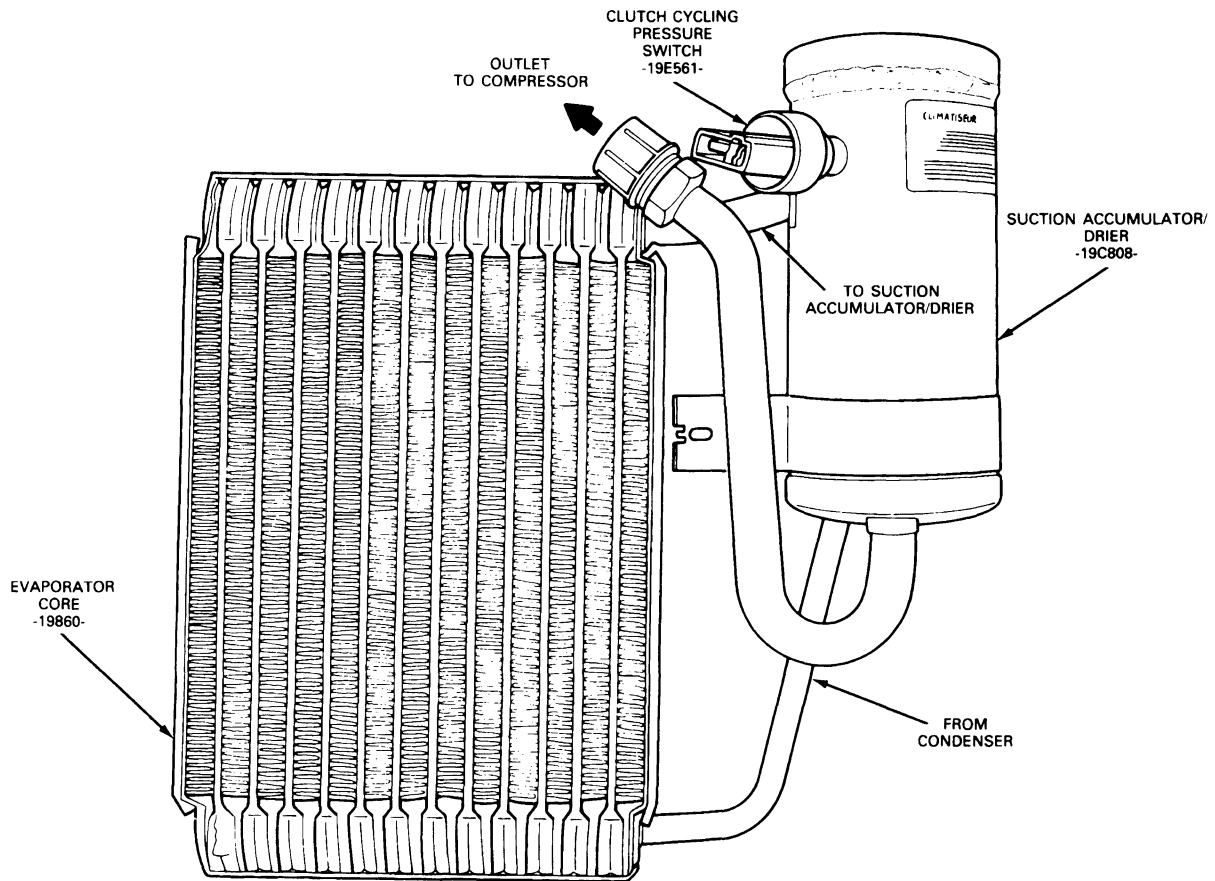
TYPICAL FOR DIESEL VEHICLES ONLY
UPPER BRACKETS
VIEW CTYPICAL FOR GAS VEHICLES ONLY
UPPER BRACKETS
VIEW DTYPICAL FOR GAS VEHICLES ONLY LOWER BRACKETS
VIEW ATYPICAL FOR DIESEL VEHICLES ONLY
LOWER BRACKETS
VIEW BVIEW SHOWING DISCHARGE
HOSE CONNECTION
VIEW EVIEW SHOWING LIQUID
HOSE CONNECTION
VIEW F

ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1.	19710	CONDENSOR ASSY. (7.3L DIESEL)	5.	N620481-S2	NUT
2.	19710	CONDENSOR ASSY. (GAS)	6.	19972	HOSE ASSY. (7.3L DIESEL)
3.	19D702	CAP	7.	19N651	HOSE ASSY.
4.	N606691-S2	SCREW & WASHER ASSY.	10.	380976-S	O-RING
	N623333-S100	U-NUT	11.	19D734	MANIFOLD & TUBE ASSY. (GAS)

CCL 4203-A

Evaporator Core

The evaporator core is a "flooded type" (plate-fin) core similar to passenger car cores. The liquid line connects to the bottom of the core and the suction accumulator / drier assembly connects to the top of the core.

DESCRIPTION AND OPERATION (Continued)**Evaporator Core and Suction Accumulator / Drier**

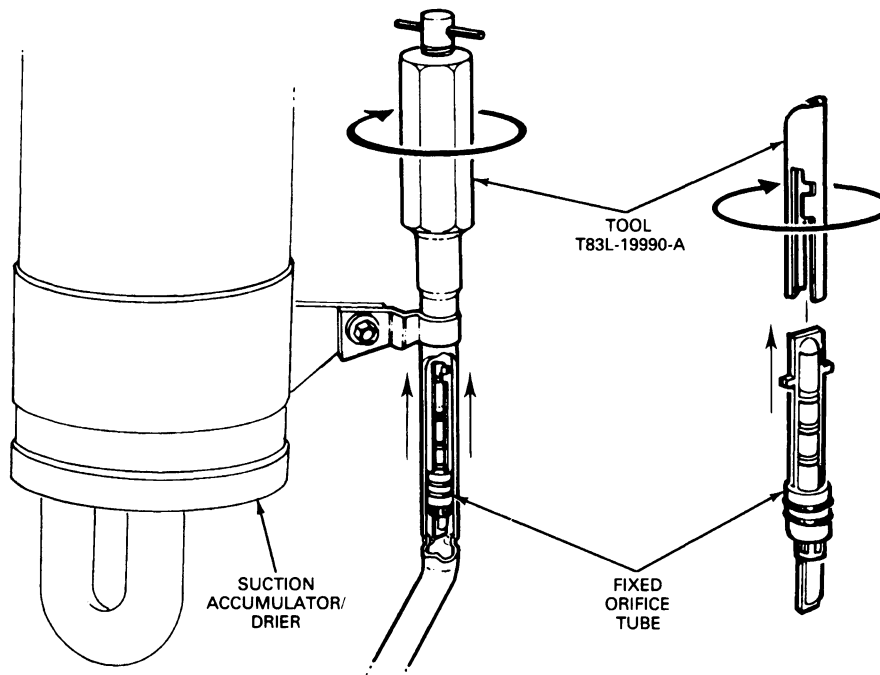
CCL 3162-A

Fixed Orifice Tube

The evaporator inlet tube is fitted with a fixed orifice to control refrigerant flow. This orifice tube can be removed from the evaporator core inlet tube for replacement if it becomes necessary. However, Orifice Tube Remover and Installer T83L- 19990-A (Motorcraft YT-1008) or equivalent is necessary to prevent breakage when removing the tube.

The fixed orifice tube assembly is a restriction between the high and low pressure refrigerant and meters the flow of liquid refrigerant into the evaporator core. The diameter of the orifice within the orifice tube is 1.7mm (0.067 inch). The orifice tube can be identified by the BLUE body color with a white outlet tip.

The fixed orifice tube is located in the evaporator inlet tube and has filter screens on the inlet and outlet ends of the tube body. The filter screens act as strainers for the liquid refrigerant flowing through the fixed orifice opening. O-rings on the tube body prevent the high pressure liquid refrigerant from bypassing the orifice. Adjustment or repairs cannot be made to the fixed orifice tube assembly and it must be replaced as a unit.

DESCRIPTION AND OPERATION (Continued)**Fixed Orifice Tube Removal**

CCL 2714-B

Suction Accumulator / Drier

The suction accumulator / drier is mounted inside the evaporator case and attaches directly to the evaporator outlet tube.

Refrigerant enters the accumulator / drier canister through the inlet tube and the heavier, oil-laden refrigerant falls to the bottom of the canister. A small diameter aspirator tube is located close to the bottom of the canister and runs to the top of the vapor return tube. This aspirator tube is covered with a filter screen and allows a small amount of the heavier liquid refrigerant and oil mixture to re-enter the suction line at a controlled rate. When the heavier liquid refrigerant and oil mixture enters the compressor suction line, it has a second opportunity to vaporize and circulate through the compressor without causing damage to the compressor due to refrigerant slugging.

A desiccant bag is mounted inside the suction accumulator / drier canister to absorb any moisture which may be in the refrigerant system.

A fitting located on the top or side of the canister is used to attach the clutch cycling pressure switch. A long-travel Schrader-type valve stem core is installed in the fitting opening to prevent refrigerant loss when the clutch cycling pressure switch is removed.

If it is necessary to check the suction accumulator / drier for excessive refrigerant oil, the oil must be poured from the accumulator through the pressure switch fitting when the Schrader valve stem is removed.

Suction Accumulator / Drier Replacement

Replacement of the suction accumulator / drier is necessary anytime a major component of the refrigerant system is replaced. A major component includes condenser, compressor, evaporator core or a refrigerant hose / line. An orifice tube or O-ring is not considered a major component but the orifice tube should be replaced whenever the compressor is replaced for lack of performance.

In addition to the preceding condition, the accumulator / drier should also be replaced if one of the following conditions exist.

1. The accumulator / drier is perforated.
2. The refrigerant system has been opened to the atmosphere for a period of time longer than required to make a minor repair.

DESCRIPTION AND OPERATION (Continued)

3. There is evidence of moisture in the system such as internal corrosion of metal refrigerant lines or the refrigerant oil is thick and dark.

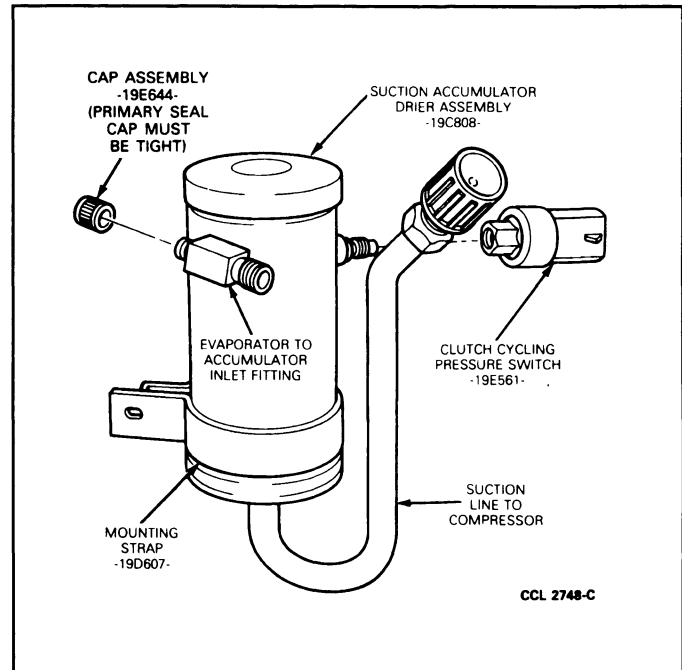
NOTE: The compressor oil from vehicles equipped with an FX-15 Compressor may have a dark color while maintaining a normal oil viscosity. This is normal for this compressor because carbon from the compressor piston rings may discolor the oil.

When replacing the suction accumulator / drier, the procedure given here must be followed to ensure that the total oil charge in the system is correct after the new accumulator / drier is installed.

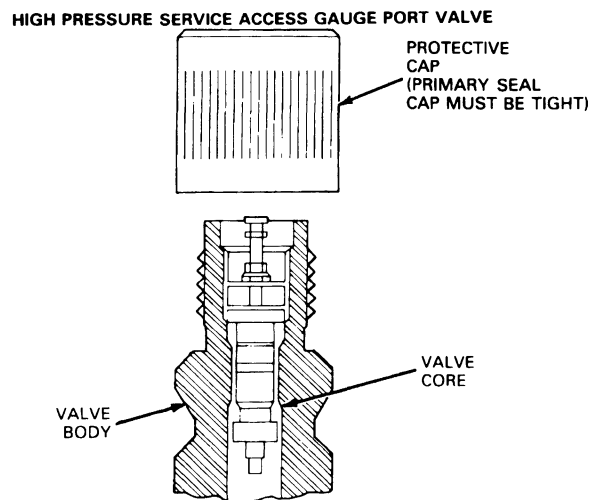
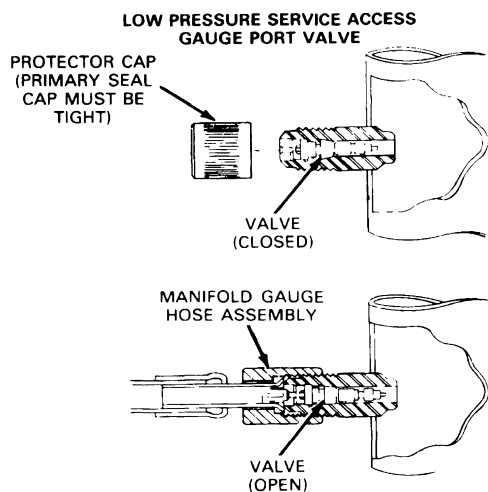
- Drain the oil from the removed accumulator / drier into a suitable measuring container. It may be necessary to drill one or two 1/2-inch holes in the bottom of the old accumulator / drier to make sure that all the oil has drained out.
- Add the same amount of clean new refrigerant oil plus two fluid ounces to the accumulator / drier. Use only the oil specified for the specific vehicle being serviced.

Clutch Cycling Pressure Switch

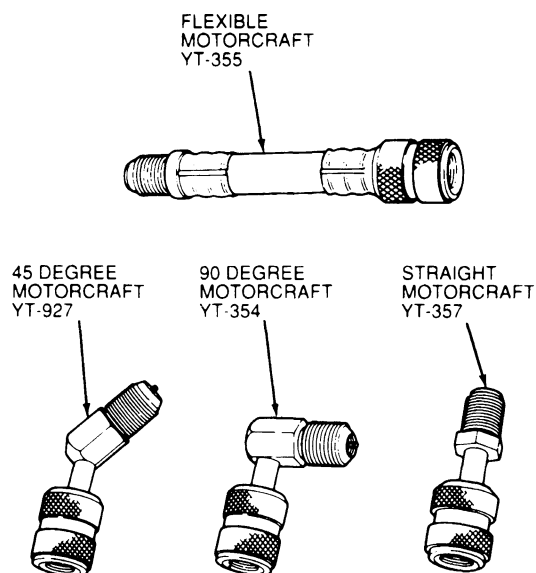
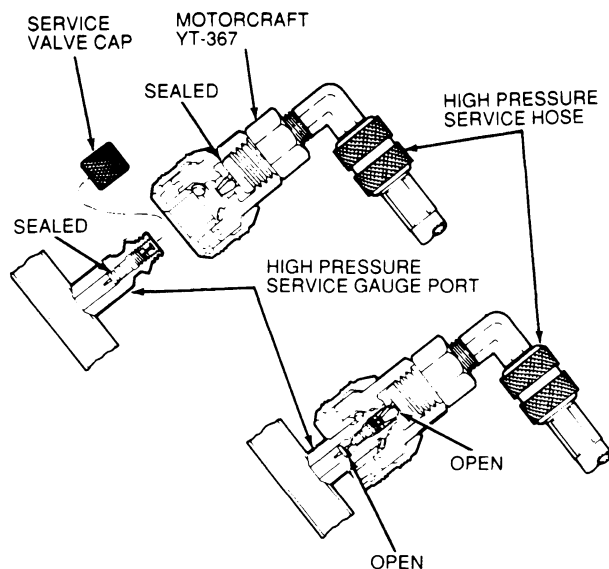
The clutch cycling pressure switch is mounted on a Schrader valve-type fitting on the side of the suction accumulator / drier assembly. A valve depressor, located inside the threaded end of the pressure switch, presses in on the Schrader valve stem as the switch is mounted and allows the suction pressure inside the accumulator / drier housing to activate the switch. The electrical switch contacts are normally open when the suction pressure is at or below 179 kPa (26 psi); they will close, activating the compressor clutch, when the suction pressure rises to approximately 310 kPa (45 psi) or above. Lower ambient temperatures (below approximately 7°C or 45°F) during cold weather seasons will also open the clutch cycling pressure switch contacts, because of the pressure / temperature relationship of the refrigerant in the system. The electrical switch contacts control the electrical circuit to the compressor's magnetic clutch coil. When the switch contacts are closed, the clutch coil is energized and the air conditioner clutch is engaged to drive the compressor. When the switch contacts are open, the compressor's magnetic clutch coil is de-energized, the air conditioner clutch is disengaged and the compressor does not operate. The clutch cycling pressure switch, when functioning properly, will control the evaporator core pressure at a point where the plate-fin surface temperature will be maintained slightly above freezing which prevents evaporator icing and the blockage of air flow.

**Service Access Gauge Port Valves**

Two service access gauge port valves are used in the refrigerant system. The high pressure (discharge) valve is located in the discharge line near the condenser. This service access gauge port valve requires High Pressure Service Port Adapter Set D81L-19703-A (Motorcraft YT-354 or 355) or equivalent to connect a manifold gauge set or charging station to it. The other service access gauge port valve is located on the side of the suction accumulator and is used to measure evaporator pressure. An additional Low Pressure Gauge Port Valve adapted to the accumulator is available for attaching a service hose and pressure gauge. See Tee Adapter Tool Installation in Section 12-03.

DESCRIPTION AND OPERATION (Continued)**Service Access Gauge Port Valves**

CCL 2749-B

High Pressure Service Port Adapters

CCL 4068-A

Refrigerant Lines

On vehicles equipped with gasoline engines, the manifold and suction / discharge tubes are serviced as an assembly.

On vehicles equipped with diesel engines, the manifold and suction / discharge tubes are serviced separately.

The compressor discharge line has a Schrader-type service access gauge port valve located near the condenser. This is the high pressure service port. A High Pressure Service Port Adapter Set D81L-19703-A (Motorcraft YT-354 or 355) or equivalent is necessary to connect a manifold gauge set or a charging station to this service port.

DIAGNOSIS AND TESTING

For instructions and illustrations covering diagnosis and testing of the heater and air conditioning systems used on current F-Series and Bronco vehicles, refer to Sections 12-02 and 12-03.

- Heating system coverage includes the following:

- Blower motor current draw test
- Blower motor voltage test
- Blower switch continuity test
- Heater core leak testing
- Loose blower wheel test
- Open circuit test

Procedures are also provided for bleeding air from the heater core, visually checking the blower, and backflushing the heater core.

- Air conditioning system coverage includes the following:

- Air conditioner performance testing
- Magnetic clutch test
- Pressure switch test

Procedures are also provided for leak testing, making visual inspections, and using a manifold gauge set.

6. Remove the vacuum harness connector from the notch in the lower edge of the floor distribution duct. Disconnect the vacuum harness from the connector on the plenum.
7. Using a screwdriver or needlenose pliers, carefully release the temperature control snap-in flange from the underside of the control assembly.
8. Rotate the control assembly 90 degrees and disconnect the temperature control cable from the temperature control tab on the gear rack.
9. Move the control assembly away from the instrument panel.

Installation

1. Pull the temperature control cable through the control assembly opening in the instrument panel for a distance of approximately 200mm (8 inches).
2. Hold the control assembly against the instrument panel with the face of the control directed toward the roof of the vehicle. Attach the temperature cable to the gear rack.
3. Rotate the control assembly to position it into the instrument panel opening. Snap the cable end into the control bracket. Be sure that the end is firmly seated.
4. Connect the wire harness to the blower switch and control illumination lamp. Attach the vacuum harness to the vacuum selector valve and to the plenum harness.
5. Attach the vacuum harness connector to the notch in the lower edge of the floor distribution duct.
6. Position the control assembly into its instrument panel opening while being careful that the vacuum and electrical harness are properly stowed.
7. Install the finish panel.
8. Install the trim strip above the control assembly and glove compartment.
9. Connect the battery ground cable(s).
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
10. Check the system for proper operation.

REMOVAL AND INSTALLATION

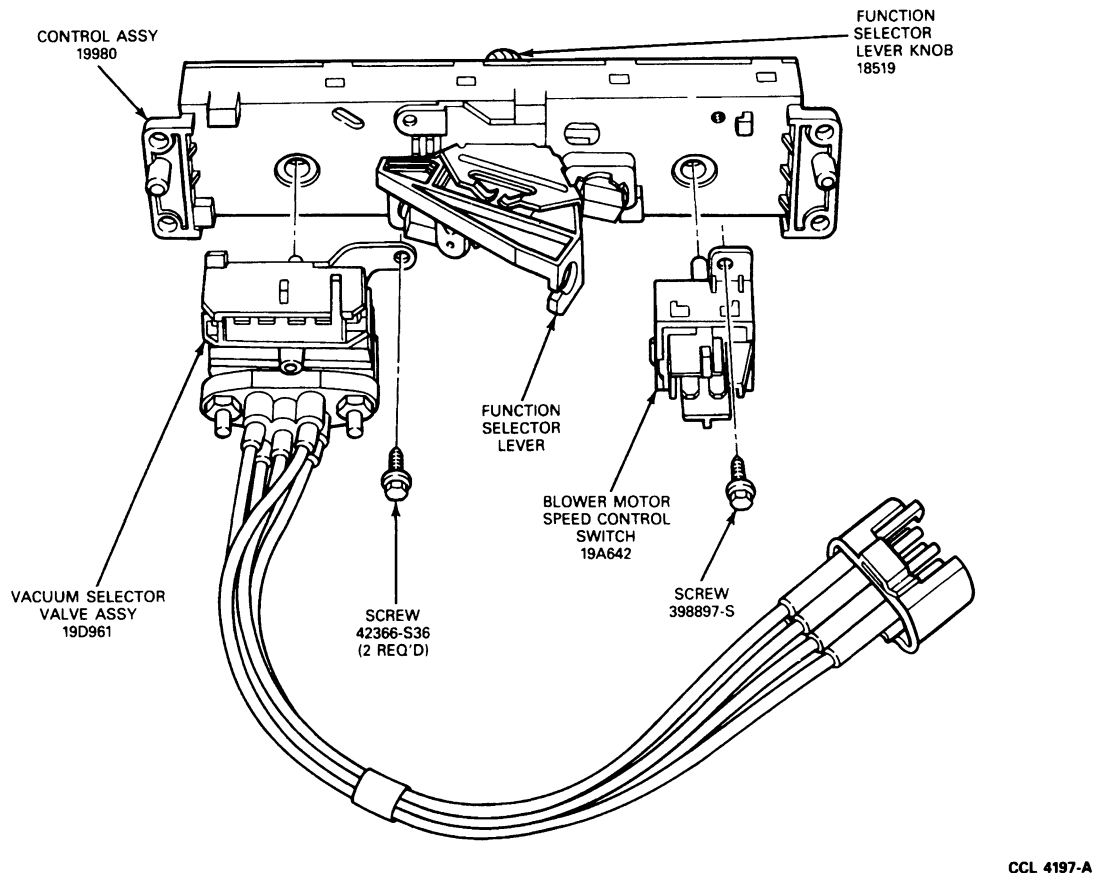
Control Assembly

Removal

1. Disconnect the battery ground cable(s).
2. Remove the trim strip located above the control assembly and glove compartment door.
3. Pull the center finish panel away from the instrument panel to gain access to the four screws which attach the control assembly to the instrument panel. Refer to Section 01-12A for the position of the instrument panel assembly and its components.
4. Remove the four screws. Then, pull the control assembly far enough through the opening in the panel to allow disengagement of the electrical connectors for the blower switch and control illumination lamp.
5. Disconnect the electrical harness connectors from the vacuum selector valve, blower switch and illumination connections on the control assembly.

REMOVAL AND INSTALLATION (Continued)

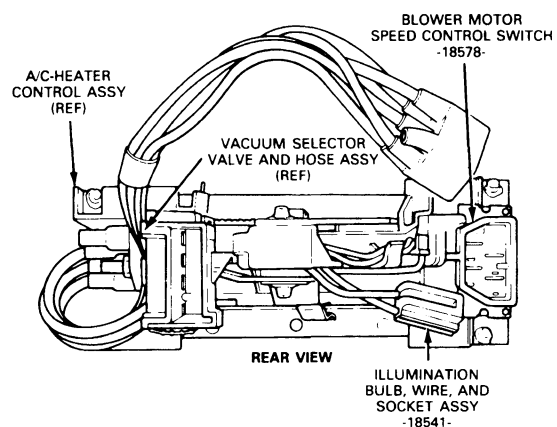
Vacuum Select Valve Assembly and Blower Switch Removal



Blower Speed Control Switch

Removal

1. Remove control assembly from instrument panel, as outlined. Do not detach the cables.
2. Remove knob from the blower switch by pulling it off its shaft.
3. Move control assembly away from instrument panel opening and disconnect wire connector by lifting the snap-lock retainer with a screwdriver and pulling the connector off the switch.
4. Remove the screw attaching the switch to the bottom of the control assembly, and rotate the switch counterclockwise to release the switch retaining tabs.



Installation

1. Insert the switch shaft without its knob through its opening in the control assembly
2. Rotate the switch clockwise to engage the switch retaining tabs.
3. Connect the wire connector to the switch.

REMOVAL AND INSTALLATION (Continued)

4. Install control assembly as described in this section.
5. Check the blower switch for proper blower motor operation.

Vacuum Selector Valve**Removal and Installation**

1. Remove control assembly as outlined.
2. Remove the electrical connector from the switch by lifting the snap-lock retainer with a screwdriver and pulling on the connector.
3. Remove the screw which attaches the vacuum selector valve to the control assembly and remove selector valve. Then, rotate the valve counterclockwise to release it from its retaining tabs.
4. Remove the two nuts which secure the vacuum harness to the selector valve, and remove the harness.
5. For installation, follow removal steps in reverse order.
6. Start the engine to provide vacuum. Then, move the function lever to each of its operating positions to verify that vacuum is being distributed properly through the selector valve to the applicable vacuum motor.

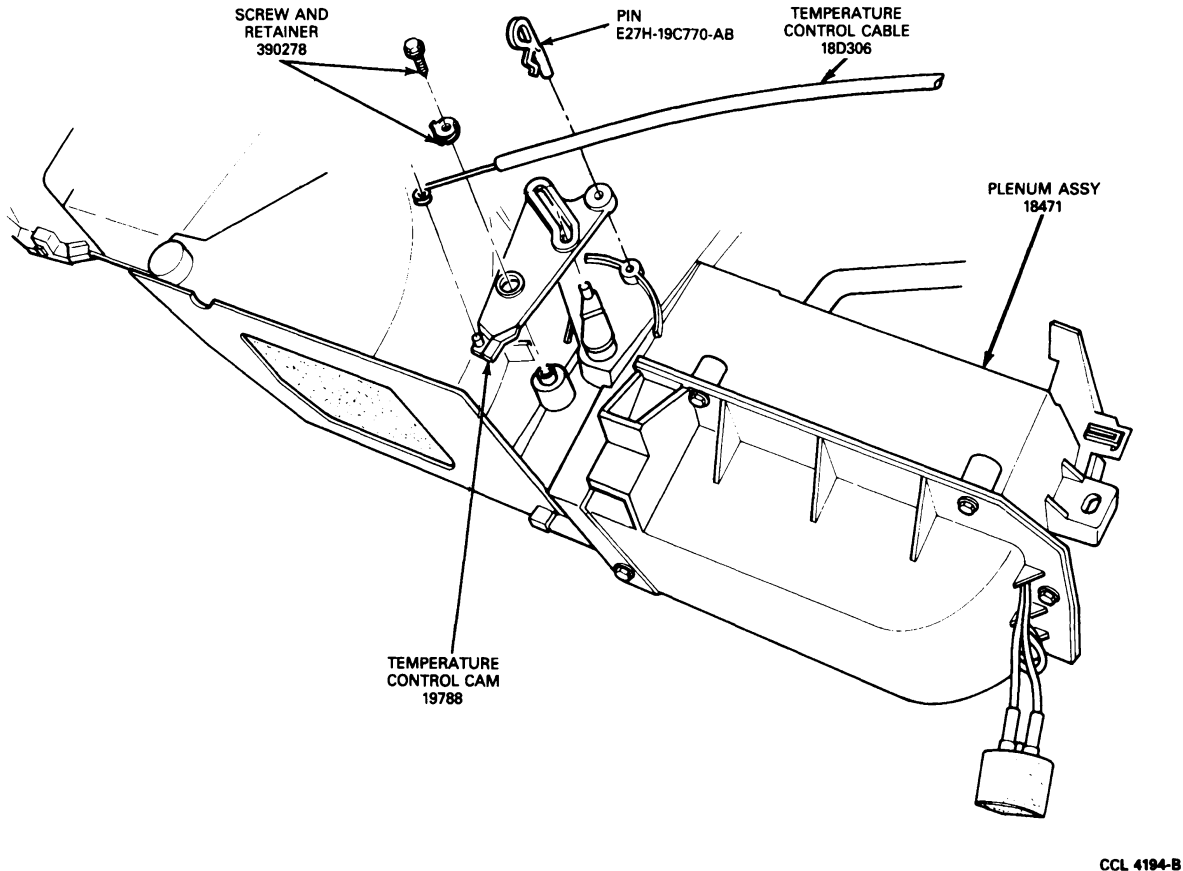
Temperature Control Cable**Removal**

1. Remove the control assembly from the instrument panel as described in this section. Disconnect the cable.
2. Disengage the glove compartment door by squeezing the sides at the door stops. Swing the door down and remove it from its hinges.
3. Remove the two screws which attach the RABS module.
4. Working through the glove compartment, using Special Service Tool D91T-18532-A Heater-A/C Temperature Cable Clip Remover or equivalent, release the temperature control cable from the heater core cover on the plenum.

5. Disconnect the temperature control cable from the cam on top of the plenum.
6. From underneath the lower edge of the instrument panel, pull the cable from its upper retaining tabs which are part of the electrical harness retaining brackets.

Installation

1. Feed the control end of the wire up to the control from beneath the instrument panel.
2. Snap the cable into the upper cable retaining tabs. These tabs are part of the electrical harness retaining brackets located along the bottom edge of the instrument panel. The part number imprinted on the cable should be located in the right-hand clip located beneath the ash tray.
3. Attach the wire loop end of the cable to the temperature cam assembly on top of the plenum. Make sure that the wire loop coil is up and that the cable is routed under the cable hold-down on cam assembly.
4. Install the cable into the square retaining hole in the heater core cover.
5. Attach the temperature control cable to the temperature control lever.
6. Position the control assembly close to the opening in the instrument panel. Working through this opening, route the cable so that it will not have kinks or sharp bends anywhere along its course between the control assembly and the cam on the plenum.
7. Actuate the temperature control lever and check for proper cable adjustment. Adjust as necessary.
8. Connect wire and vacuum harness to control assembly and plenum.
9. Install the control assembly in the instrument panel using four attaching screws.
10. Check system for proper operation.
11. Complete installation of the control assembly, trim strips and glove compartment.

REMOVAL AND INSTALLATION (Continued)**Temperature Control Cable Installation**

CCL 4194-B

Temperature Control Cam**Removal and Installation**

1. Disengage glove compartment door by squeezing the sides at the door stops. Swing the door down and remove it from its hinges.
2. Remove the two screws which attach the RABS module.
3. Remove the temperature control cable from the heater core cover as described in this section.
4. Working through glove compartment opening, remove temperature control cam retaining screw and lift cam away from plenum.
5. Move cam as necessary, to disconnect the temperature control cable and remove cam from the vehicle.

For installation, follow removal steps in reverse order. Check system operation. Adjust temperature control cable as necessary.

Instrument Panel

Procedures for removal and installation of the instrument panel are covered in Section 01-12A.

Defroster Duct and Ventilation Ducts

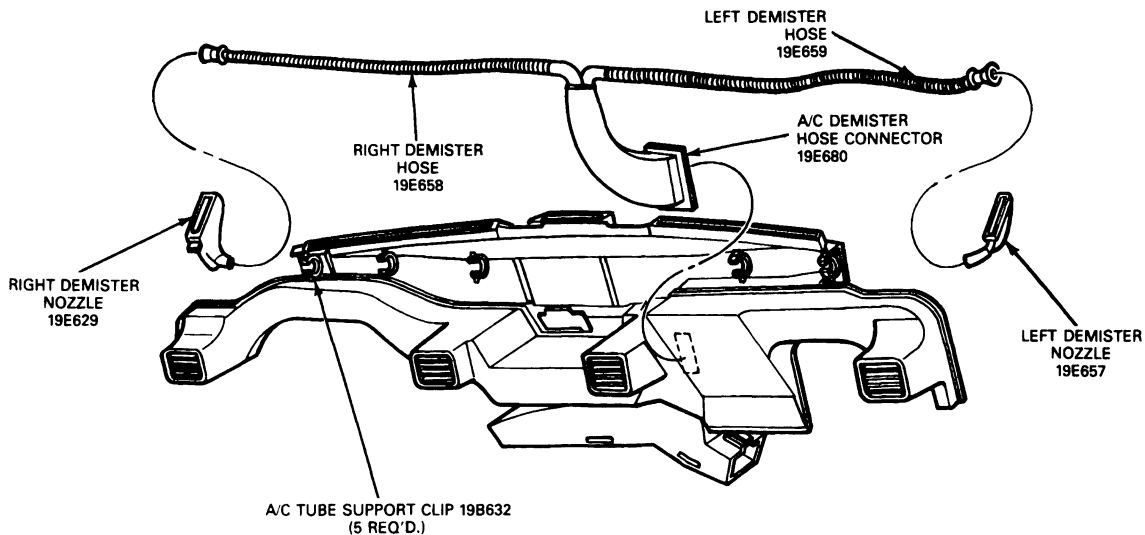
The defroster duct and ventilation ducts are a two-piece, adhesively bonded assembly which attaches to the instrument panel with screws.

Demister Hoses and Nozzles**Removal and Installation**

1. Remove instrument panel as described in Section 01-12A.
2. Remove two nuts which attach the right demister nozzle and one nut plus one spring nut which attach the left demister nozzle to the instrument panel.

REMOVAL AND INSTALLATION (Continued)

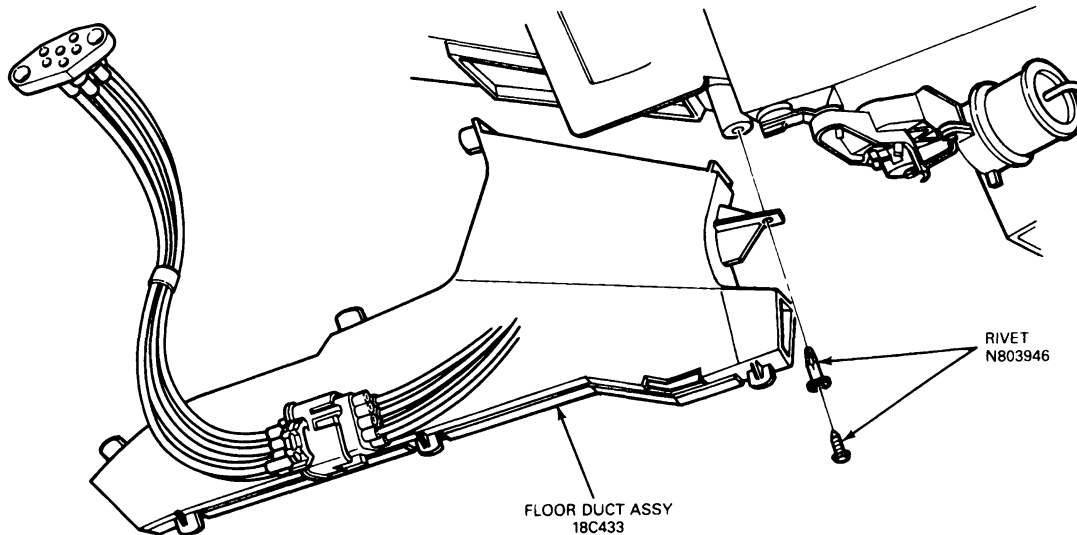
3. Remove three push-screws which attach the demister hose connector to the structural duct assembly. Disconnect the flexible hoses which slide over the input end of each nozzle.
4. To install the nozzles, hoses, and / or connector, install two attaching nuts to the right nozzle and one nut to the left nozzle.
5. Attach three push-screws through the demister hose connector and into the structural duct.
6. Slide the demister hoses which were removed over their attaching locations.
7. Install the instrument panel as described in Section 01-12A.

Demister Hoses and Nozzles

CCL 4199-A

Floor Duct**Removal and Installation**

1. Remove the vacuum harness from the forward slot on the bottom edge of the floor duct.
2. Remove the plastic attaching screw from the bottom side of the plenum.
3. Remove the push nut sleeve from the attaching hole.
4. Disengage the floor duct from the plenum.
5. To install, position the duct on the plenum and engage the lugs inside the duct with their mating slots in the plenum. Tilt the duct into place, then push in to secure engagement.
6. Start the plastic screw into the push nut sleeve. Then, install through the floor duct flange and into the attaching hole in the plenum. Be sure that the attachment is secure.
7. Clip the vacuum harness to the floor duct.

REMOVAL AND INSTALLATION (Continued)**Floor Duct Installation**

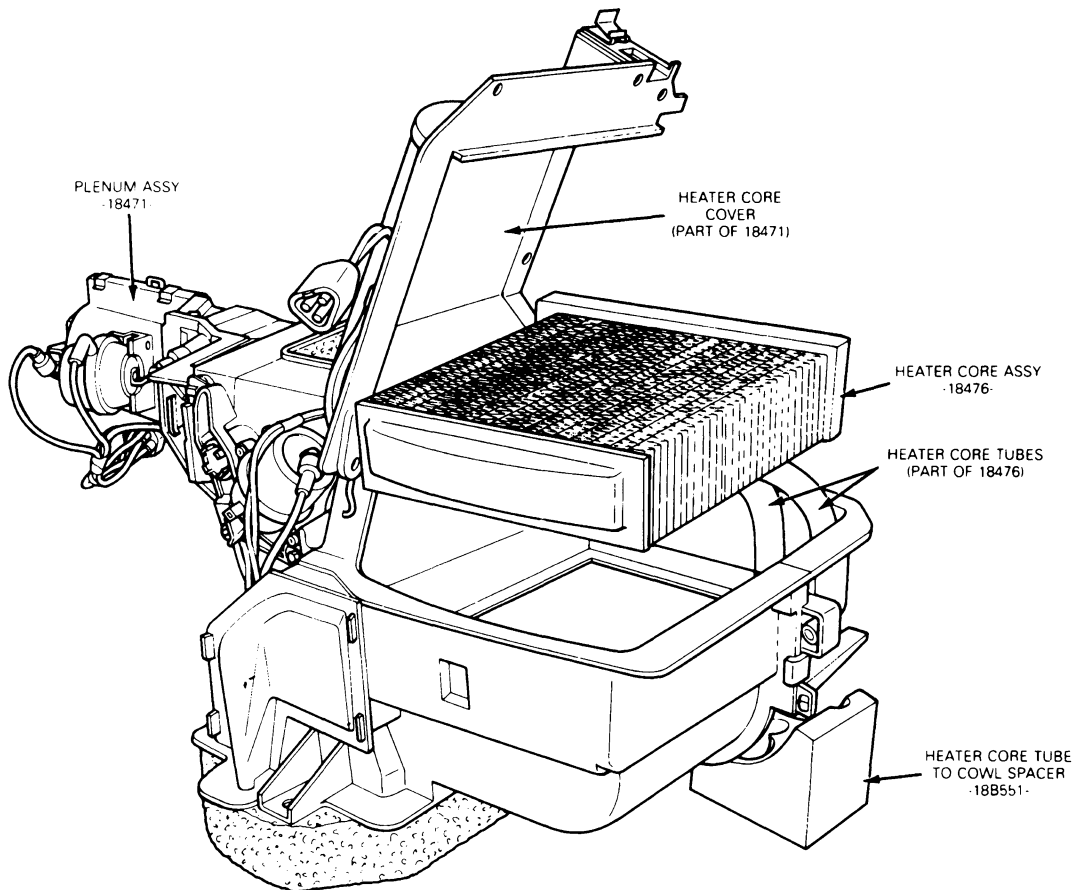
CCL 4200-A

Heater Core**Removal**

1. Allow the engine to cool. Observe the safety precautions outlined in the Powertrain / Drivetrain Manual, Section 03-03; then, proceed as follows:
 - Place a thick cloth over the radiator cap.
 - Turn the cap slowly to its first stop to release system pressure.
 - When the pressure has been released, tighten the radiator cap.
2. Disconnect the heater hoses from the heater core tubes. Plug the hoses.
3. Remove the glove compartment.
4. From inside the passenger compartment, remove the seven screws which attach the heater core access cover to the plenum.
5. Disconnect the vacuum source. Leave the vacuum harness attached to the cover. Remove the cover.
6. Remove the heater core from the plenum.

Installation

1. Position the heater core and seal in the plenum assembly.
2. Install the heater core access cover on the plenum assembly and secure it with its seven attaching screws. Make sure the vacuum harness is not trapped or pinched during the cover installation.
3. Connect the vacuum harness to its source connection.
4. Install heater hoses on the heater core tubes at dash panel in engine compartment. Do not over-tighten the hose clamps.
5. Check coolant level and add coolant as required. Refer to the Powertrain / Drivetrain Manual, Section 03-03.
6. Check system for proper operation and coolant leaks.
7. Install glove compartment.

REMOVAL AND INSTALLATION (Continued)**Heater Core Installation**

CCL 3151-A

Register Ducts**Removal**

1. Disconnect ground cable from battery negative terminal.
2. Remove instrument panel as outlined in Section 01-12A.
3. Rotate instrument panel rearward as far as necessary to permit removal of register ducts from panel.
4. Remove defroster nozzle as described in this section.
5. Remove register duct attaching screws. Remove the duct.

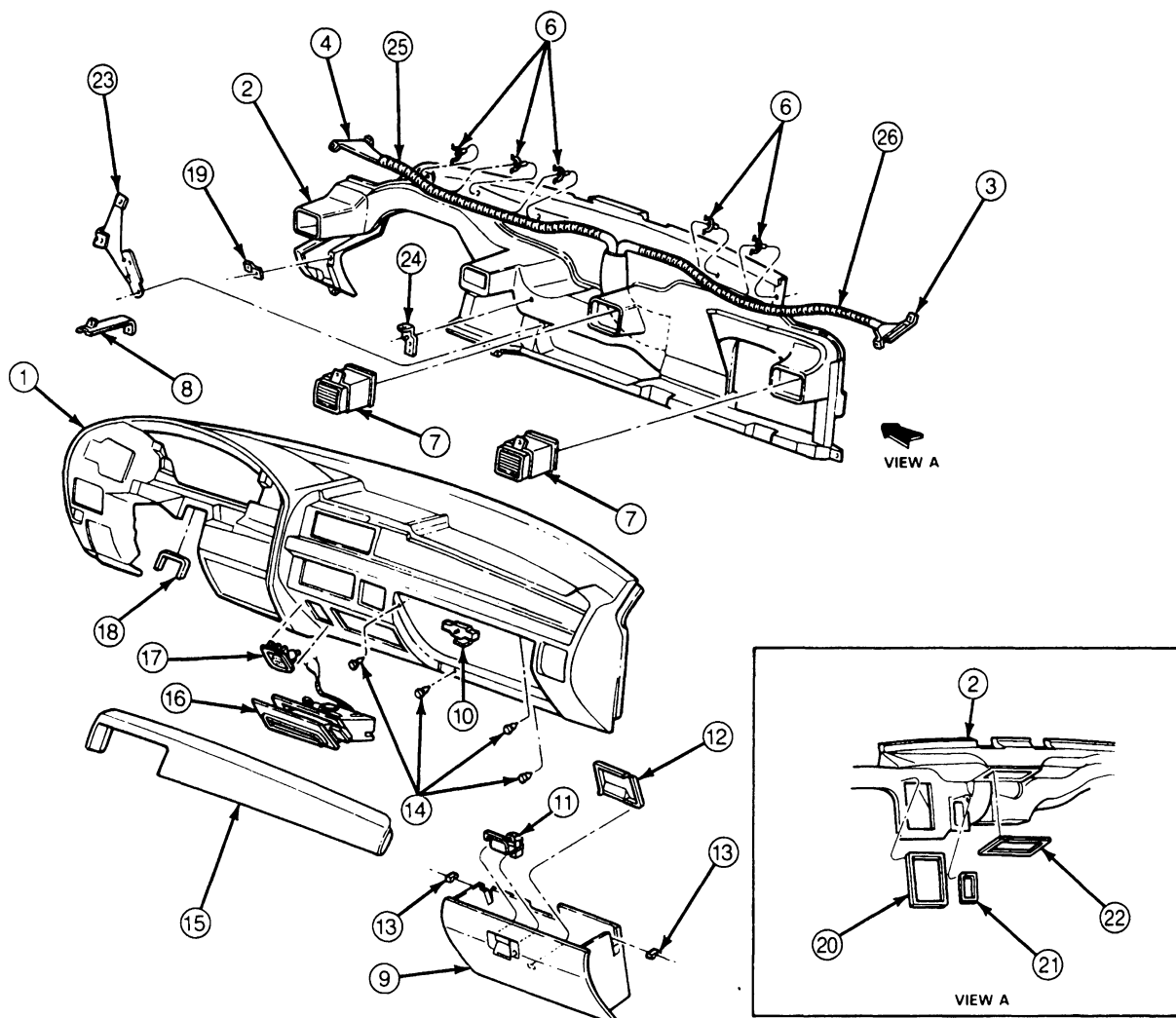
Installation

1. Position register ducts in instrument panel and install the attaching screws.
2. Install defroster nozzle.
3. Rotate instrument panel forward and install as outlined.
4. Connect battery ground cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

REMOVAL AND INSTALLATION (Continued)

Duct and Support Assembly Installation



ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1.	1504326	PANEL-INSTRUMENT	16.	1504810	RECEPTACLE ASSY.-
2.	19E726	DUCT & SUPPORT ASSY.	17.	19N236	INSTRUMENT PANEL ASH
3.	19E656	DUCT-DEMISTER — RH	18.	1501657	SOCKET ASSY.-AUXILIARY
4.	19E657	DUCT-DEMISTER — LH	19.	14W163	BLOWER
5.	19E680	CONNECTOR	20.	19C901	INSULATOR-STEERING COLUMN
6.	198632	CLIP-A/C TUBE SUPPORT	21.	19C901	OPENING
7.	19C639	REGISTER ASSY.-A/C	22.	18C367	BRACKET-FUSE BLOCK
8.	15044F80	BRACKET ASSY.-INSTRUMENT	23.	15047A30	SEAL-A/C
9.	1506024	PANEL RADIO MOUNTING	24.	10D876	SEAL-DEMISTER
10.	15A563	COMPARTMENT ASSY.-GLOVE	25.	19E659	SEAL-DEFROSTER NOZZLE
11.	6106004	LAMP & CATCH ASSY.-GLOVE	26.	19E658	BRACKET-INSTRUMENT PANEL-
12.	15061A40	COMPARTMENT	27.	—	CENTER
13.	7006115	LATCH ASSY.-GLOVE			BRACKET-SEAT BELT W/BUZZER/
14.	N804A28-S	COMPARTMENT DOOR			CHIME
15.	1504282	COVER-GLOVE COMPARTMENT			HOSE-A/C SIDE WINDOW
		DOOR LATCH			DEMISTER (RH)
		BUMPERS-GLOVE			HOSE-A/C SIDE WINDOW
		COMPARTMENT			DEMISTER (LH)
		BUMPERS-GLOVE			DEMISTER HOSE CONNECTOR
		COMPARTMENT			
		PAD & RETAINER ASSY.-			
		INSTRUMENT PANEL			

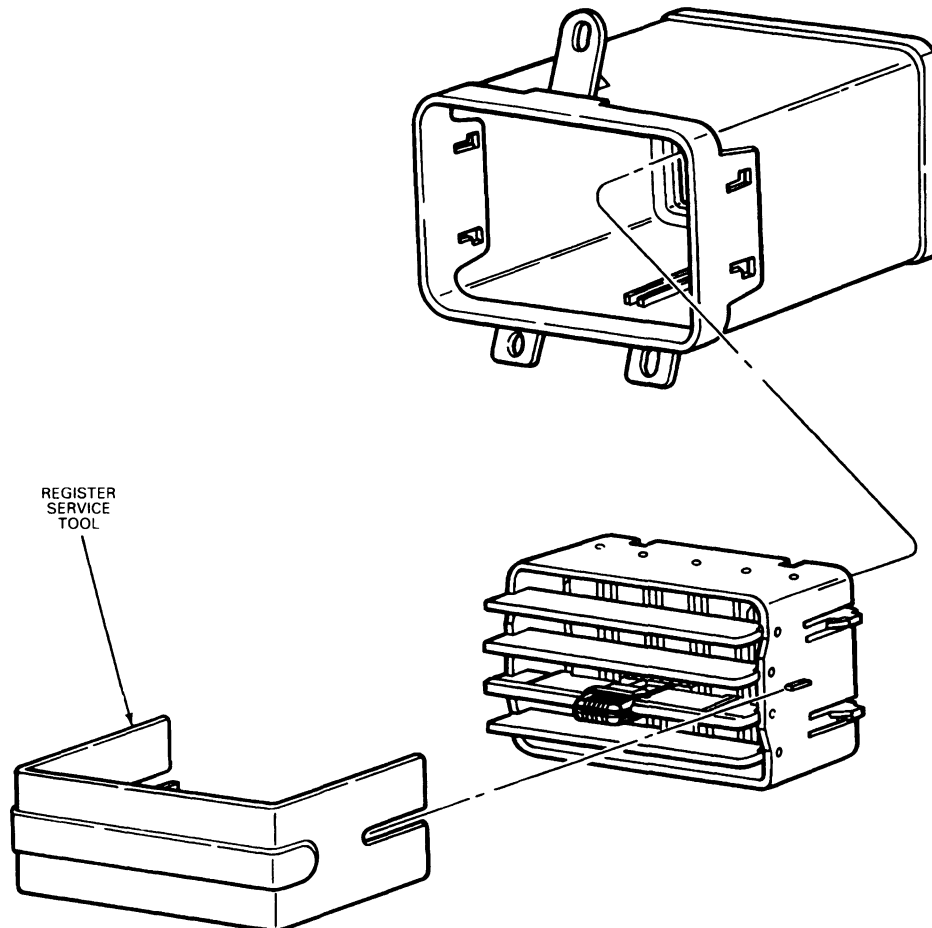
CCL 4186A

REMOVAL AND INSTALLATION (Continued)**Register and Louver Assembly****Removal and Installation**

There are four register and louver assemblies in the instrument panel. Two are located in the instrument panel in the areas near the upper corners of the glove compartment door; the other two are located near the right and left edges of the instrument cluster.

The louvers in each of these registers are similar with a single adjusting knob provided to move the vertical vanes from side to side and the horizontal vanes up and down. The primary difference between the two types of register assemblies is length and mounting tabs. The registers in the instrument cluster have four mounting lugs and are shorter front-to-rear than those in the right-hand portion of the instrument panel which have three mounting lugs.

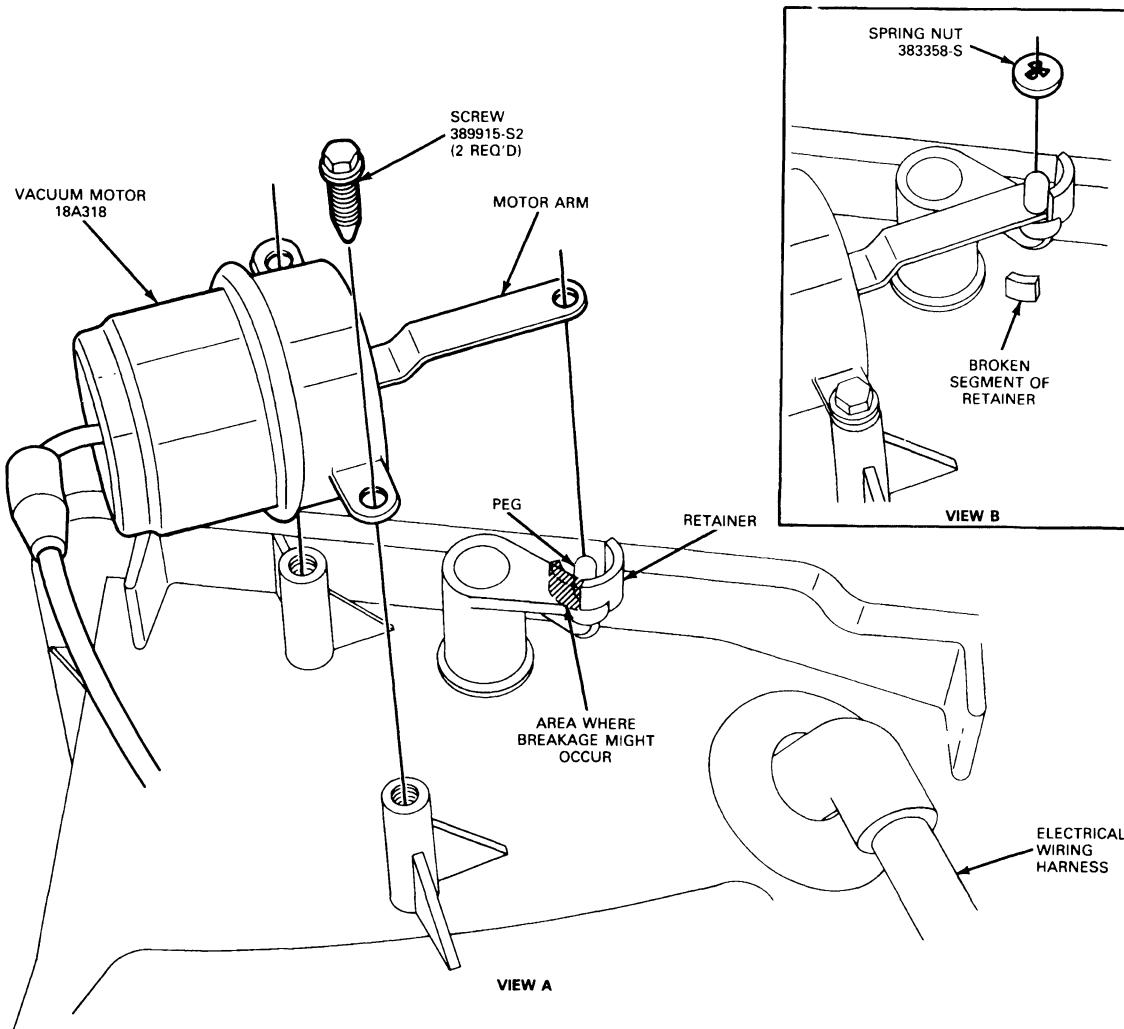
The louvers in each register can be removed from the register with Remover Tool D921-19703-A or equivalent. The illustration shows how this tool is to be inserted between the outer surface of the louver assembly and the inner surface of the register. The tool, when pushed forward, will depress the louver retainers and allow removal of the tool and louver as a unit.

Removal of Louver from Instrument Panel Register Assembly

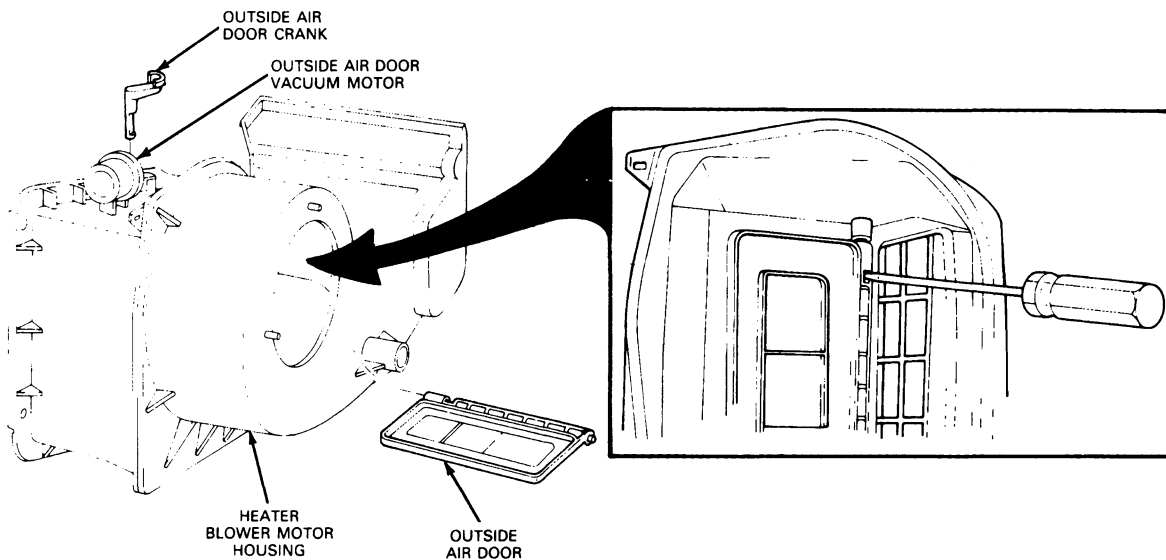
CCL 4407-A

REMOVAL AND INSTALLATION (Continued)**Outside Air / Recirculated Air Door, Vacuum Motor or Door Crank****Removal**

1. Disconnect the blower motor connector and remove the blower motor as described in this section.
2. If only the vacuum motor is to be removed, disconnect the two screws which attach the motor to the upper surface of the outside door duct.
3. Pry the motor and arm assembly upward at the arm end to free it from its mounting peg. A retaining flange which is an integral part of the crank, peg, and flange component may partially obstruct the motor arm in its upward movement along the peg. If this retaining flange should break off when forcing the motor arm upward, a 3 / 16-inch spring nut (Part No. 383358-S) must be used to retain the motor arm when the same or replacement motor is installed. The illustration shows removal in View A and the area in which retainer flange breakage might occur in View B.
4. Look through blower motor opening in the case and use a screwdriver to depress the snap-on door crank while pulling up on door shaft to release the crank from the door.
5. Remove the door through the blower motor opening.

Outside Air / Recirculated Air Door Vacuum Motor Installation

CCL2716-A

REMOVAL AND INSTALLATION (Continued)**Outside Air Door and Crank Removal**

CCL2728-A

Installation

1. Insert the door through the blower motor opening. Seat the bottom door pivot first, then swing the top door pivot into place.
2. Hold the door in the full outside air position (swing to full in-board position) and snap in crank.
3. Align the hole in the vacuum motor arm with peg in the door crank.
4. Slide the arm downward over the peg and along the inner surface of the retaining flange with the arm seats the base of the flange surface, and install motor retaining screws.

NOTE: If the flange has been broken off install the spring nut as described in Step 3 of the removal procedure.

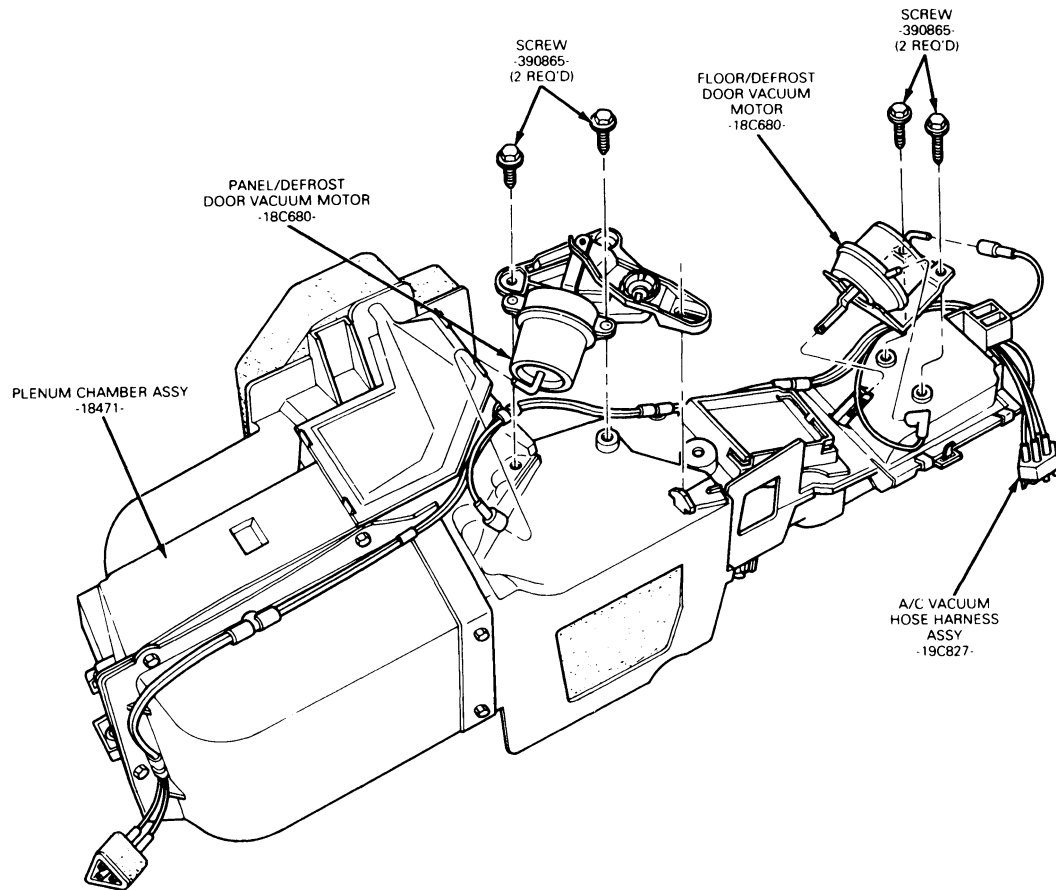
5. Install blower motor in the housing and connect the blower motor electrical harness as described in this section.

Plenum Doors**Removal and Installation**

The damper doors inside the plenum assembly cannot be replaced. As a result, if there is a damaged MIX or PANEL / DEFROST door, the plenum, including these doors, must be replaced. The plenum must also be replaced if there is damage to the case mounting studs which cannot be repaired.

Plenum Door Vacuum Motors**Removal and Installation**

The vacuum motors for the PANEL / DEFROST and MIX damper doors are attached to the underside of the plenum assembly. The illustration shows these motors disassembled from the plenum.

REMOVAL AND INSTALLATION (Continued)**Plenum Door Vacuum Motors**

CCL 3150-A

Panel/Defrost Door Vacuum Motor**Removal and Installation**

1. Remove the vacuum hose from the vacuum motor.
2. Remove the two screws which attach the motor and bracket assembly to the plenum.
3. Rotate the assembly so that the slot in the bracket is parallel with the tee-shaped end of the door crank arm. Pull the motor and bracket assembly off the crank arm.

For installation, follow removal steps in reverse order. Verify that the system functions properly.

3. Remove the two screws which secure the motor and bracket assembly to the plenum.
4. Using a small screwdriver, depress the tang on the side of the door operating lever and pull the motor arm out of the lever.

For installation, follow removal steps in reverse order, sliding motor arm into door lever until locking tang engages. Verify that the system functions properly.

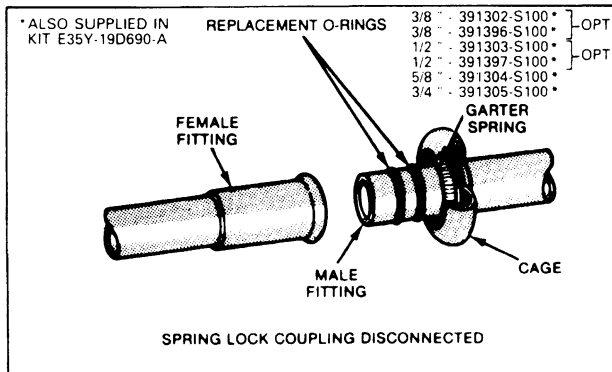
Mix Door Motor**Removal and Installation**

1. Remove the floor duct as described in this section.
2. Disconnect the two vacuum hoses from the vacuum motor.

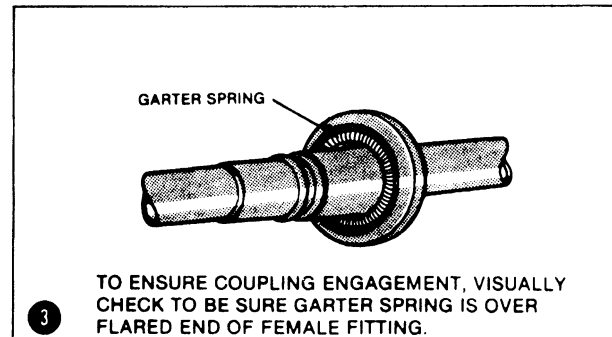
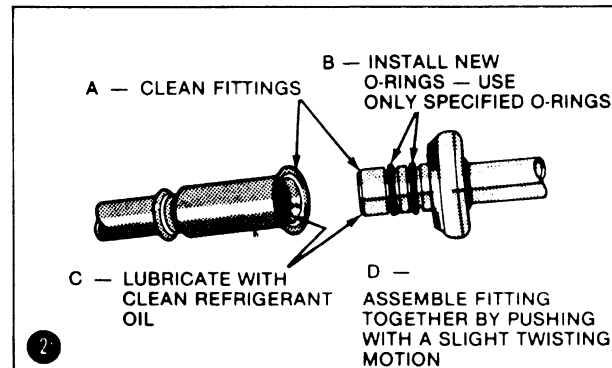
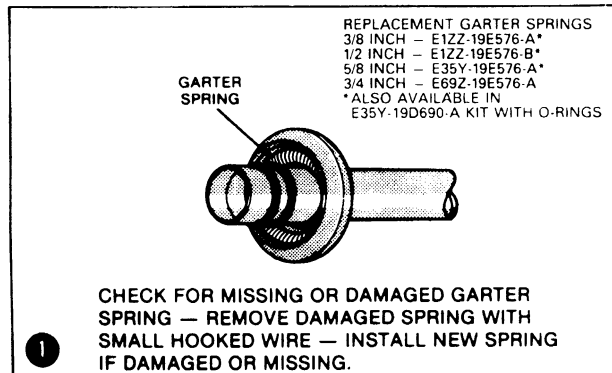
Evaporator Case**Removal**

1. Discharge refrigerant system following the recommended service procedures. Refer to Section 12-03. Observe all safety precautions.
2. Disconnect vacuum supply hose at dash panel. Position check valve away from evaporator case.
3. Disconnect liquid line from evaporator core using a spring lock coupling removal tool.

REMOVAL AND INSTALLATION (Continued)

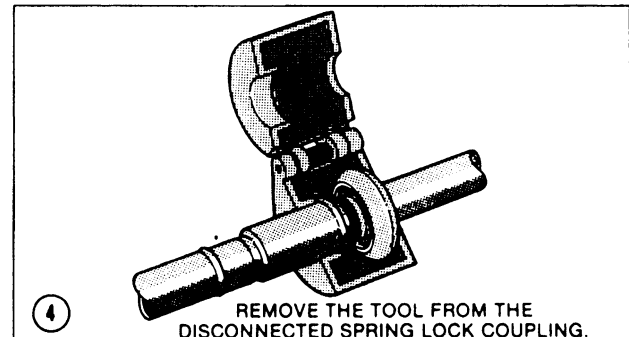
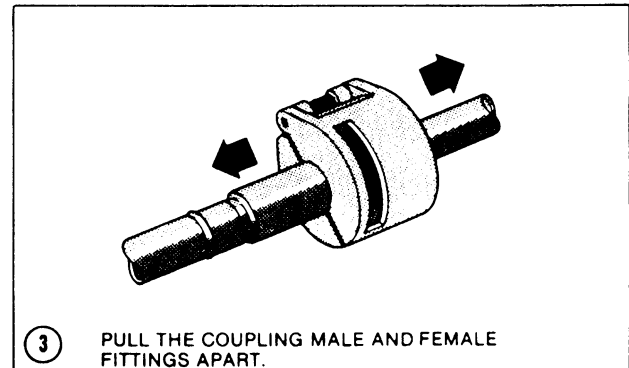
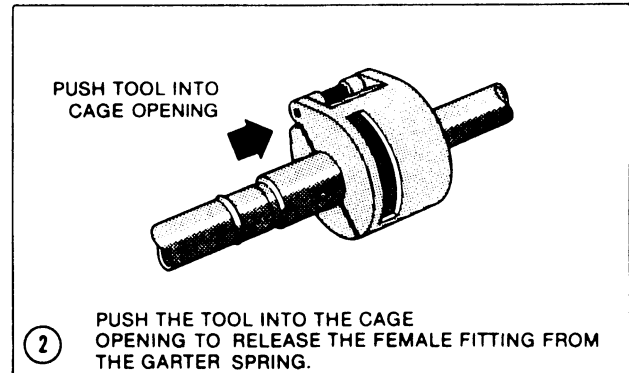
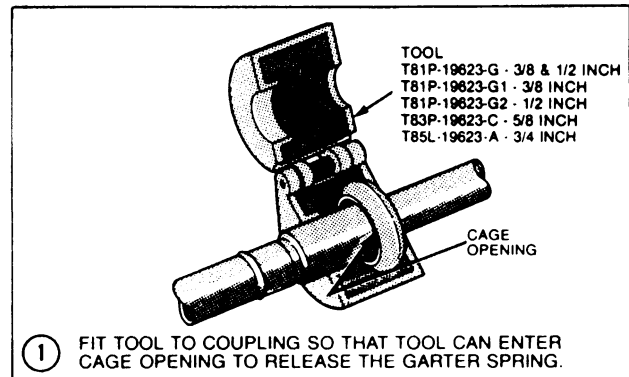


TO CONNECT COUPLING



TO DISCONNECT COUPLING

CAUTION — DISCHARGE SYSTEM BEFORE DISCONNECTING COUPLING



CCL 4011-C

REMOVAL AND INSTALLATION (Continued)

4.

Disconnect suction line from accumulator. Cap all open refrigerant lines to prevent entrance of dirt and moisture.
5.

Disconnect heater hoses from heater core and plug hoses with suitable 15.87mm (5 / 8-inch) plugs.
6.

Working in passenger compartment, remove two screws or nuts attaching bottom of evaporator case to dash panel. One screw also attaches lower edge of plenum to dash panel.
7.

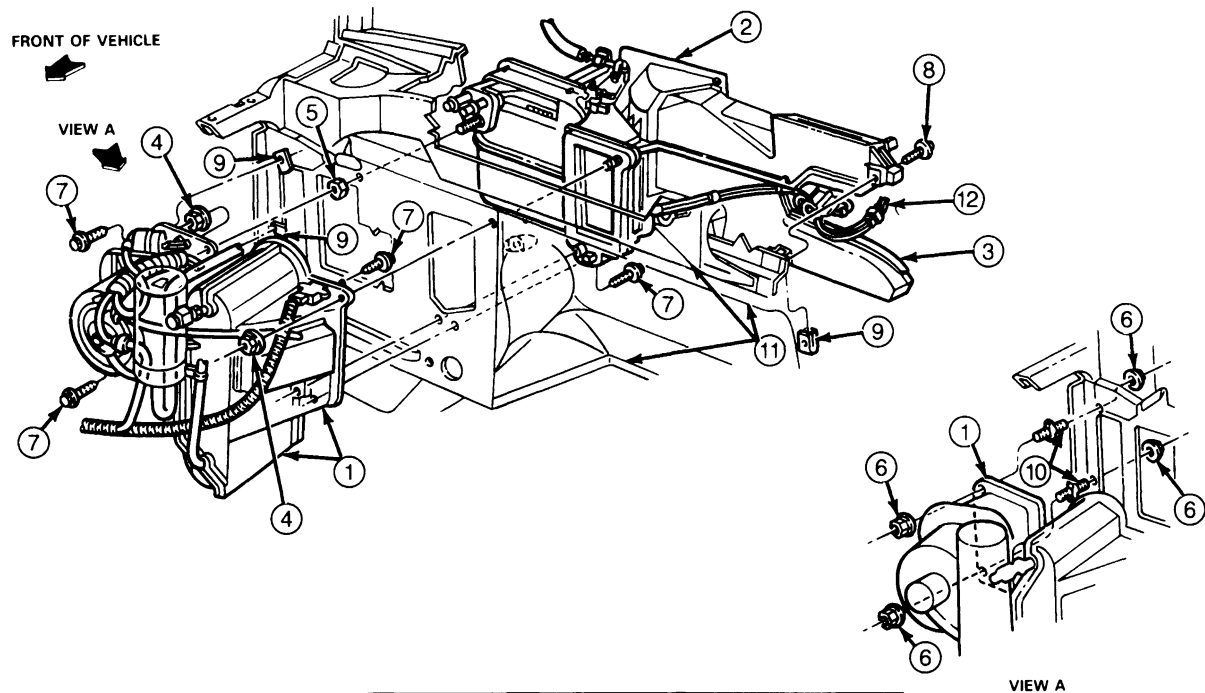
Unplug vacuum harness and two wiring connectors to wiring assembly (14401) located near right end of plenum harness coming from recirc duct opening back into opening.
8.

Remove two screws attaching right side of recirc duct to dash panel.
9.

Remove two retaining nuts attaching evaporator case and recirc duct to dash panel.
10.

Pull evaporator case and recirc duct forward and remove it from vehicle.

Evaporator Assembly and Plenum Chamber Removal



ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1	19850	EVAPORATOR ASSY.	7	56956-S2 (4 REQ'D.)	HEX SCREW & WASHER ASSY.
2	18471	PLENUM CHAMBER ASSY.	8	J6950-S2 or 56952-S2	HEX SCREW/WASHER HEAD
3	18C433	FLOOR DUCT ASSY.	9	45261-S2 (3 REQ'D.)	J-NUT
4	N621906-S2	NUT (2 REQ'D.)	10	N803912-S2	STUD
5	801696-S2	NUT	11	REF.	PART OF DASH PANEL ASSY.
6	PLANT OPTION (AS REQ'D.)		12	REF. P.I.A. 19980 CONTROL ASSY.	VACUUM HOSE
	621906 (4 REQ'D.)	NUT			

*PIA — PURCHASED IN ASSEMBLY

CCL 4214-A

Installation

1.

Position recirc duct and evaporator case to dash panel. Install two retaining nuts along top edge of assembly.
2.

Install two screws along right side of recirc duct.
3.

Working in passenger compartment, install top screws to attach bottom of evaporator case to dash panel.
4.

Connect vacuum harness from recirc duct opening to the dash panel.
5.

Using a new O-ring lubricated with clean refrigerant oil, connect liquid line to evaporator core. Tighten connection to 2 1-27 N·m (15-20 ft·lb) using two wrenches.

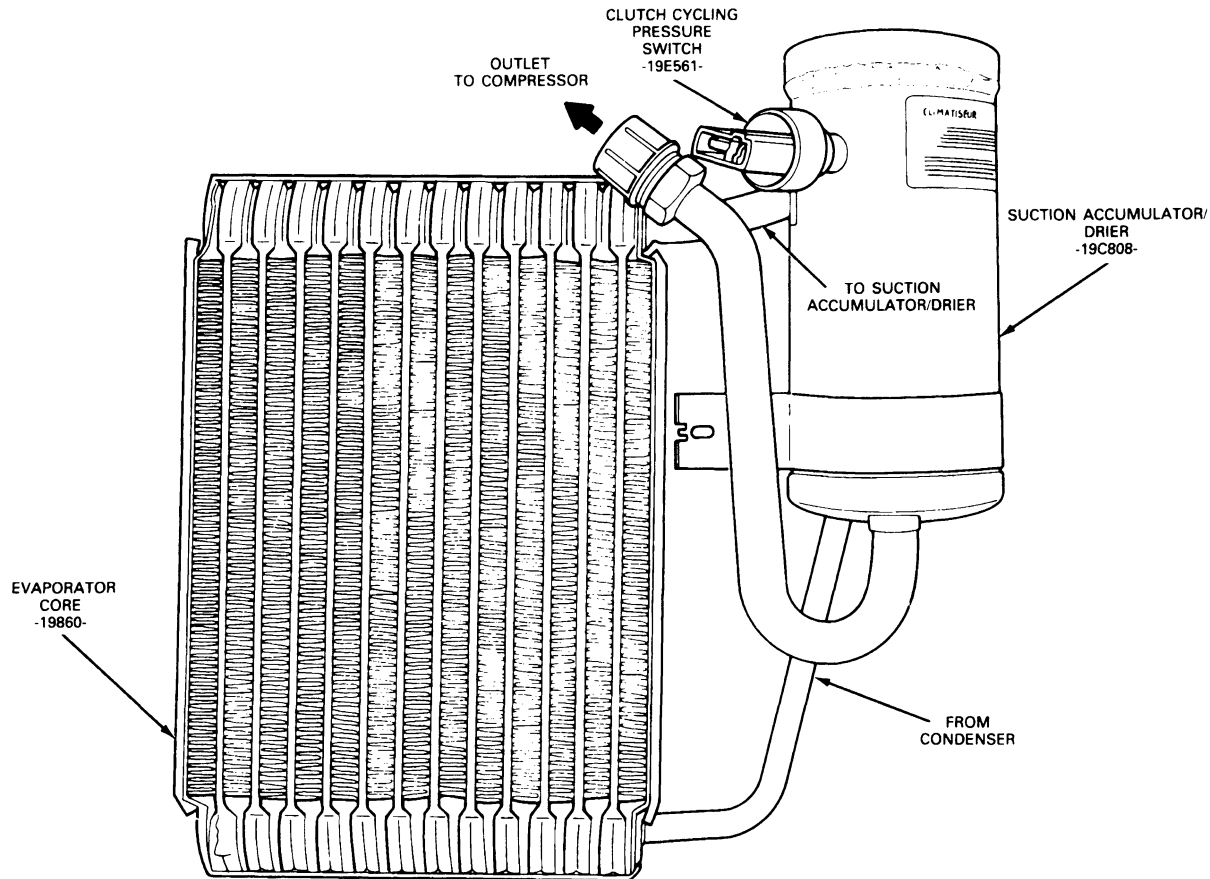
REMOVAL AND INSTALLATION (Continued)

6. Using a new O-ring lubricated with clean refrigerant oil, connect suction line to accumulator. Tighten connection to 34-44 N·m (25-32 ft-lb) using two wrenches.
7. Connect heater hoses to heater core. Tighten clamps only to 1.4-2.0 N·m (12-18 in-lb).
8. Connect vacuum harness and two wiring connectors to wiring assembly (14401) under instrument panel.
9. Fill and bleed cooling system. Refer to the Powertrain / Drivetrain Manual, Section 03-03.
10. Leak test, evacuate and charge system following recommended procedures. Refer to section 12-03. Observe all safety precautions.
11. Check system for proper operation.
12. Refer to Section 12-03 for Evaporator Leak Test.

Evaporator Core**Removal**

1. Discharge refrigerant system following recommended service procedures. Observe all safety precautions. Refer to Section 12-03.

2. Disconnect electrical connector from pressure switch on side of suction accumulator.
3. Remove pressure switch from accumulator.
4. Disconnect suction hose from suction accumulator. Use a backup wrench to loosen fitting. Cap suction hose to prevent entry of dirt and excess moisture.
5. Using a spring lock coupling tool, disconnect liquid line from evaporator core. Cap liquid line to prevent entry of dirt and excess moisture.
6. Remove one nut retaining MAP sensor bracket to the upper left corner of evaporator case.
7. Remove spring clip holding MAP sensor to housing (on all gas engines). Put MAP sensor aside.
8. Remove one nut retaining upper left corner of evaporator case to dash panel.
9. Remove six screws attaching left evaporator cover to evaporator case.
10. Remove left evaporator cover from evaporator case.
11. Remove evaporator core and suction accumulator from evaporator case.

REMOVAL AND INSTALLATION (Continued)**Evaporator Core and Suction Accumulator / Drier**

CCL 3162-A

Installation

1. Transfer suction accumulator support straps and spring nuts to the replacement evaporator core.
2. Install evaporator core into evaporator case.
3. Position evaporator cover to evaporator case. Install six screws to attach cover to evaporator case along flange.
4. Install one nut to retain upper left corner of case to dash panel.
5. Install one spring clip to rib on evaporator case and push into position.
6. Install one nut to retain upper left corner of MAP sensor bracket to the upper left corner of evaporator case.
7. In passenger compartment, install one screw to attach lower edge of the plenum and bottom of the evaporator case to dash panel.
8. Remove cap from evaporator core liquid line connection and install a new fixed orifice tube in the evaporator core tube as outlined.
9. Using new O-ring lubricated with clean refrigerant oil, connect liquid line to evaporator core. Push spring lock coupling until it snaps secure. Pull back to make sure connection is completed.
10. Add 88.7ml (3 ounces) of clean refrigerant oil to a new suction accumulator to compensate for oil lost in evaporator core replacement.
11. Using a new O-ring lubricated with clean refrigerant oil, connect suction accumulator to evaporator core.
12. Install suction accumulator support straps (two screws). Tighten accumulator-to-evaporator core fitting to 21-27 N·m (15-20 ft·lb). Use a backup wrench on accumulator to prevent component damage.
13. Using a new O-ring lubricated with clean refrigerant oil, connect suction hose to suction accumulator. Use a backup wrench to prevent component damage.
14. Using a new O-ring lubricated with clean refrigerant oil, install pressure switch on suction accumulator nipple.

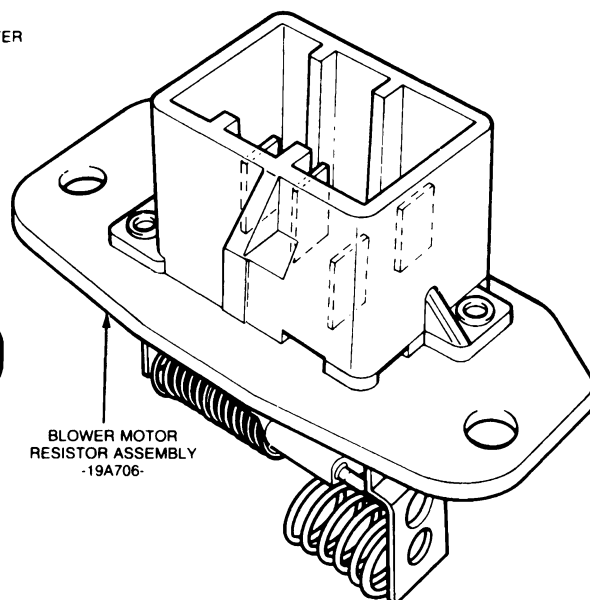
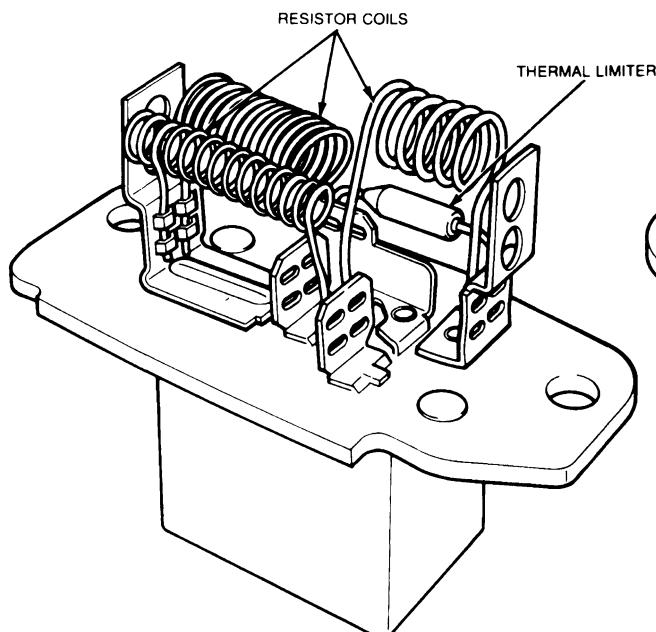
REMOVAL AND INSTALLATION (Continued)

15. Connect electrical connector to pressure switch.
16. Leak test, evacuate and charge system following recommended procedures. Refer to Section 12-03. Observe all safety precautions.
17. Check system for proper operation.

Blower Motor Resistor**Removal and Installation**

1. Disconnect wire connector from resistor assembly.
2. Remove two screws attaching resistor assembly to evaporator case and remove resistor.

3. To install, apply a bead of sealer D6AZ-19560-A or equivalent around the resistor mounting board.
4. Position resistor in opening in evaporator case, and install two attaching screws.
5. Connect wire connector to resistor assembly.
6. Check blower motor for proper operation in all blower speeds.

Blower Motor Resistor

CCL 2733-A

Blower Motor and/or Wheel**Removal**

1. Disconnect motor connector.
2. Disconnect blower motor air cooling tube from motor.
3. Remove four blower motor mounting plate attaching screws and remove motor and wheel assembly from blower housing.
4. Remove hub clamp spring from blower wheel hub and remove blower wheel from motor shaft.

Installation

1. Position blower wheel on blower motor shaft. Then, install a new hub clamp spring on blower hub.
NOTE: The hub clamp spring (Part No. 384260-S32) is included with a new blower wheel, but not with blower motor.
2. Install a new motor mounting seal on blower motor flange.
3. Position blower motor and wheel assembly in blower housing and install four attaching screws.
4. Cement blower motor air tube on nipple of blower housing with Liquid Butyl Sealer C9AZ-19554-B or equivalent.

REMOVAL AND INSTALLATION (Continued)

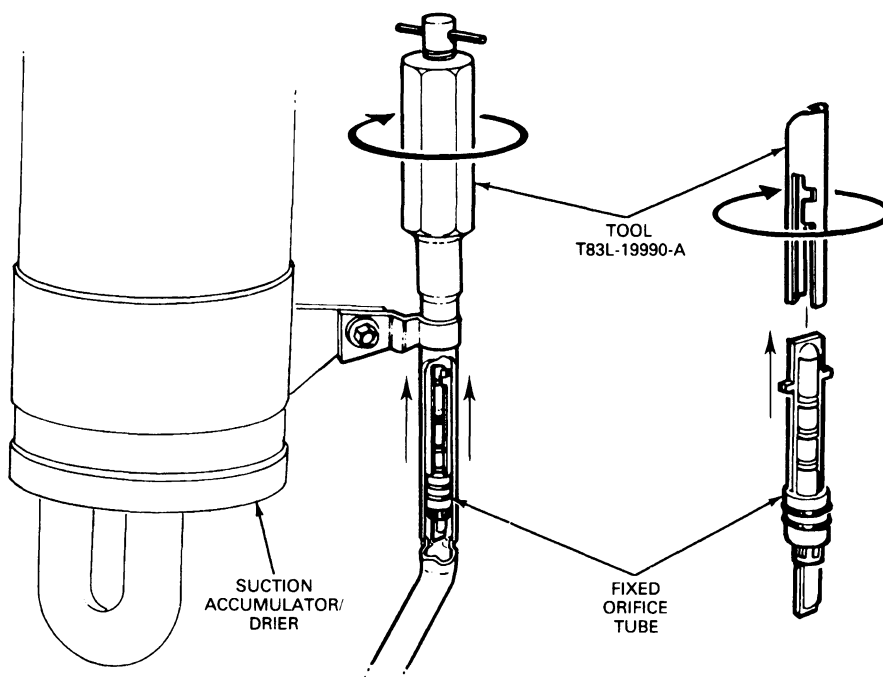
5. Connect blower motor connector.

6. Check blower motor for proper operation.

Fixed Orifice Tube

The fixed orifice tube is constructed with a plastic body, two screens and a small brass tube down the center of the orifice body. Two O-rings are around the orifice tube body to seal against leakage.

CAUTION: DO NOT attempt to remove the fixed orifice tube with pliers or to twist or rotate the orifice tube in the evaporator core tube. To do so will break the fixed orifice tube body in the evaporator core tube. USE ONLY the recommended tool following the recommended service procedures.

Fixed Orifice Tube Removal

CCL 2714-B

Removal

1. Discharge refrigerant from air conditioning system following recommended service procedures. Refer to Section 12-03. Observe all safety precautions.
2. Disconnect liquid line from evaporator core using specified spring lock coupling tool. Cap liquid line to prevent entrance of dirt and excessive moisture.

3. Pour a small amount of clean refrigerant oil into evaporator core inlet tube to lubricate tube and orifice O-rings during removal of fixed orifice tube from evaporator core tube.
4. Engage the Orifice Tube Remover and Installer T83L-19990-A (Motorcraft YT-1008) or equivalent with the two tangs on the fixed orifice tube.

CAUTION: Do not twist or rotate the fixed orifice tube in the evaporator core tube as it may break off in the evaporator core tube.

REMOVAL AND INSTALLATION (Continued)

5. Hold T-handle of Orifice Tube Remover and Installer T83L-19990-A (Motorcraft YT-1008) to keep it from turning and run nut on tool down against evaporator core tube until orifice is pulled from tube.
6. If fixed orifice tube breaks in evaporator core tube, it must be removed from tube with Broken Orifice Tube Extractor T83L-19990-B (Motorcraft YT-1009).
7. To remove a broken orifice tube, insert screw end of Broken Orifice Tube Extractor T83L-19990-B (Motorcraft YT-1009) into evaporator core tube. Thread screw end of tool into brass tube in center of fixed orifice tube. Pull fixed orifice tube from evaporator core tube.
8. If only brass center tube is removed during Step 7, insert screw end of the Broken Orifice Tube Extractor T83L-19990-B (Motorcraft YT-1009) into evaporator core tube and screw end of tool into fixed orifice tube body. Pull fixed orifice tube body from evaporator core tube.

Installation

1. Lubricate O-rings on fixed orifice tube body liberally with clean refrigerant oil.
2. Place fixed orifice tube in Orifice Tube Remover and Installer T83L-19990-A (Motorcraft YT-1008) and insert fixed orifice tube into evaporator core tube until orifice is seated at stop.
3. Remove Orifice Tube Remover and Installer T83L-19990-A from fixed orifice tube.
4. Using a new O-ring lubricated with clean refrigerant oil, connect liquid line to evaporator core tube. Push spring lock coupling until it snaps securely in place. Pull back to make sure connection is completed.
5. Leak test, evacuate and charge system following recommended service procedures. Refer to Section 12-03. Observe all safety precautions.
6. Check system for proper operation.

4. Disconnect suction hose from suction accumulator / drier. Use two wrenches to prevent component damage. Cap suction hose to prevent entrance of dirt and moisture.
5. Loosen fitting connecting suction accumulator / drier to evaporator core. Use two wrenches to prevent component damage.
6. Remove two screws attaching suction accumulator / drier strap to evaporator case and clip to evaporator core inlet tube.

Installation

1. Using a new O-ring lubricated with clean refrigerant oil, connect suction accumulator / drier to evaporator core tube. Tighten connection finger-tight.
2. Position strap on suction accumulator / drier to evaporator case and clip to evaporator core inlet tube. Align strap and clip with mounting bracket and install two attaching screws. Loosen connection of accumulator / drier to evaporator core if it is necessary to re-position accumulator / drier to install strap attaching screws.
3. Tighten suction accumulator / drier-to-evaporator core fitting to specification using two wrenches.
4. Using a new O-ring lubricated with clean refrigerant oil, connect suction hose to accumulator / drier. Use two wrenches and tighten connection to specification. Refer to Torque Chart at end of this section.
5. Install a new O-ring lubricated with clean refrigerant oil on pressure switch nipple of suction accumulator / drier. Install pressure switch. Tighten switch to 7-13 N·m (5-10 ft·lb) if switch has metal base and **hand tighten only** if switch has plastic base.
6. Connect electrical connector to pressure switch.
7. Leak test, evacuate and charge system following the recommended service procedures. Refer to Section 12-03. Observe all safety precautions.
8. Check system for proper operation.

Suction Accumulator / Drier**Removal**

1. Discharge refrigerant from air conditioning system following recommended service procedures. Refer to Section 12-03. Observe all safety precautions.
2. Disconnect electrical connector from pressure switch.
3. Remove pressure switch by unscrewing it from suction accumulator.

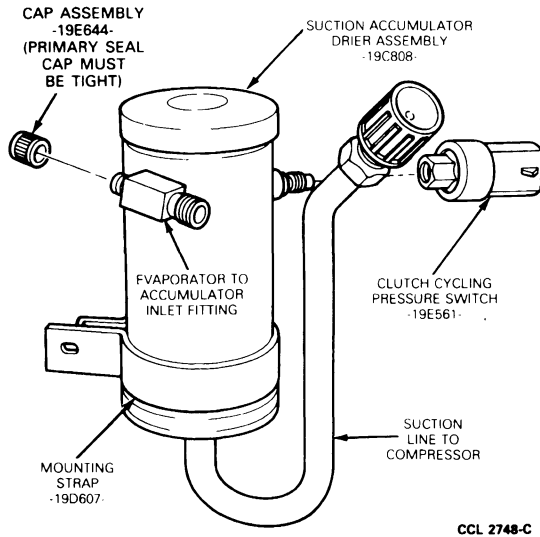
Clutch Cycling Pressure Switch**Removal and Installation**

1. Disconnect wire connector from pressure switch.
2. Unscrew pressure switch from suction accumulator.

NOTE: Do not vent refrigerant charge.

REMOVAL AND INSTALLATION (Continued)

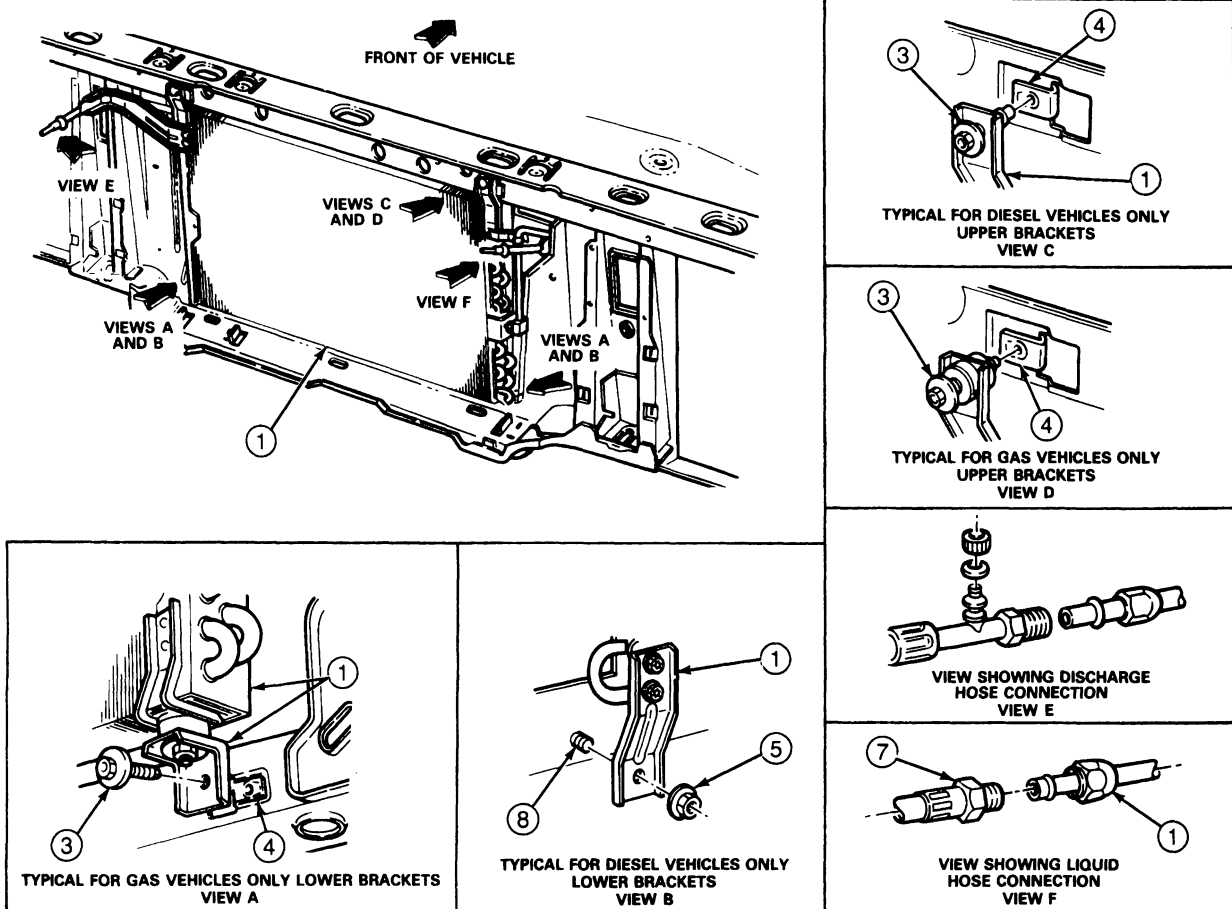
For installation, follow removal steps in reverse order. Use new O-ring lubricated with clean refrigerant oil and hand-tighten switch only. Check system for proper operation.

**Condenser****Removal**

1. Discharge refrigerant from system following recommended service procedures. Refer to Section 12-03. Observe all safety precautions.
2. Disconnect liquid line from condenser. Cap liquid line to prevent entrance of dirt and moisture.
3. Disconnect compressor discharge line from condenser. Cap discharge line to prevent entrance of dirt and moisture.
4. Partially drain radiator and disconnect upper hose from radiator.
5. Working under vehicle, remove two screws attaching two condenser lower mounting brackets to front radiator support.
6. Remove bolts from radiator upper retaining brackets.
7. Tilt top of radiator rearward and remove two screws attaching two condenser upper mounting brackets to rear side of radiator support.
8. Lift condenser from vehicle.

REMOVAL AND INSTALLATION (Continued)

Condenser Installation



ITEM	PART NUMBER	DESCRIPTION	ITEM	PART NUMBER	DESCRIPTION
1.	19710	CONDENSOR ASSY. (7.3L DIESEL)	5.	N620481-S2	NUT
2.	19710	CONDENSOR ASSY. (GAS)	6.	19972	HOSE ASSY. (7.3L DIESEL)
3.	19D702	CAP	7.	19N651	HOSE ASSY.
4.	N606691-S2	SCREW & WASHER ASSY.	10.	380976-S	O-RING
	N623333-S100	U-NUT	11.	19D734	MANIFOLD & TUBE ASSY. (GAS)

CCL 4203-A

Installation

1. Position condenser to vehicle with lower mounting brackets on front side of radiator support and upper brackets on rear side.
2. Install four screws attaching four mounting brackets to radiator support. Tighten screws to 13-18 N·m (10-14 ft-lb).
3. Move radiator into correct installed position and install bolts to upper retaining brackets.
4. Connect radiator upper hose to radiator and fill cooling system to specified level. Refer to the Powertrain / Drivetrain Manual, Section 03-03.

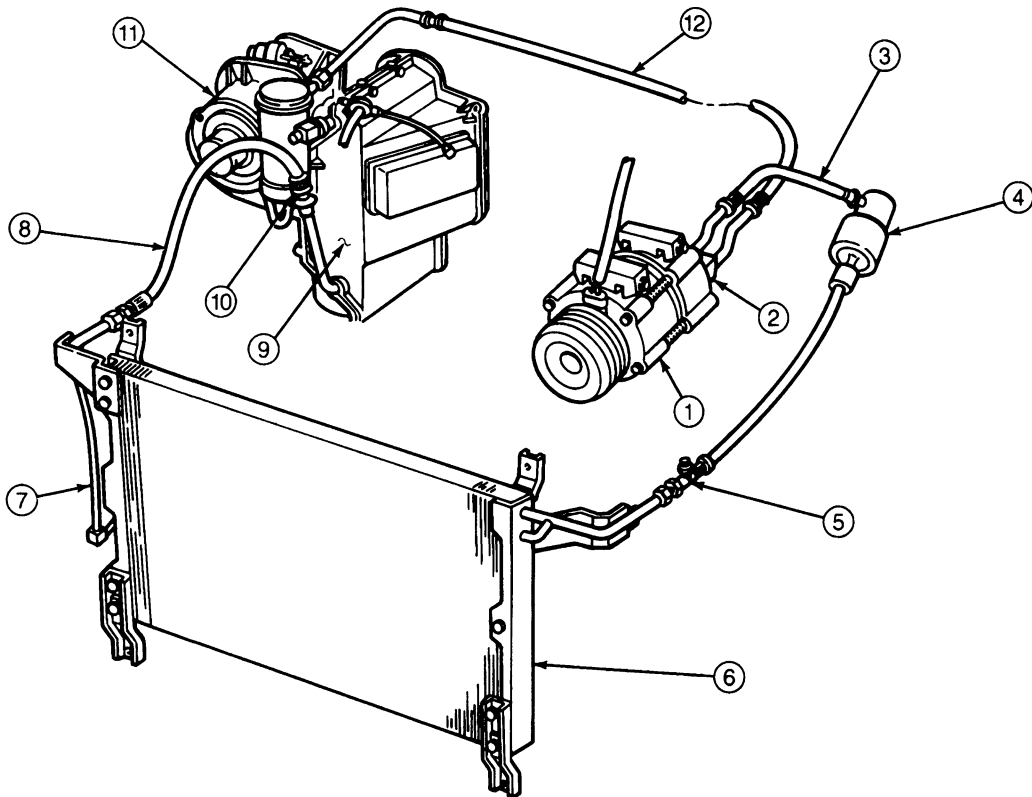
5. Using a new O-ring lubricated with clean refrigerant oil, connect compressor discharge line to condenser. Tighten connection to 21-27 N·m (15-20 ft-lb).
6. Connect liquid line to condenser using a new O-ring lubricated with clean refrigerant oil. Tighten connection to 21-27 N·m (15-20 ft-lb).
7. Leak test, evacuate and charge system following recommended service procedures. Refer to Section 12-03. Observe all safety precautions.
8. Check system for proper operation.
9. Refer to Condenser Leak Test in Section 12-03.

REMOVAL AND INSTALLATION (Continued)

Refrigerant Lines

The following illustration is a diagram of a typical refrigerant line installation.

Air Conditioning System



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	COMPRESSOR ASSEMBLY	7.	HIGH PRESSURE LIQUID LINE
2.	COMPRESSOR MANIFOLD	8.	LOW PRESSURE LIQUID LINE
3.	DISCHARGE LINE	9.	EVAPORATOR CASE ASSY.
4.	MUFFLER ASSY.	10.	SUCTION ACCUMULATOR DRIER
5.	HIGH PRESSURE SERVICE VALVE	11.	BLOWER MOTOR
6.	CONDENSER ASSY.	12.	SUCTION LINE TO COMPRESSOR

CCL 4208-B

Heater Hoses

Refer to Section 12-02B for details regarding the servicing of heater hoses on F-150-250-350, F-Super Duty and Bronco vehicles.

1. Drain coolant from cooling system.
2. Loosen clamps and remove heater hose(s) from vehicle.
3. Cut a new length of heater hose to dimension of removed heater hose(s).

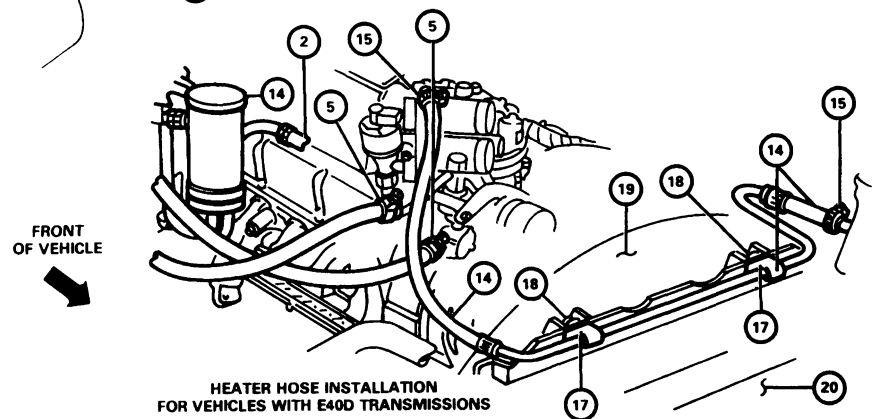
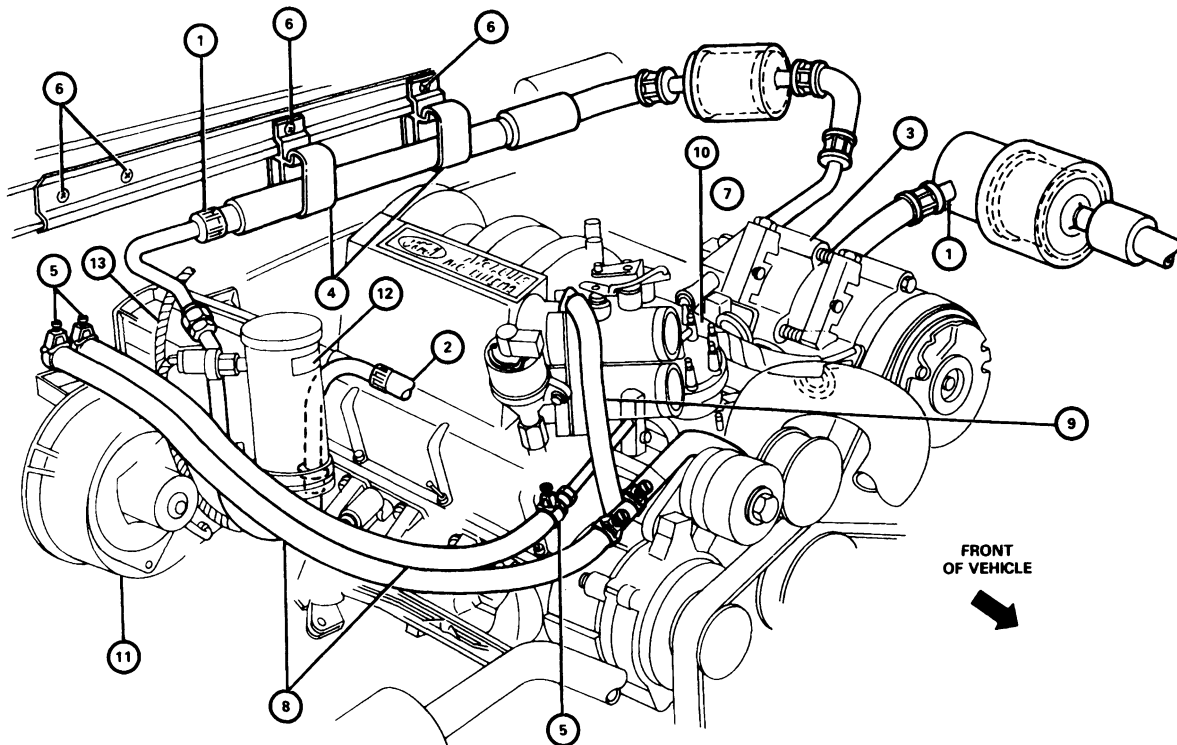
4. Route heater hose(s).
5. Connect heater hose to fittings and tighten clamps to 2-3 N·m (18-27 in·lb). DO NOT over-tighten hose clamps.
6. Fill and bleed cooling system. Refer to the Powertrain / Drivetrain Manual, Section 03-03.
7. Check for coolant leaks and for proper operation of system.

REMOVAL AND INSTALLATION (Continued)**A/C-Heater Tubes and Hoses****Removal and Installation**

1. Discharge refrigerant from system following recommended procedure. Refer to Section 12-03. Observe all safety precautions.
2. Disconnect and remove refrigerant line using a wrench on each side of fitting.
3. If spring lock couplings are used, disconnect couplings as shown previously in this section. Use Spring Lock Coupling T81P-19623-G, -G2 and/or T83P-19623-C to disconnect the 12.7mm (1/2-inch) and the 15.87mm (5/8-inch) coupling.
4. Route new refrigerant line (with protective caps installed).
5. Connect refrigerant line into system using new O-rings lubricated with clean refrigerant oil. Tighten connections to 9 N·m (7 ft-lb) (self-sealing coupling) and 21-27 N·m (15-20 ft-lb) (non self-sealing coupling), using a backup wrench to prevent component damage.
6. Connect spring lock couplings as shown previously. Use only specified O-rings.
7. Leak test, evacuate and charge refrigerant system following recommended procedures and safety precautions. Refer to Section 12-03. Then, check system for proper operation.

REMOVAL AND INSTALLATION (Continued)

Refrigerant and Heater Line Routing, 5.0L (302 CID) MFI Engine



ITEM DESCRIPTION

1. MANIFOLD & TUBE ASSY
2. LIQUID LINE - 19N651
3. COMPRESSOR & CLUTCH ASSY - 19D629
4. CLIP - 19N704 (2 REQ'D)
5. CLAMP - 390761-S100 OR 389628-S100 (4 REQ'D)
6. EXISTING SCREW
7. BOLT - N805334-S2 (1 REQ'D)
8. HOSE - 381260-S320A (2 REQ'D)
9. HEATED THROTTLE BODY SYSTEM
10. WIRING ASSY - 9D930
11. EVAPORATOR ASSY

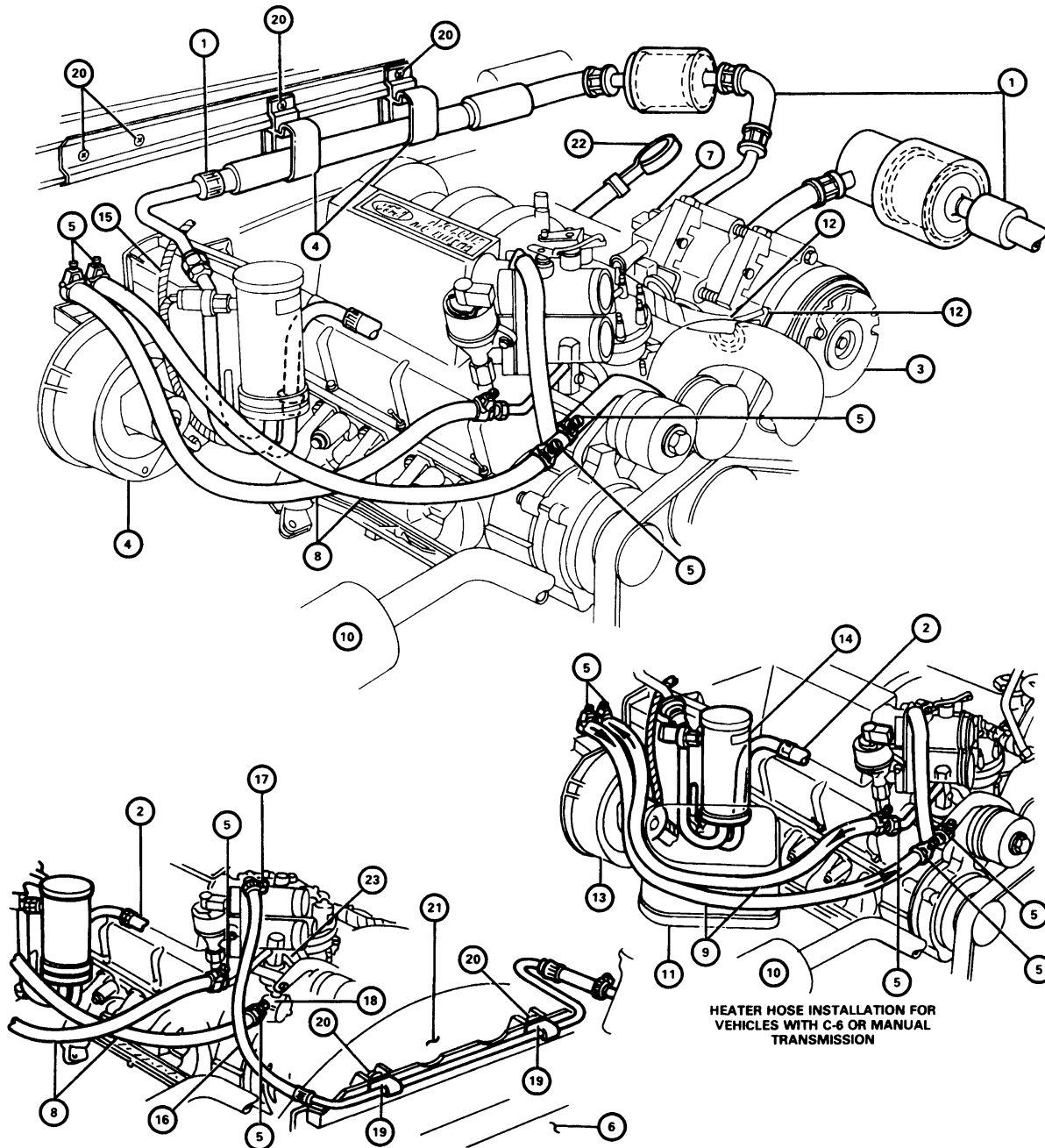
ITEM DESCRIPTION

12. TAG - A/C SERVICE INSTRUCTIONS
13. WIRING ASSY - 18A586
14. HOSE & TUBE ASSY - 8548
15. HOSE CLAMP - 376240-S100 (2 REQ'D)
16. CONNECTOR - 18A568
17. U-NUTS
18. EXISTING SCREW
19. FAN SHROUD
20. RADIATOR (REF.)

CCL 4103-B

REMOVAL AND INSTALLATION (Continued)

Refrigerant and Heater Line Routing, 5.8L (351 CID) MFI Engine



HEATER HOSE ASSY INSTALLATION FOR VEHICLES WITH E40D TRANSMISSION

HEATER HOSE INSTALLATION FOR
VEHICLES WITH C-6 OR MANUAL
TRANSMISSION

ITEM DESCRIPTION

1. MANIFOLD & TUBE ASSY - 19D734
2. LIQUID LINE
3. COMPRESSOR & CLUTCH ASSY - 19D629
4. CLIP - 19N704 (2 REQ'D)
5. CLAMP - 390761-S100 OR 389628-S100 (5 REQ'D)
6. RADIATOR (REF.)
7. BOLT - N805334-S2
8. HOSE - 381260S320A (2 REQ'D)
9. HOSE - 381260-S360A (2 REQ'D)
10. THERMACTOR SYSTEM
11. ENGINE VACUUM SUPPLY RESERVOIR

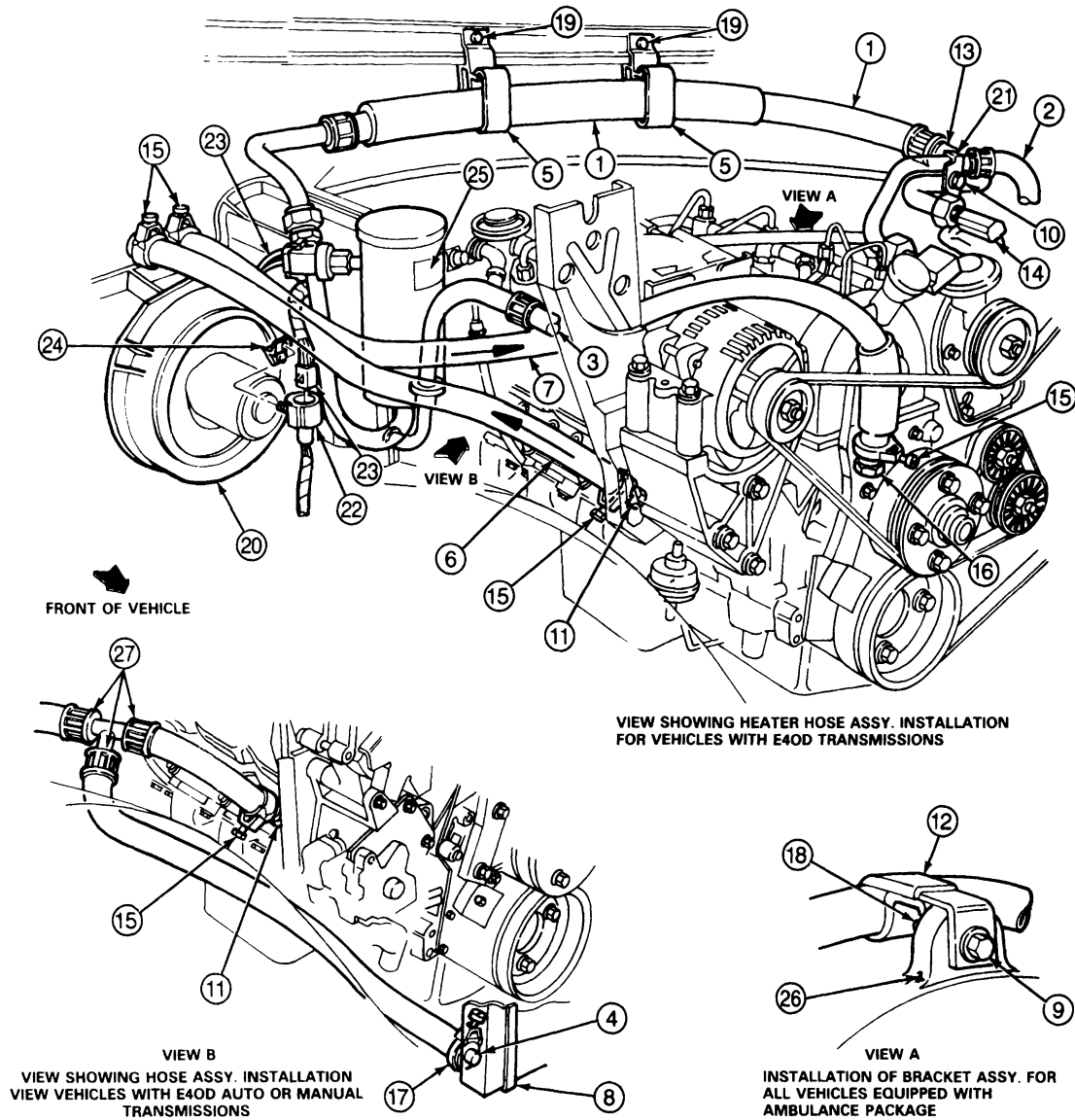
ITEM DESCRIPTION

12. WIRING ASSY - 9D930
13. EVAPORATOR ASSY
14. TAG - A/C SERVICE INSTRUCTIONS
15. WIRING
16. HOSE & TUBE ASSY - 8548
17. HOSE CLAMP - 376240-S100 (2 REQ'D)
18. CONNECTOR - 18A568
19. U-NUTS
20. EXISTING SCREW
21. FAN SHROUD
22. DIPSTICK
23. HEATED THROTTLE BODY SYSTEM

CCL 4104-A

REMOVAL AND INSTALLATION (Continued)

Refrigerant and Heater Line Routing, 7.3L (444 CID) Diesel Engine

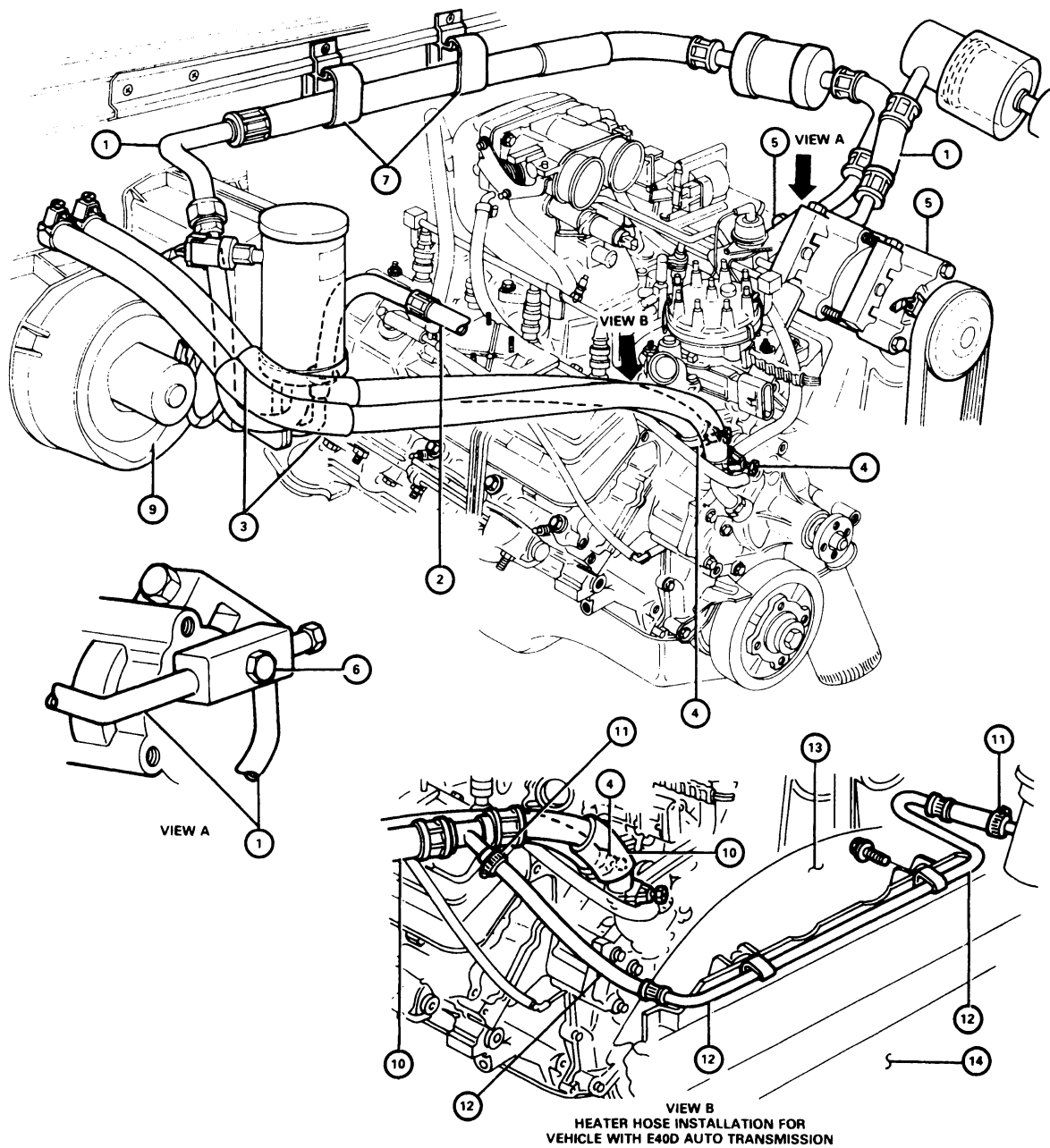


ITEM	BASE PART NUMBER	DESCRIPTION	ITEM	BASE PART NUMBER	DESCRIPTION
1.	19N617	HOSE ASSY. (SUCTION)	15.	390761-S100M	CLAMP (4-REQD.)
2.	19972	HOSE ASSY. (DISCHARGE)		389628-S100	HEATER HOSE CONNECTOR
3.	19N651	HOSE ASSY. (LIQUID LINE)	16.	389766-S100	HOSE CLAMP
4.	18C60	FITTING-HEATER HOSE (BYPASS)	17.	389772-S100	SPRING NUT, PART OF 18D331
5.	19N704	CLIP (2 REQ'D.)	18.	(REF.)	BRACKET ASSY.
6.	381260-S360A	HOSE	19.	(REF.)	EXISTING SCREW
7.	18C266	HOSE ASSY., FOR VEHICLES WITH C-6 AUTO OR MANUAL TRANSMISSIONS	20.	(REF.)	EVAPORATOR ASSY.
8.	(REF.)	RADIATOR	21.	(REF.)	SUPPORT BRACKET
9.	N606677-S2	SCREW & WASHER ASSY.	22.	(REF.)	INSTALL LOCATOR IN RETAINER
10.	N611058-S2	SCREW	23.	18A586	WIRING ASSY. (P.I.A. EVAPORATOR ASSY.)
11.	18D406	CONTROL ASSY. - HEATER COOL FLO	24.	(REF.)	EXISTING RETAINER
12.	18D331	BRACKET ASSY.	25.	19850	EVAPORATOR A/C SERVICE INSTRUCTIONS TAG
13.	19B632	CLIP-A/C TUBE SUPPORT	26.	(REF.)	ALTERNATOR EAR
14.	19D629	COMPRESSOR & CLUTCH ASSY.	27.	(REF.)	HEATER HOSE ASSY. CRIMPS

CCL 4375-A

REMOVAL AND INSTALLATION (Continued)

Refrigerant and Heater Line Routing, 7.5L (460 CID) MFI Engine



ITEM DESCRIPTION

1. MANIFOLD AND HOSE ASSY - 19D734
2. HOSE ASSY - 19N651
3. HEATER HOSE ASSY (FOR VEHICLES WITH C-6 OR MANUAL TRANSMISSION) - 18C266 (2 REQ'D)
4. CLAMP - 390761-S100 OR 389268-S100 (4 REQ'D)
5. A/C COMPRESSOR AND CLUTCH ASSY - 19D629
6. BOLT (MANIFOLD TO COMPRESSOR) - N805334-S2
7. CLIP - 19N704 (2 REQ'D)
8. HEATER HOSE (FOR VEHICLES WITH E40D TRANS.) - 18C266 (1 REQ'D)

ITEM DESCRIPTION

9. EVAPORATOR ASSY (REF.)
10. HEATER HOSE ASSY. (ONLY FOR VEHICLES WITH E40D TRANS.) - 18C266
11. HOSE CLAMP ASSY. - 376240-S100 (2 REQ'D)
12. HOSE & TUBE ASSY. (ONLY FOR VEHICLES WITH E40D TRANS.) - 8548
13. FAN SHROUD (REF.)
14. RADIATOR ASSY (REF.)

CCL 4106-A

REMOVAL AND INSTALLATION (Continued)**Cross References****Compressor Clutch**

For removal and installation instructions of the compressor clutch on FX-15 compressors, refer to section 12-03C. For service procedures on FX-6 compressors, refer to Section 12-03F.

Compressor Clutch Field Coil

For removal and installation instructions of the compressor clutch field coil on FX-15 compressors, refer to section 12-03C. For service procedures on FX-6 compressors, refer to Section 12-03F.

Compressor Mounting

F-Series and Bronco vehicles are equipped with one of the five engines specified for standard or optional applications. These engines are identified in the following chart.

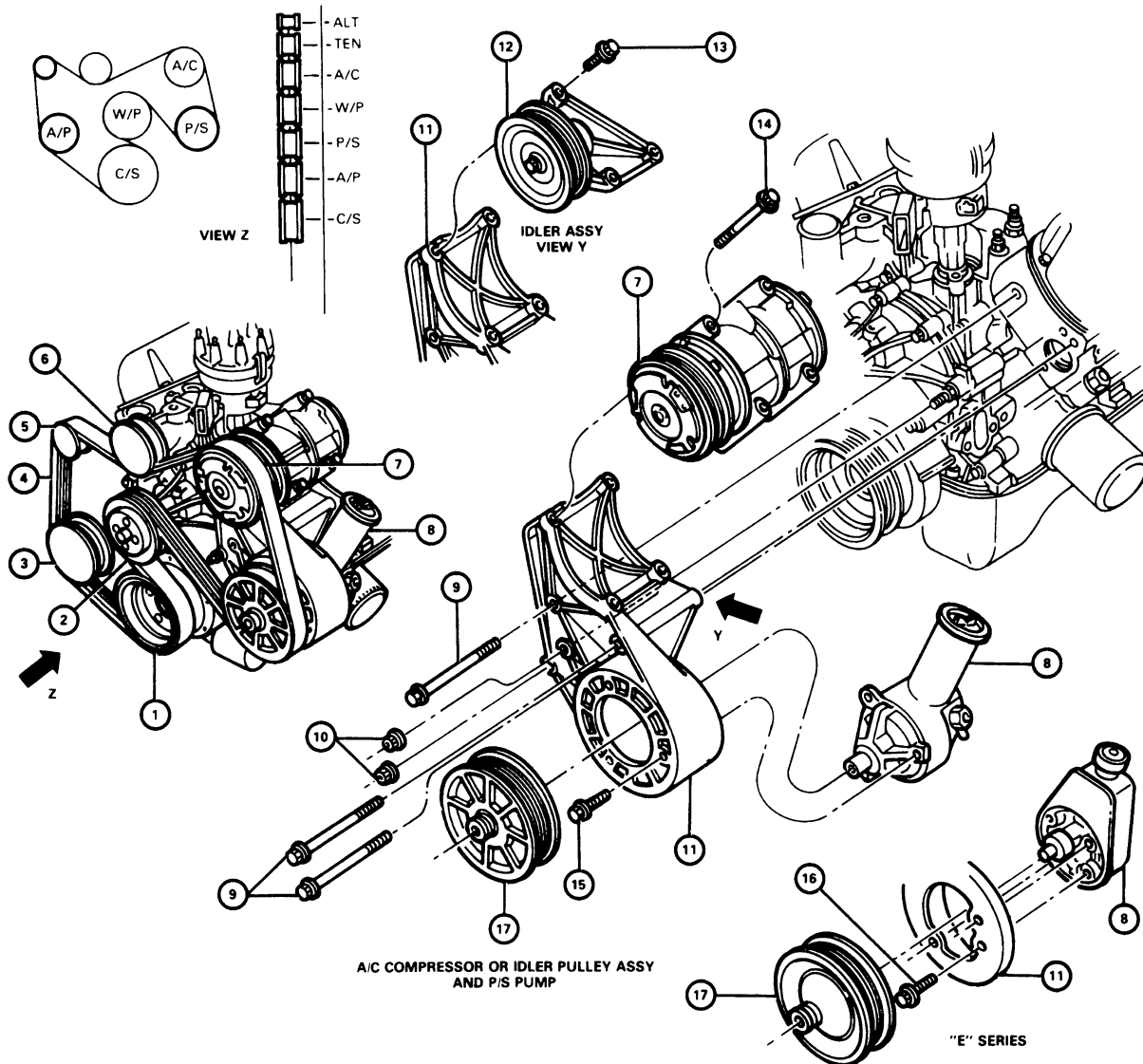
Displacement (Liters)	Fuel System
4.9L	MFI
5.0L	MFI
5.8L	MFI
7.3L	Diesel
7.5L	MFI

The next series of illustrations shows the compressor installation for each of the engines in the chart.

Refer to Section 12-03 for compressor removal and installation procedures.

REMOVAL AND INSTALLATION (Continued)

Compressor Installation, 5.0L and 5.8L MFI Engines



ITEM DESCRIPTION

1. CRANKSHAFT PULLEY (REF.)
2. WATER PUMP PULLEY (REF.)
3. AIR PUMP PULLEY (REF.)
4. DRIVE BELT (REF.)
5. ALTERNATOR PULLEY (REF.)
6. BELT TENSIONER (REF.)
7. A/C COMPRESSOR - 19D629
8. POWER STEERING PUMP - 3A674
9. BOLT (ATTACHES 3C511 TO ENGINE) - 56576-S2 (3 REQ'D)
10. NUT (ATTACHES 3C511 TO ENGINE) - 382802-S2 (1 REQ'D)
11. P/S PUMP SUPPORT BRACKET - 3C511

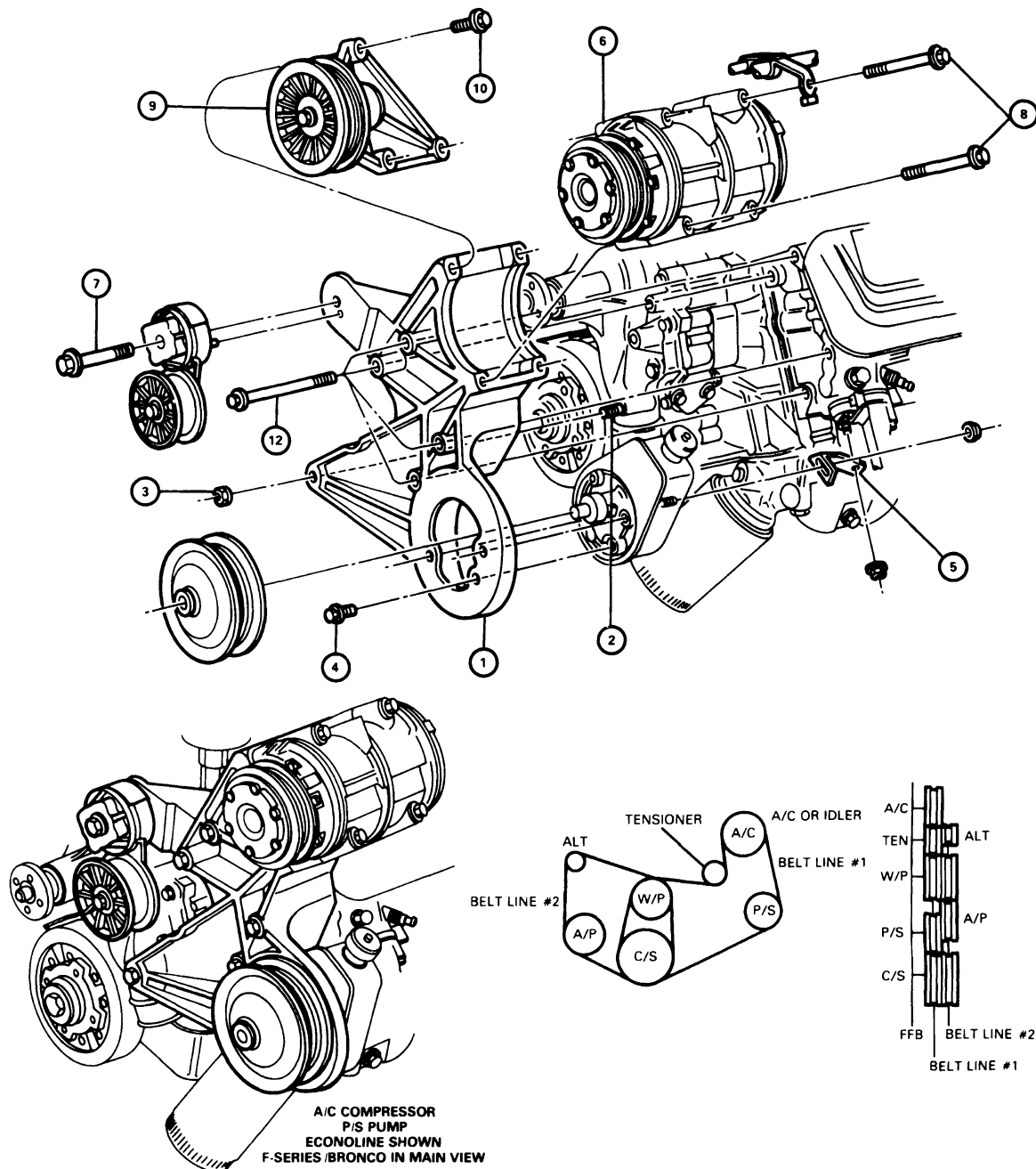
ITEM DESCRIPTION

12. A/C DRIVE BELT IDLER ASSY - 19A216
13. BOLT (ATTACHES 19A216 TO 3C511) - N605803-S2 (3 REQ'D)
14. BOLT (ATTACHES 19D629 TO 3G511) - N606572-S2 - F-SERIES/BRONCO (4 REQ'D)
15. SCREW (ATTACHES 3C511 TO 3A674) - N800199-S8M - F-SERIES/BRONCO (3 REQ'D)
16. SCREW (ATTACHES 3C511 TO 3A674) - N801879-S2 - ECONOLINE (3 REQ'D)
17. POWER STEERING PULLEY ASSY (REF.)

CCL 4125-A

REMOVAL AND INSTALLATION (Continued)

Compressor Installation, 7.5L MFI Engine



ITEM DESCRIPTION

1. A/C COMPRESSOR & POWER STEERING PUMP MOUNTING BRACKET - 19E708
2. STUD (REF.)
3. NUT (ATTACHES 19E708 TO 6007) - 382802-S2
4. SCREW (ATTACHES 3A674 TO 19E708) - N800199-S8M
5. POWER STEERING PUMP BASE (REF.)
6. A/C COMPRESSOR AND CLUTCH ASSY - 19D629

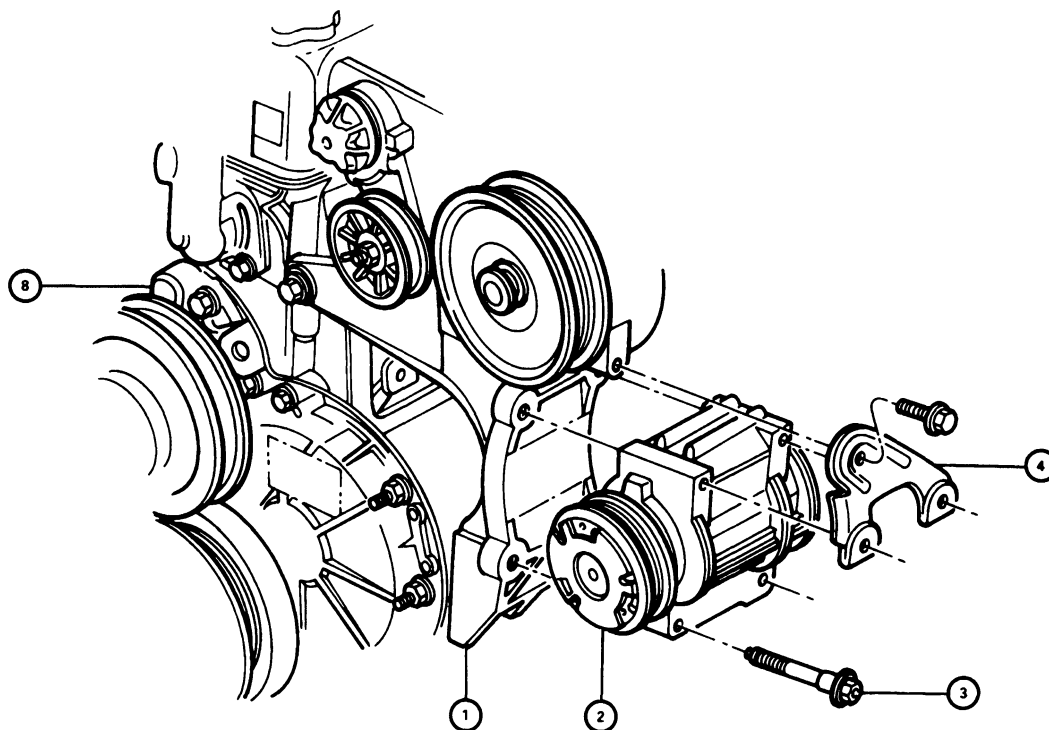
ITEM DESCRIPTION

7. BOLT (ATTACHES 6B209 TO 19E708) - 56192-S2
8. BOLT (ATTACHES 19D629 TO 19E708) - N906020-S2
9. BOLT (ATTACHES 19A216 TO 19E708) - N605790-S2 (3 REQ'D)
10. BOLT (ATTACHES 19A216 TO 19E708) - N605790-S2 (3 REQ'D)
11. ACCESSORY DRIVE BELT (CRANKSHAFT TO WATER PUMP TO IDLER OR A/C TO POWER STEERING) (REF.)

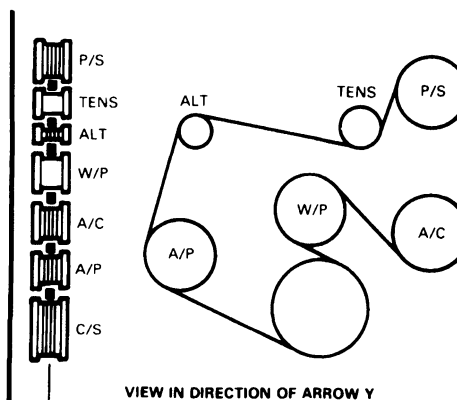
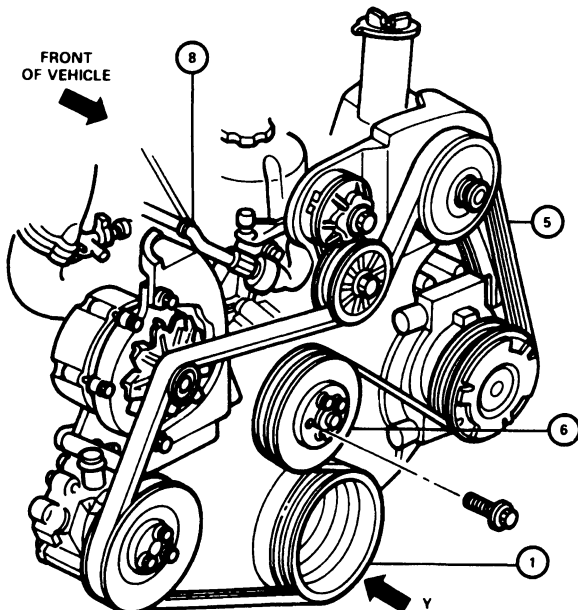
CCL 4127-A

REMOVAL AND INSTALLATION (Continued)

Compressor Installation, 4.9L MFI Engine



A/C COMPRESSOR INSTALLATION



VIEW IN DIRECTION OF ARROW Y

ITEM DESCRIPTION

1. A/C COMPRESSOR & PWR. STEERING PUMP MOUNTING BRACKET - 19E70R
2. A/C COMPRESSOR & CLUTCH ASSY - 19D629
3. COMPRESSOR TO MOUNTING BRACKET BOLT - N806020 (4 REQ'D)
4. PWR. STEERING PUMP BRACE (REF)

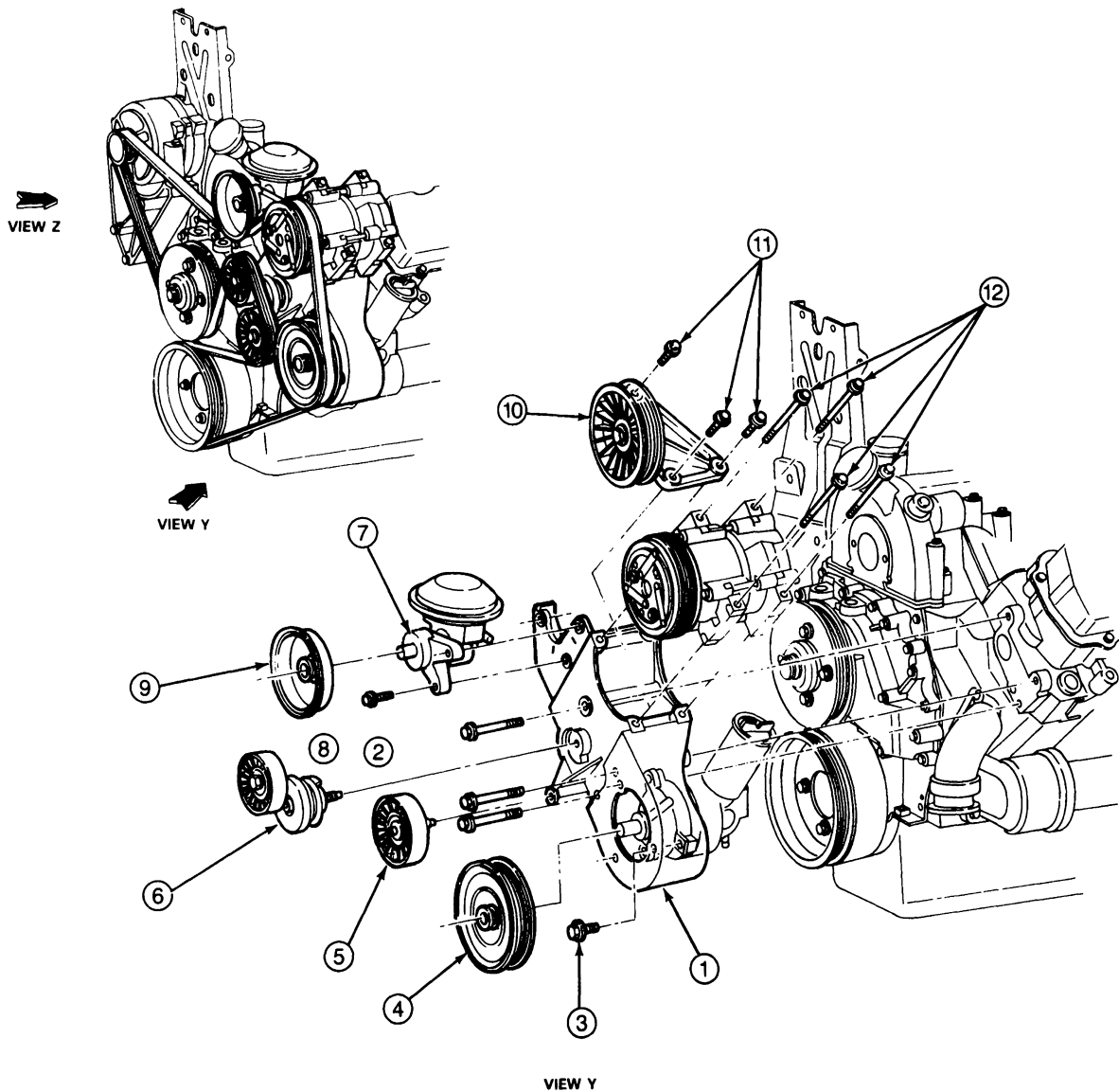
ITEM DESCRIPTION

5. DRIVE BELT - 8620
6. WATER PUMP PULLEY ASSY (REF.)
7. CRANKSHAFT PULLEY ASSY
8. ENGINE ASSY (REF.)

CCL 4124-A

REMOVAL AND INSTALLATION (Continued)

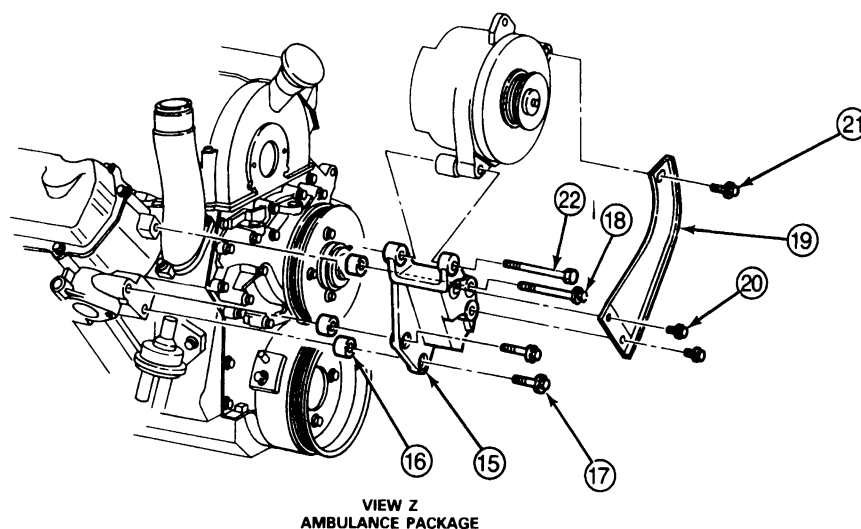
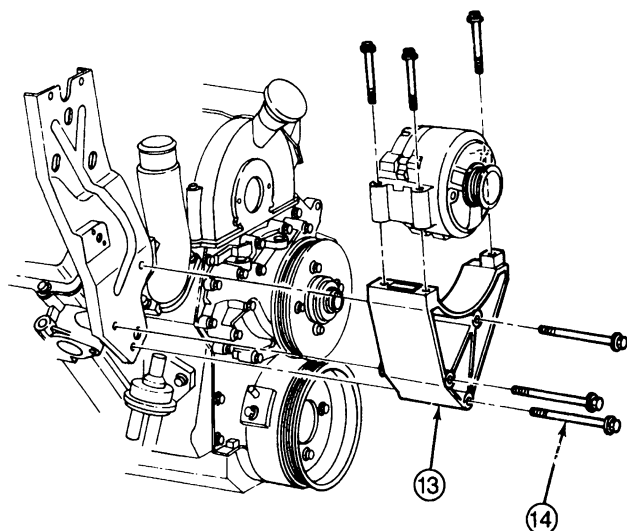
Compressor Installation, 7.3L Diesel Engine



ITEM	BASE PART NUMBER	DESCRIPTION	ITEM	BASE PART NUMBER	DESCRIPTION
1.	19E708	BRKT - P/S & A/C & V/P	14.	389706-S2	SC - 3/8-16 x 5.50 HEX FLNG HD SERR
2.	389706-S2	SC - 3/8-16 x 5.50 HEX FLNG HD SERR	15.	10039	BRKT - ALT
3.	N800199-S810	SC - M10 x 1.5 x 33 HEX FLNG SERR	16.	10039	BRKT - ALT
4.	3D673	PULLEY - P/S	17.	N807217	SPACER
5.	19A216	PULLEY - IDLER	18.	56545-S2	BOLT - 3/8-16 x 2.25
6.	6B209	TENSIONER - BELT	19.	56554-S2	BOLT - 3/8-16 x 4.5
7.	2A451	PUMP - VAC	20.	10N345	SUPT - ALT MNTG
8.	N605908-S2	BOLT - M8 - 1.25 x 35 HEX FLNG PLT	21.	N605786-S2	BOLT - M8 - 1.25 x 25 HEX HD LK
9.	2L487	PULLEY - V/P	22.	N605802-S2	BOLT - M10 x 3.5
10.	19A216	IDLER ASSY.	23.	58669-S36	BOLT - 7/16-14 x 4.5 HEX HD
11.	N605790-S2	BOLT - M8 x 40	24.	N606067-S2	BOLT - M10 x 17
12.	N806202-S2	BOLT - M8 x 120		8620	BELT - DRIVE
13.	10039	BRKT - ALT		8620	BELT - DRIVE
	10039	BRKT - ALT			

CCL 4376-A

REMOVAL AND INSTALLATION (Continued)



ITEM	BASE PART NUMBER	DESCRIPTION	ITEM	BASE PART NUMBER	DESCRIPTION
1.	19E708	BRKT - P/S & A/C & V/P	14.	389706-S2	SC - 3/8-16 x 5.50 HEX FLNG HD SERR
2.	389706-S2	SC - 3/8-16 x 5.50 HEX FLNG HD SERR	15.	10039	BRKT - ALT
3.	N800199-S810	SC - M10 x 1.5 x 33 HEX FLNG SERR	16.	10039	BRKT - ALT
4.	3D673	PULLEY - P/S	17.	N807217	SPACER
5.	19A216	PULLEY - IDLER	18.	56545-S2	BOLT - 3/8-16 x 2.25
6.	6B209	TENSIONER - BELT	19.	56554-S2	BOLT - 3/8-16 x 4.5
7.	2A451	PUMP - VAC	20.	10N345	SUPT - ALT MNTG
8.	N605908-S2	BOLT - M8 - 1.25 x 35 HEX FLNG PLT	21.	N605786-S2	BOLT - M8 - 1.25 x 25 HEX HD LK
9.	2L487	PULLEY - V/P	22.	N605802-S2	BOLT - M10 x 3.5
10.	19A216	IDLER ASSY.	23.	58669-S36	BOLT - 7/16-14 x 4.5 HEX HD
11.	N605790-S2	BOLT - M8 x 40	24.	N606067-S2	BOLT - M10 x 17
12.	N806202-S2	BOLT - M8 x 120		8620	BELT - DRIVE
13.	10039	BRKT - ALT		8620	BELT - DRIVE
	10039	BRKT - ALT			

CCL 4377-A

ADJUSTMENTS**Vacuum Controls and Temperature Control Cables**

To check for proper functional control in the system, move the blower switch to HIGH. Then, move the function lever to each of its seven positions. There should be air flow from the appropriate registers, floor duct and / or nozzles and no air flow in the OFF position.

If proper air flow is not provided, look for the following:

- A vacuum harness which is not fully seated at the vacuum motor.
- A damaged connector between the control assembly and plenum.
- A damaged connection between the plenum and vacuum source.
- A vacuum harness which is pinched or trapped.
- A transposed vacuum line. This condition is evident when the color code on the vacuum line fails to match the color code on its mating vacuum nipple.
- An inoperative vacuum selector valve.

To check the temperature control cable adjustment, move the temperature control knob back and forth, checking for the sound of the temperature blend door seating against the stop. If the sound of the door seating is not heard before the knob reaches its limit of travel, the temperature control cable may be misadjusted or not connected. Refer to Cable Adjustment or Cable Removal and Installation.

NOTE: If the temperature knob does not move left or right and appears to be locked in place, the retaining pin may have been inadvertently left in the cam during assembly.

To remove the temperature control cam retaining pin:

1. Disengage glove compartment door by squeezing its sides at the door stops. Allow the door to swing down; then, remove it from its hinges.
2. Working through glove compartment opening, remove the red assembly pin from the heater core cover.
3. Check for proper control cable operation.
4. Install the glove compartment and door.

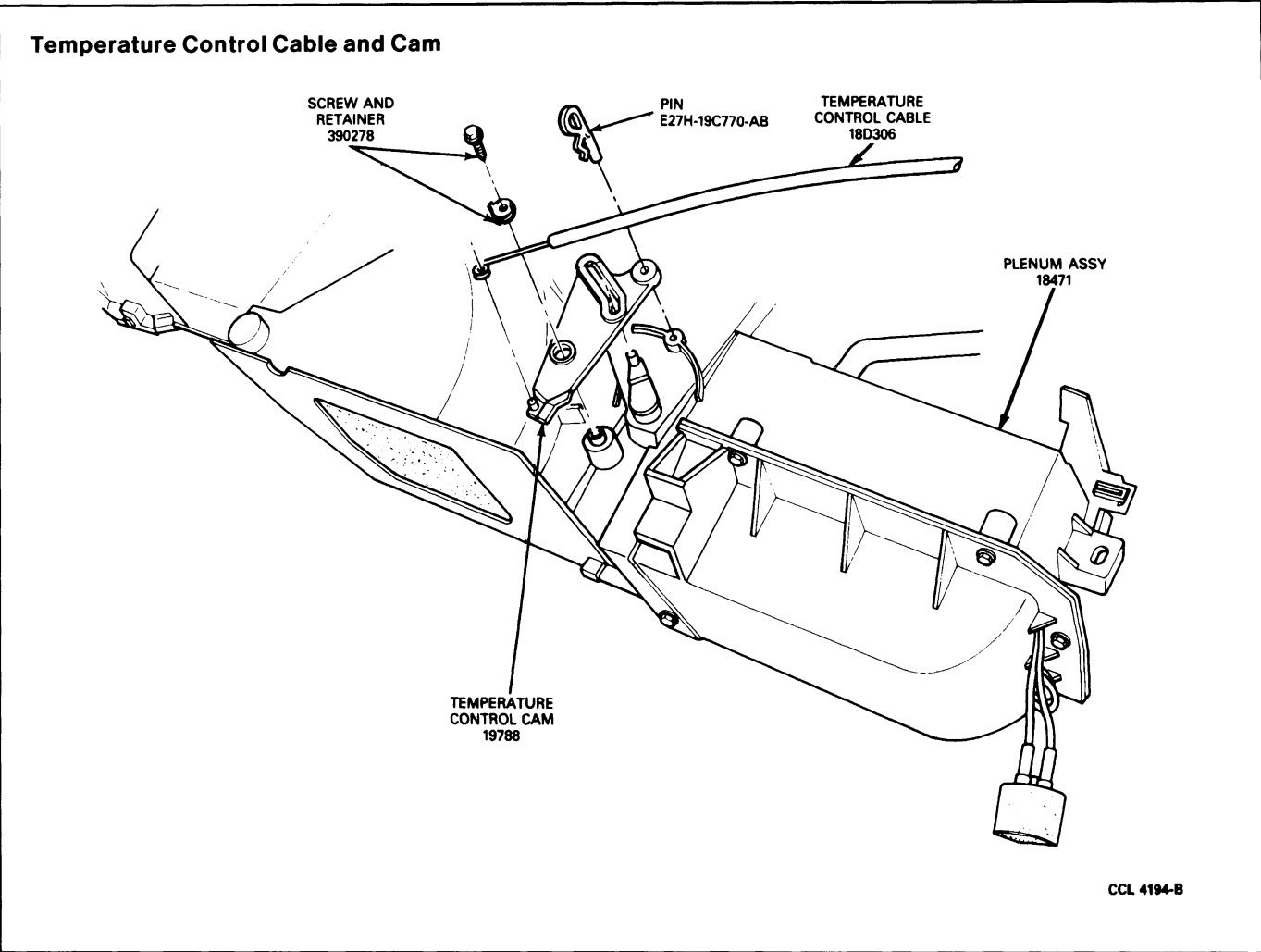
To adjust the temperature control cable, proceed as follows:

1. Disengage the glove compartment as outlined in the preceding paragraph. Allow the door to hang free.
2. Working through the glove compartment opening, remove the cable jacket from the metal attaching clip on the top of the plenum by depressing the clip tab and pulling the cable up.

NOTE: The cable end should remain attached to the door cam and / or crank arm.

3. Set the temperature control knob to COOL and hold it firmly.
4. With the cable end attached to the temperature door cam, push gently on the cable jacket to seat the blend door (push until resistance is felt). Install the cable into the clip by pushing the cable jacket into the clip from the top until it snaps into place.
5. Operate the system to check temperature control.

ADJUSTMENTS (Continued)



Compressor Drive Belt Tension

For compressor drive belt adjustment procedures, refer to Section 03-05.

SPECIFICATIONS

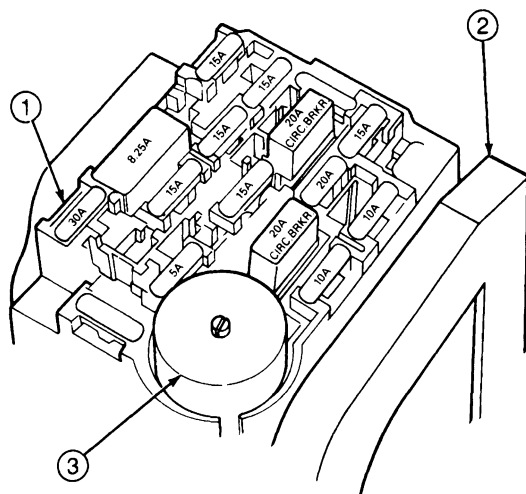
TORQUE SPECIFICATIONS		
Description	N·m	Lb·Ft
Liquid Line to Evaporator Core	21-27	15-20
Suction Line to Accumulator	34-44	25-32

(Continued)

TORQUE SPECIFICATIONS (Cont'd)

Description	N·m	Lb·Ft
Pressure Switch	7-13	5-10
Condenser Mounting Brackets	13-18	10-14
Compressor Discharge Line to Condenser	21-27	15-20
Liquid Line to Condenser	21-27	15-20
Line Connections (Self-Sealing)	9	7

SPECIFICATIONS (Continued)



ITEM	PART NUMBER	DESCRIPTION
1.		BLOWER CIRCUIT FUSE
2.		FUSE PANEL BRACKET (REF.)
3.		TURN SIGNAL FLASHER

CCL 4202-A

ELECTRICAL

Protective Device	30 Amp. Fuse (Lt. Green) F-15		
	Thermal Limiter in Blower Resistor Circuit (Integral with Resistor)		
Blower Motor	Blower Speed	Amps	Volts
Current Draw	Low	6.0	5.0
(Amps and Voltage)	Med. Low	8.0	7.0
	Med. High	15.0	10.0
	High	25.0	12.8
Magnetic Clutch			
Current Draw	— Approximately 4.57 Amps @ 12.8 Volts		
Illumination Control Assembly	One ICP-161 Bulb		

REFRIGERANT

System Protection	
Pressure Switch	Close Maximum 47 psi
	Open Minimum 23 psi
High Pressure Relief Valve (Located on Compressor Discharge Manifold)	3103kPa (450 psi)
Maximum Capacity	2.75 lbs. 44 Oz.
Type	
Refrigerant 12 (R-12)	Dichlorodifluoromethane CCL ₂ F ₂
ESA-M17B2-A	Ford D4AZ-198519-A
	Motorcraft YN-1A 14 Oz. Can
	YN-7 30 Lb. Container
Fixed Orifice Tube	0.067 inch (Color Code-Blue)

CL5334-E

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number / Description	Illustration
T63L-8620-A Belt Tension Gauge (Motorcraft YT-371)	 T63L-8620-A
T83P-18532-AH Control Cable Remover (Motorcraft YT-1246)	 T83P-18532-AH
T83L-19990-A Fixed Orifice Tube Remover and Installer (Motorcraft YT-1008)	 T83L-19990-A
T83L-19990-B Broken Orifice Tube Extractor (Motorcraft YT-1009)	 T83L-19990-B
T81P-19623-G1 Spring Lock Coupling Disconnect Tool-3/8 In.	 T81P-19623-G1
T81P-19623-G2 Spring Lock Coupling Disconnect Tool-1/2 In.	 T81P-19623-G2
T83P-19623-C Spring Lock Coupling Disconnect Tool-5/8 In.	 T83P-19623-C

Tool Number	Description
D81L-19703-A	High Pressure Service Port Adapter Set

MOTORCRAFT TOOLS

Tool Number	Description
YT-371	Belt Tension Gauge
YT-354	High Pressure Service Port Adapter Set
YT-1246	Control Cable Remover
YT-1008	Fixed Orifice Tube Remover and Installer
YT-1009	Broken Orifice Tube Extractor
YT-202	Flame-Type Leak Detector

(Continued)

**SPECIAL SERVICE TOOLS/EQUIPMENT
(Continued)****MOTORCRAFT TOOLS (Cont'd)**

Tool Number	Description
YT-227	Dial Thermometer
YT-288	Electronic Leak Detector
YT-335	Hand Operated Vacuum Pump Tester

ROTUNDA EQUIPMENT

Tool Number	Description
023-00006	Flame-Type Leak Detector
023-00007	Dial Thermometer
055-00015	Electronic Leak Detector
021-00014	Hand Operated Vacuum Pump Tester

SECTION 12-03B Air Conditioning, Heater System, Econoline

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Control Assembly	12-03B-2	Heater and Air Conditioner Tube and Hose	
Vacuum System	12-03B-8	Routing	12-03B-30
DIAGNOSIS AND TESTING		Instrument Panel	12-03B-19
Blower Motor Voltage Test	12-03B-13	Outside / Recirculating Air Door Vacuum	
REMOVAL AND INSTALLATION		Motor	12-03B-22
Air Ducts	12-03B-20	Resistor Assembly	12-03B-24
Blower Switch	12-03B-19	Right, Center and Left Register	
Clutch Cycling Pressure Switch	12-03B-23	Assembly	12-03B-20
Compressor Assembly	12-03B-30	Vacuum Selector Valve	12-03B-19
Compressor Clutch and Field Coil	12-03B-30	SPECIAL SERVICE TOOLS / EQUIPMENT	12-03B-35
Control Assembly	12-03B-17	SPECIFICATIONS	12-03B-35
Defroster Nozzle	12-03B-19	VEHICLE APPLICATION	12-03B-1

VEHICLE APPLICATION

E-150-250-350 Vehicles

DESCRIPTION AND OPERATION

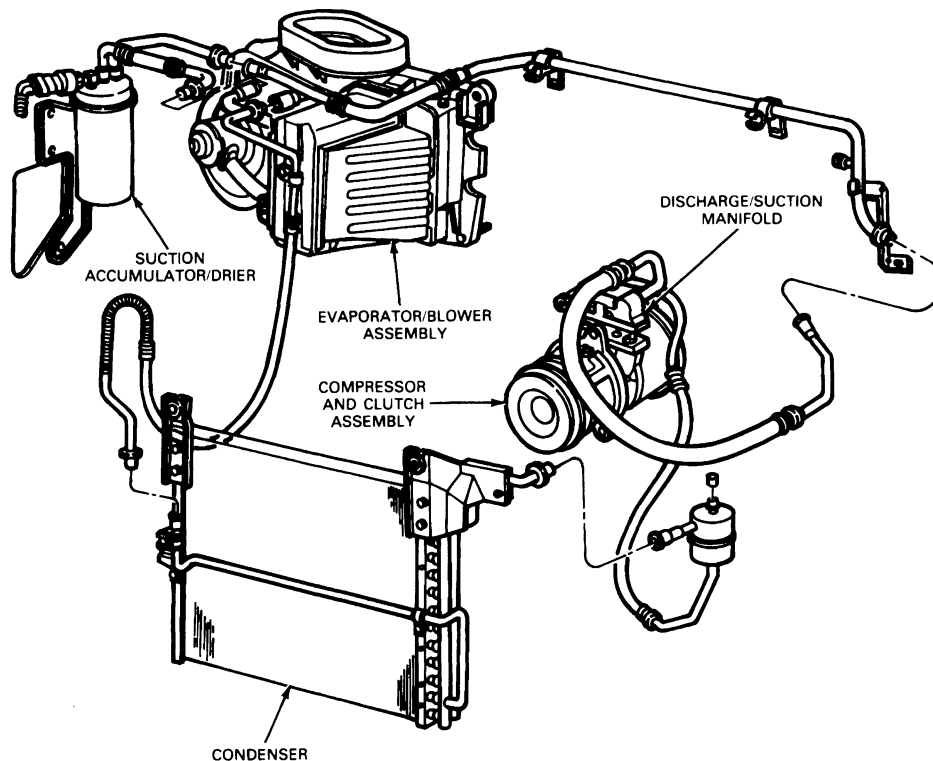
This section covers the controls and components of the manually operated air conditioning-heater system. Section 12-03 provides information and service procedures regarding refrigerants. Depending upon the service operation being performed, reference to both of these sections in the manual may be necessary.

The air conditioner used in the E-150-250-350 is a combination air conditioning and heating system referred to as a blend air design. The system, excluding the plenum and ducts, consists of a two-piece air conditioning-heater assembly. Both pieces assemble to each other and to the dash panel on the right side of the vehicle. One part extends into the engine compartment and the other is in the passenger compartment under the instrument panel. The plenum and ducts to the registers and defrosters are located behind the instrument panel.

The control assembly is located in the instrument panel at the right of the steering column. Four registers in the instrument panel direct airflow into the passenger compartment. The louvers in the registers can be adjusted to direct airflow upward, downward, to the right or to the left. They can also be set in a closed position which will block nearly all airflow.

NOTE: The diagnostic and service procedures for the E-350 RV with an FS-6 compressor are identical to the 7.5L Econoline and should be used for that application.

The diagnostic and service procedures for the condenser and the receiver / dehydrator are similar to the Econoline; therefore the Econoline procedures should be used for the E-350 RV Chassis application.

DESCRIPTION AND OPERATION (Continued)**Air Conditioning System**

CCL 4291-A

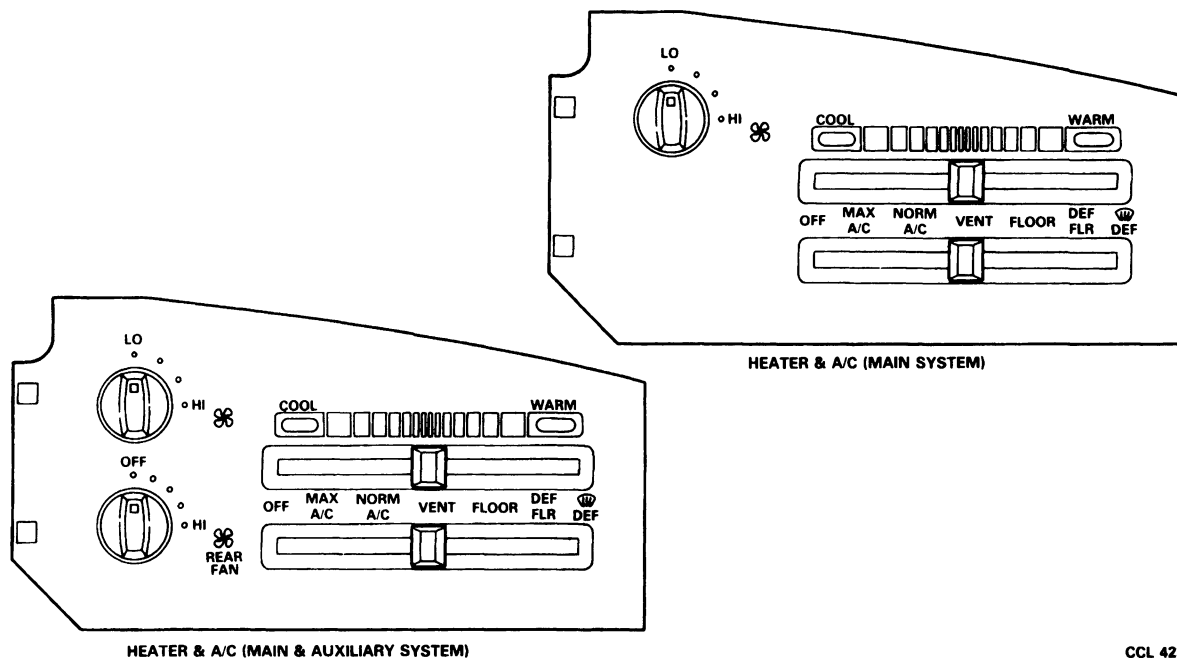
Control Assembly

Climate control equipment on Econoline is available as a heater-only system, or a combined air conditioning and heater system. An auxiliary system is also available to provide increased climate control in the passenger area located rearward of the front seats. Section 12-03D covers the servicing as well as certain restrictions which apply to the application of an auxiliary system.

The control assembly used with or without an auxiliary system is shown.

DESCRIPTION AND OPERATION (Continued)

Control Assemblies

**Function Selector Lever**

The function selector lever actuates an eight-port vacuum selector that controls vacuum motors at the floor / defrost, panel / defrost, and outside / recirc air doors. The function selector lever also controls the blower switch OFF-ON operation and activates the air conditioning clutch circuit in the A / C position.

In either A / C position (MAX or NORM) and in MIX and DEFROST positions, compressor operation is dependent upon the clutch cycling pressure switch.

The cutout pressure is approximately 169 kPa (24.5 psi). Cut-in pressure is approximately 300 kPa (43.5 psi).

Temperature Selector Lever

The temperature selector lever actuates a control cable which operates the temperature blend door.

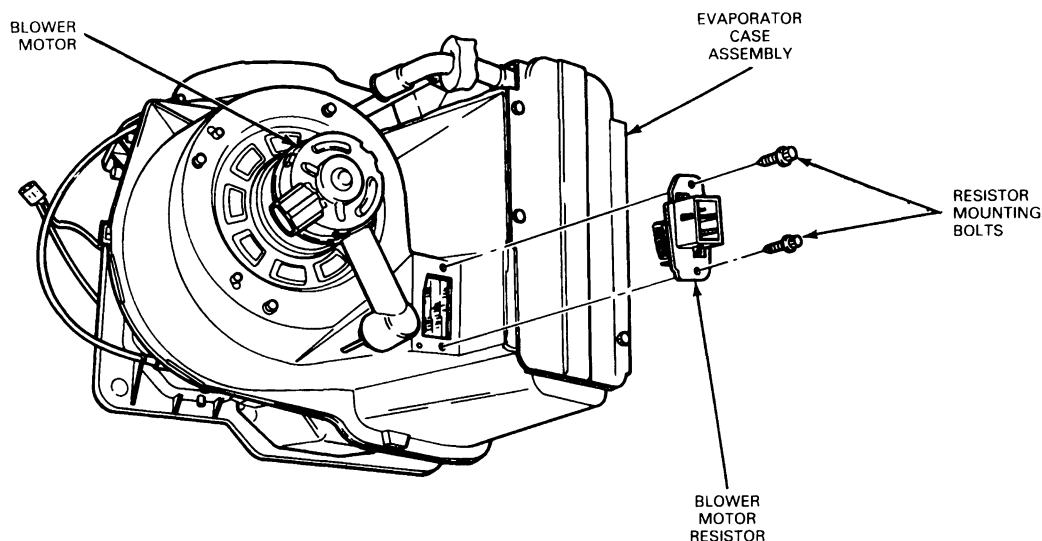
Blower Control Switches

A four-speed blower control switch with a range between LO and HI is located in the left side of the control assembly. To completely stop blower operation, it is necessary to move the function selector lever to its OFF position. If the vehicle is equipped with auxiliary air, a second blower control switch will be included. This switch provides four blower speeds plus an OFF position.

Blower Motor Resistor

The blower motor resistor assembly attaches to the evaporator case in the area near the blower motor.

DESCRIPTION AND OPERATION (Continued)

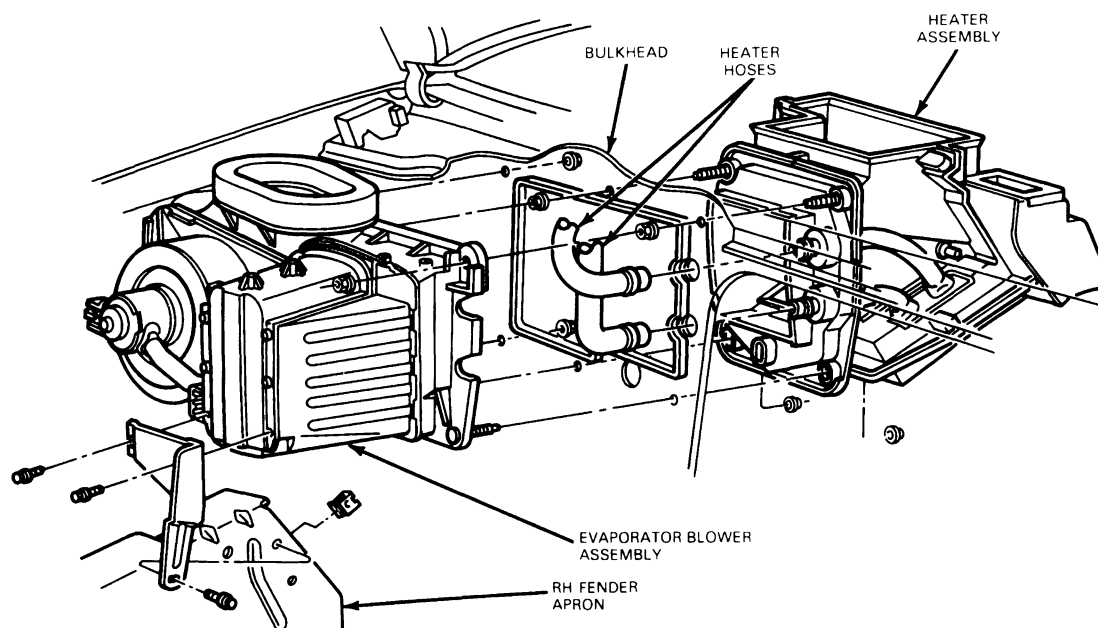
Blower Motor Resistor

CCL 4238-B

Evaporator Assembly

The heater core and blend air door, are housed in the heater housing, which is located on the passenger compartment side of the dash panel. The blower motor and wheel, blower motor resistor and evaporator core and recirc door are located in the evaporator / blower assembly which is on the engine compartment side of the dash panel.

When servicing any of these components it is not necessary to loosen or remove the instrument panel.

Evaporator / Blower and Heater Assembly

CCL 4235-A

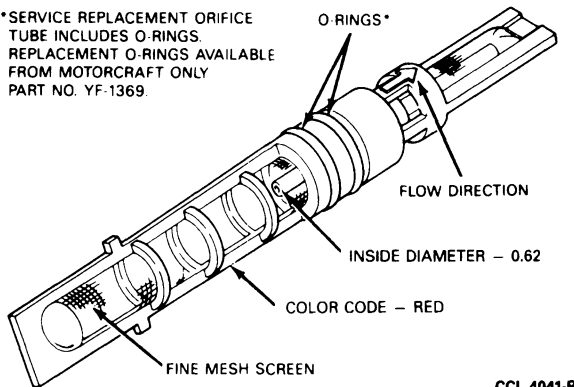
DESCRIPTION AND OPERATION (Continued)

Fixed Orifice Tube

The fixed orifice tube regulates the flow of refrigerant into the evaporator. It is the dividing point in the refrigerant system between high and low pressure.

Econoline vehicles are equipped with an orifice tube that is color-coded red. It is also identified as an 0.062-inch tube. This dimension is the inside diameter of the short brass tube which protrudes inside the transparent surface of the orifice tube assembly.

*SERVICE REPLACEMENT ORIFICE TUBE INCLUDES O-RINGS. REPLACEMENT O-RINGS AVAILABLE FROM MOTORCRAFT ONLY PART NO. YF-1369



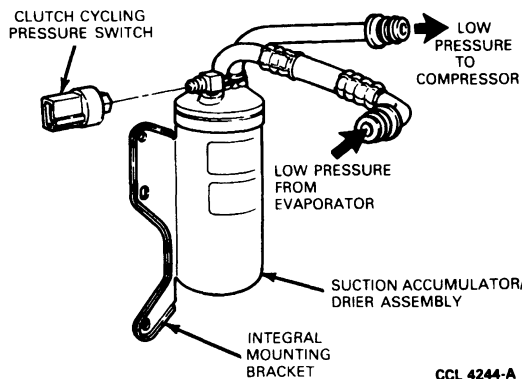
CCL 4041-B

Suction Accumulator / Drier

Refrigerant enters the assembly through the inlet tube and the heavier oil-laden refrigerant falls to the bottom of the canister. A small diameter bleed hole is located in the side of the outlet tube near the bottom of the canister. This bleed hole is covered with a filter and allows a small amount of the heavier liquid refrigerant and oil mixture to re-enter the suction line at a controlled rate. When the heavier liquid refrigerant and oil mixture enters the compressor suction line, it has a second opportunity to vaporize and circulate through the compressor without causing damage to the compressor due to refrigerant slugging.

A desiccant bag is mounted inside the suction accumulator / drier canister to absorb any moisture which may be in the refrigerant system.

A fitting located on the top of the canister is used to attach the clutch cycling pressure switch. A long travel Schrader-type valve stem core is installed in the fitting opening to prevent refrigerant loss when the clutch cycling pressure switch is removed.



CCL 4244-A

There are several control levers and switches which are involved in the operation of an Econoline climate control system. They are as follows:

- Function selector lever
- Temperature selector lever
- Blower control switch or switches

The control assembly face plates illustrated show where the levers and switches are located.

The main blower is turned on whenever the function selector lever is not in the OFF position. The air conditioner compressor clutch is actuated whenever the function selector lever is in the MAX or NORM A/C, as well as MIX or DEFROST positions. Cycling of the compressor is then controlled by a clutch cycling pressure switch on the suction accumulator / drier.

Other positions, VENT, FLOOR, MIX or DEFROST, may be selected by moving the function selector lever to the appropriate detent. This actuates a vacuum selector valve which is part of the control assembly. Vacuum lines from this valve lead to vacuum motors which operate all doors in the system except the cable-controlled temperature air door.

Air Flow

Air is drawn into the system by the blower motor and wheel through the outside-recirc door opening. The air is then blown through the evaporator core and then the heater core (when the temperature lever is moved toward the WARM position). When the cable operated temperature blend door is in the maximum COOL position, the air bypasses the heater core. When the temperature lever is moved to the right, away from the maximum COOL position, a smaller percentage of air passes through the heater core where it is warmed, and then mixed with the cool air before it is discharged through the registers.

With the function selector lever in the OFF position, the outside-recirc door is in the recirculated air position. It is closed to outside air and no air passes through the system. The blower motor is off.

DESCRIPTION AND OPERATION (Continued)

In the MAX A/C position, the outside-recirc air door is in the recirculated air position. All of the air discharges through the panel registers except for a small amount of floor bleed. The compressor operates in this function lever setting.

In the NORM A/C position the outside-recirc air door is open to the outside (no vacuum) and outside air is discharged through the panel register with a small amount of floor bleed. The compressor operates in this lever setting.

In the VENT position the outside-recirc air door is open to the outside (no vacuum), and outside air is discharged through the panel registers except for a small amount of floor bleed. The compressor does not operate in this control lever setting.

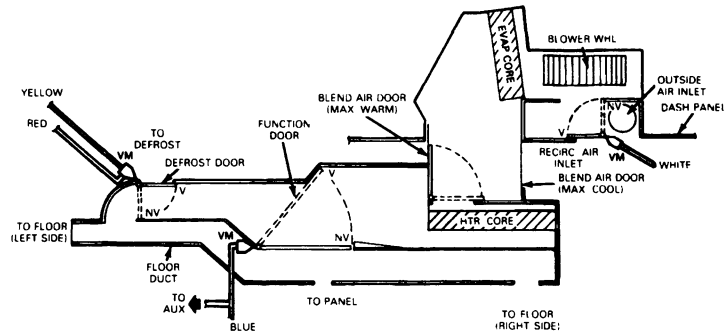
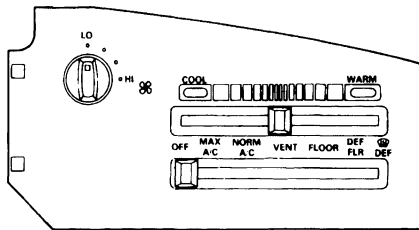
In the FLOOR position, the outside-recirc air door is open to outside air (no vacuum). Air is discharged through the floor outlets plus a small amount of defroster bleed is directed to the windshield.

In the MIX position air is discharged through both the defroster and floor outlets in approximate equal amounts. (The compressor operates in this lever setting when the clutch cycling pressure switch is energized.

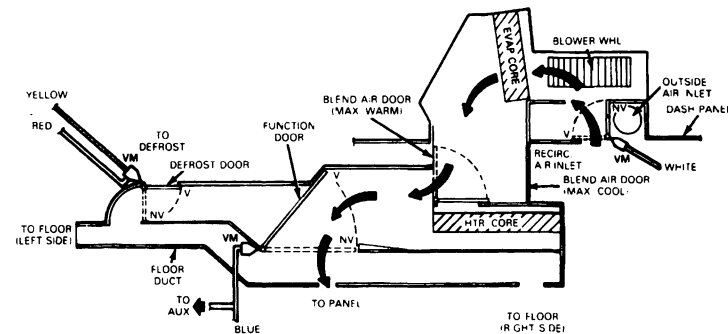
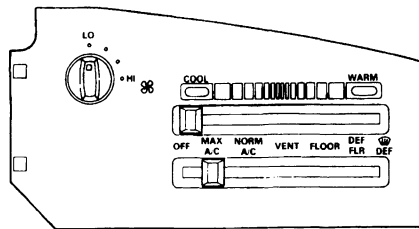
In the DEFROST position the air is discharged through the defrosters to the windshield. There is also a small amount of floor bleed. The compressor operates in this control setting to help dehumidify the air.

DESCRIPTION AND OPERATION (Continued)

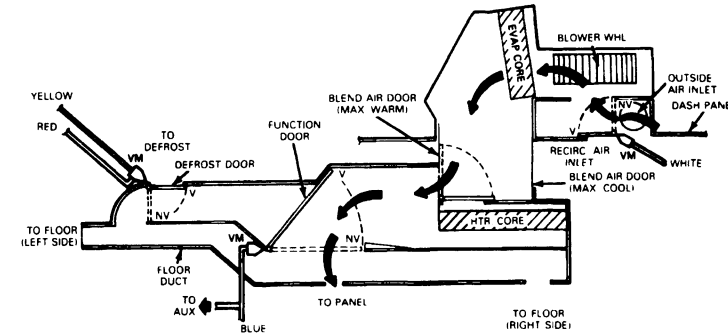
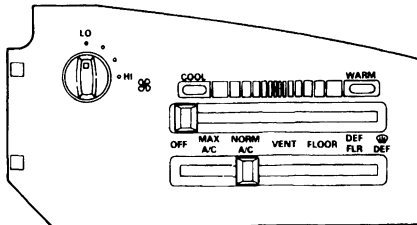
Air Flow Diagrams



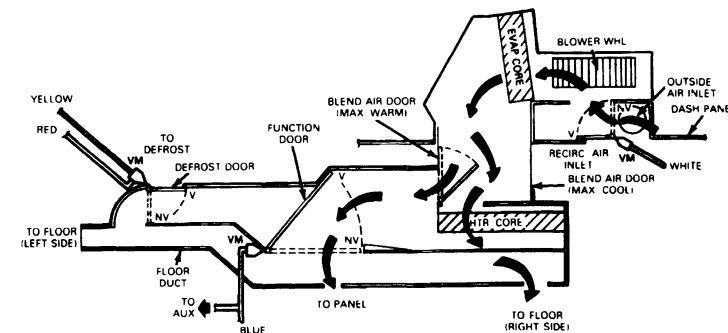
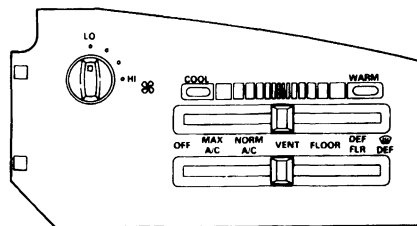
OFF POSITION



MAX A/C POSITION



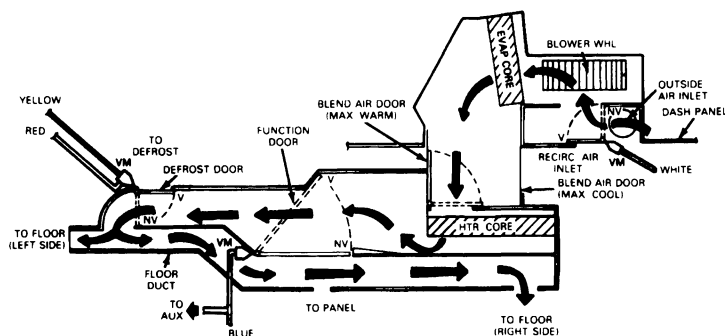
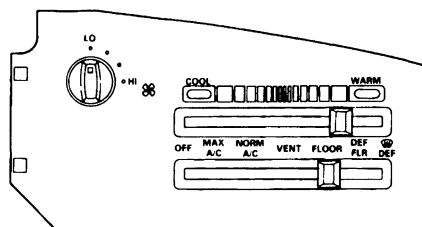
NORM A/C POSITION



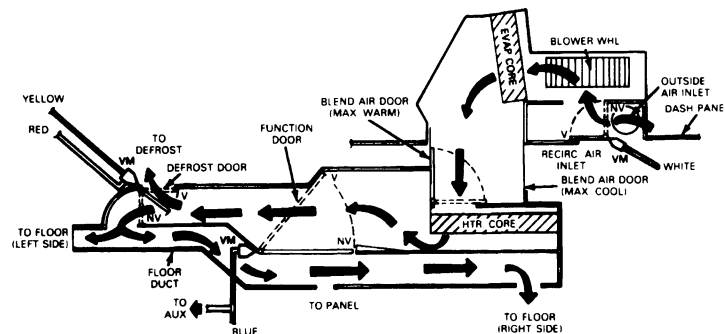
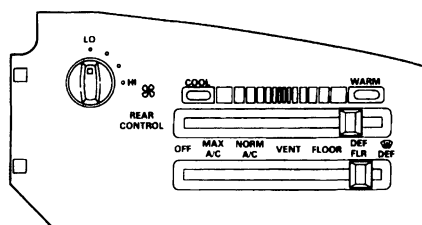
VENT POSITION

CCL 4250-B

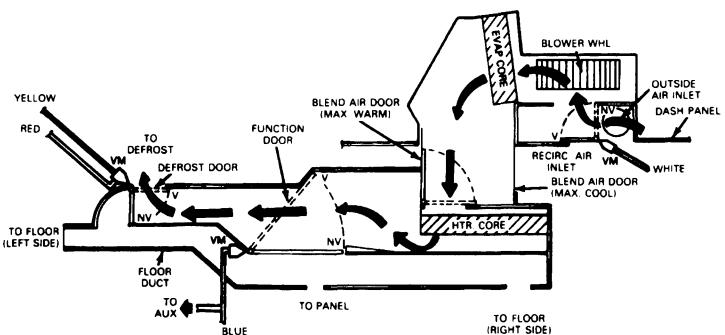
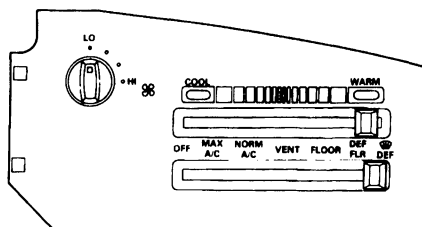
DESCRIPTION AND OPERATION (Continued)



FLOOR POSITION



DEFROST/FLOOR POSITION



DEFROST POSITION

CCL 4251-B

Vacuum System

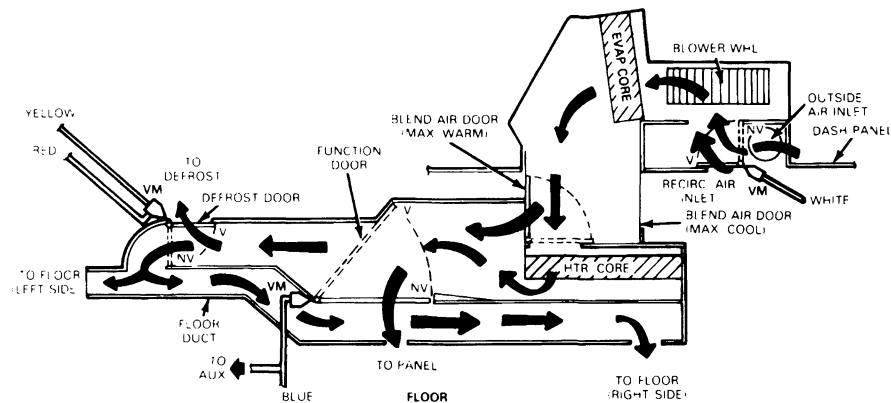
The diagram illustrates the vacuum circuit which controls the movement of three of the four doors in the system. These doors are:

- Outside / recirc air door
- Panel / defrost door
- Floor / defrost door

The temperature control door (blend air door) is cable controlled.

DESCRIPTION AND OPERATION (Continued)

Vacuum Logic



HEATER VACUUM LOGIC

PORT	FUNCTION	MODE LEVER POSITION					HOSE COLOR
		OFF	VENT	HEAT	DEFOG	DEFROST	
1	RECIRC — F/A	V	NV	NV	NV	NV	WHITE
2	FULL FLOOR	V	V	V	NV	NV	RED
3	FULL PANEL	NV	V	NV	NV	NV	BLUE
4	PARTIAL FLOOR	V	V	V	V	NV	YELLOW
		SEALED	SEALED	SEALED	SEALED	SEALED	
6		SEALED	SEALED	SEALED	SEALED	SEALED	
7	SOURCE	V	V	V	V	V	BLACK
8							
9		SEALED	SEALED	SEALED	SEALED	SEALED	

A/C VACUUM LOGIC

PORT	FUNCTION	MODE LEVER POSITION							HOSE COLOR
		OFF	MAX	NORM	VENT	HEAT	DEFOG	DEF	
1	RECIRC-F/A	V	V	NV	NV	NV	NV	NV	WHITE
2	FULL FLOOR	V	V	V	V	V	NV	NV	RED
3	PANEL	NV	V	V	V	NV	NV	NV	BLUE
4	PARTIAL FLOOR	V	V	V	V	V	V	NV	YELLOW
6		SEALED	SEALED	SEALED	SEALED	SEALED	SEALED	SEALED	
7	SOURCE	V	V	V	V	V	V	V	BLACK
8		SEALED	SEALED	SEALED	SEALED	SEALED	SEALED	SEALED	
9		SEALED	SEALED	SEALED	SEALED	SEALED	SEALED	SEALED	

CCL 4261-A

Refrigerant Flow

The following diagram is a simplified illustration of refrigerant flow through an air conditioning circuit.

The boiling or condensing temperature of a refrigerant increases or decreases according to the pressure exerted on it.

In the E-150-250-350 air conditioning system, liquid refrigerant (R-12) is delivered under high pressure from the condenser to the orifice tube located in the evaporator inlet tube. When the refrigerant passes through the orifice tube, its pressure drops and its temperature reverts to its approximate boiling point (-21.6° to -29.8°F). As the refrigerant flows through the evaporator coils, warm passenger compartment air, or outside air, passes over the **outside surface** of the coils. As it boils, the colder R-12 absorbs heat from the air and thus cools the passenger compartment. The heat from the air is absorbed by the boiling refrigerant which is converted to a gas. The refrigeration cycle is now under way. To complete the cycle, the following remains to be done:

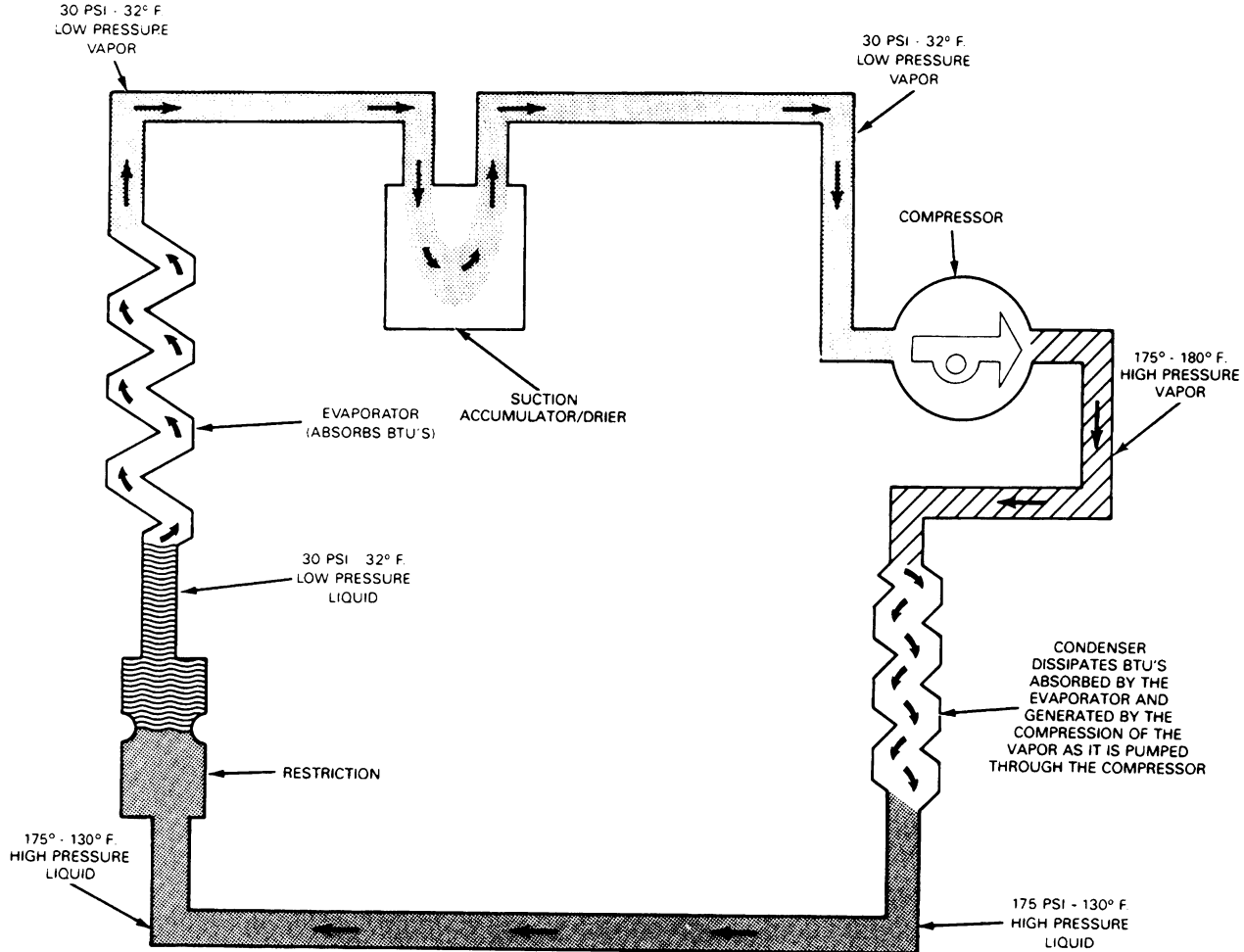
1. Dispose of the heat in the gas.

DESCRIPTION AND OPERATION (Continued)

2. Convert the gas back to liquid for re-use.

3. Return the liquid to the starting point in the refrigerant cycle.

Refrigerant Flow



CCL 2683-F

The compressor pumps the gas and liquid out of the evaporator into the suction line to the accumulator / drier which stores any liquid which may have entered the system. The drier then allows gas only to return to the compressor. The compressor forces the gaseous refrigerant under high pressure and temperature into the condenser which is located in the outside air stream at the front of the vehicle. The temperature of the gas entering the condenser is higher than that of the outside air. As the heat transfers from the hot gas to the cooler air, the R-12 condenses back to a liquid. The liquid under high pressure now returns to the orifice tube in the evaporator inlet line to repeat its flow cycle.

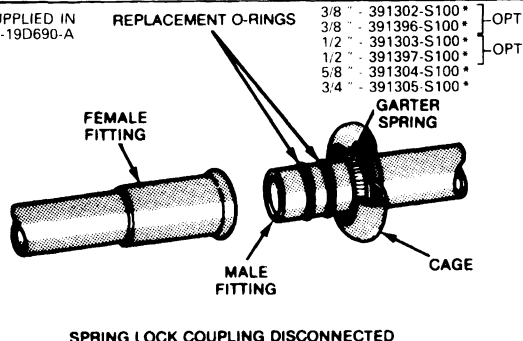
Heat can be transferred from a comparatively cooler passenger compartment to the hot outside air because of the difference between the refrigerant pressure in the evaporator and the pressure in the condenser. At the evaporator, the orifice tube reduces the pressure and thereby reduces the boiling point below the temperature of the passenger compartment. Thus, heat transfers from the passenger compartment to the boiling refrigerant. In the condenser, the compressor raises the condensation point above the temperature of the outside air. Thus, the heat transfers from the condensing refrigerant to the outside air. The orifice tube and the compressor simply create pressure conditions that permit laws of thermodynamics to provide the desired cooling effects.

DESCRIPTION AND OPERATION (Continued)**Spring Lock Couplings**

The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage. When the coupling is connected, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting. The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage.

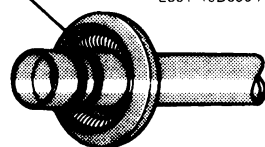
DESCRIPTION AND OPERATION (Continued)

*ALSO SUPPLIED IN
KIT E35Y-19D690-A



TO CONNECT COUPLING

GARTER SPRING

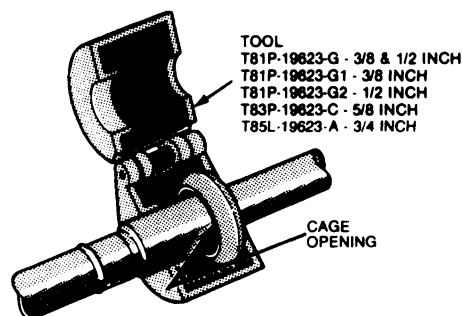


CHECK FOR MISSING OR DAMAGED GARTER SPRING — REMOVE DAMAGED SPRING WITH SMALL HOOKED WIRE — INSTALL NEW SPRING IF DAMAGED OR MISSING.

REPLACEMENT GARTER SPRINGS
3/8 INCH - E1ZZ-19E576-A*
1/2 INCH - E1ZZ-19E576-B*
5/8 INCH - E35Y-19E576-A*
3/4 INCH - E69Z-19E576-A*
*ALSO AVAILABLE IN
E35Y-19D690-A KIT WITH O-RINGS

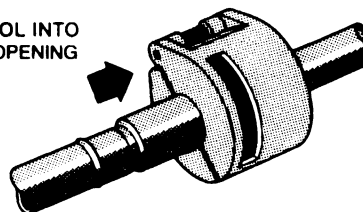
TO DISCONNECT COUPLING

CAUTION — DISCHARGE SYSTEM BEFORE DISCONNECTING COUPLING



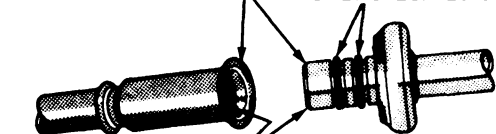
① FIT TOOL TO COUPLING SO THAT TOOL CAN ENTER CAGE OPENING TO RELEASE THE GARTER SPRING.

PUSH TOOL INTO CAGE OPENING



② PUSH THE TOOL INTO THE CAGE OPENING TO RELEASE THE FEMALE FITTING FROM THE GARTER SPRING.

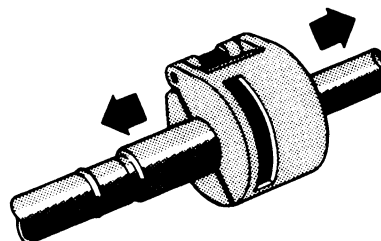
A — CLEAN FITTINGS
B — INSTALL NEW O-RINGS — USE ONLY SPECIFIED O-RINGS



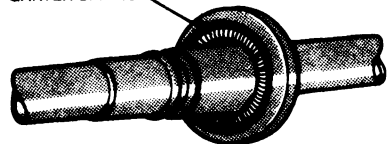
C — LUBRICATE WITH CLEAN REFRIGERANT OIL

D — ASSEMBLE FITTING TOGETHER BY PUSHING WITH A SLIGHT TWISTING MOTION

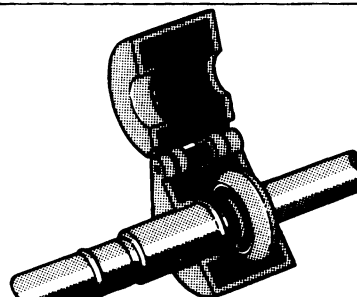
③ PULL THE COUPLING MALE AND FEMALE FITTINGS APART.



GARTER SPRING



③ TO ENSURE COUPLING ENGAGEMENT, VISUALLY CHECK TO BE SURE GARTER SPRING IS OVER FLARED END OF FEMALE FITTING.



④ REMOVE THE TOOL FROM THE DISCONNECTED SPRING LOCK COUPLING.

CCL 4011-C

DESCRIPTION AND OPERATION (Continued)

Two O-rings are used to seal between the two halves of the coupling. These O-rings are made of a special material and must be replaced with an O-ring made of the same material. The O-rings normally used in the refrigerant system connections are not the same material and should not be used with the spring lock coupling. Use only the O-rings listed in the master parts catalog for the spring lock coupling. They are available in Kit E35Y-19D690-A.

A plastic indicator ring is used on spring lock couplings to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening.

The indicator ring may also be used during repair operations to indicate connection of the coupling. After a coupling has been cleaned and new O-rings have been installed and lubricated with clean refrigerant oil, insert the tabs of the indicator ring into the cage opening. Then, connect the coupling by pushing it together with a slight twisting motion. When the coupling is connected, the indicator ring will snap out of the cage opening but will remain captured on the coupling by the refrigerant line.

Side-Mounted Auxiliary Climate Control Systems

Refer to Section 12-03D for information pertaining to the E-150-250-350 Side-Mounted Auxiliary Heater and/or Air Conditioning System.

DIAGNOSIS AND TESTING**Blower Motor Voltage Test**

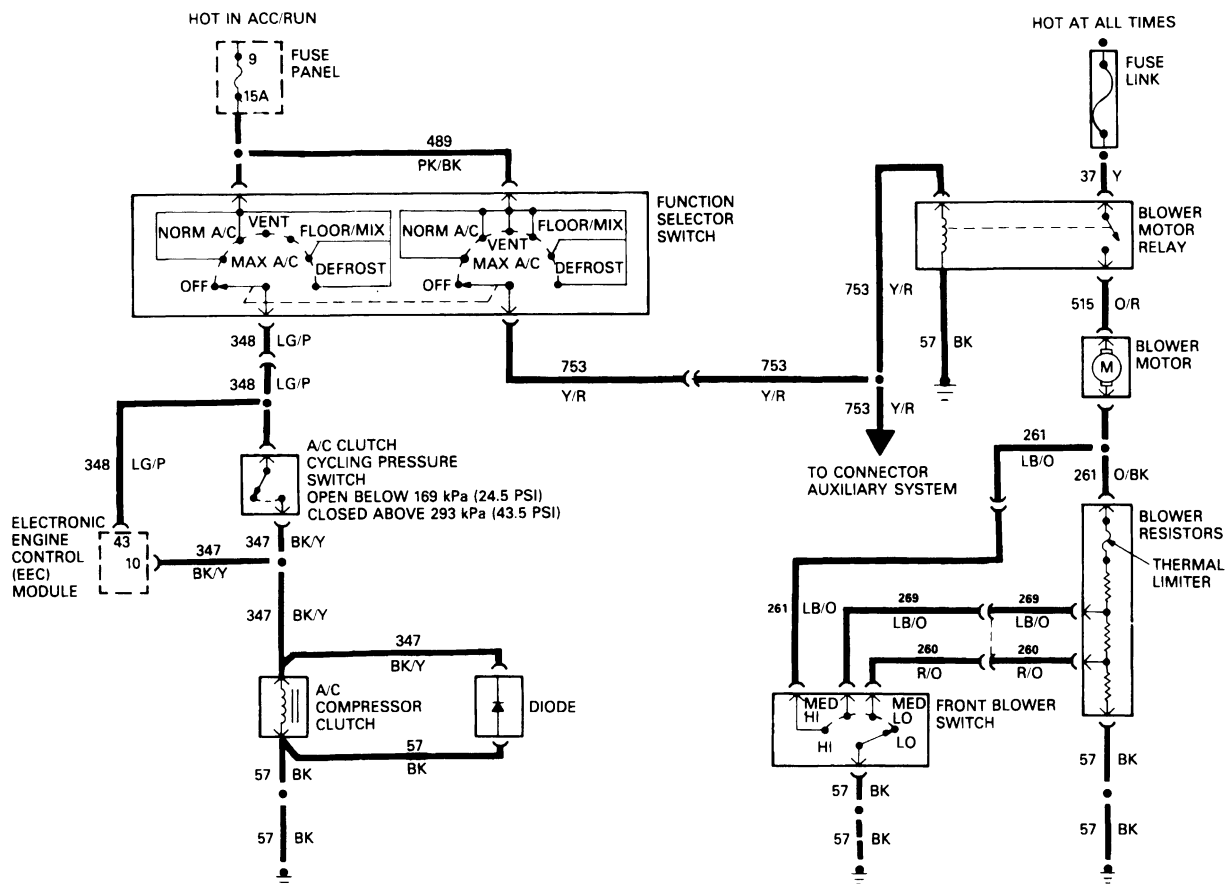
The manual air conditioning-heater system blower motor electrical circuit uses ground side switching. When performing blower motor voltage tests on systems with ground side switching, the voltage reading must be taken across the motor wires.

Test Procedure

1. Place the temperature selector lever in the **WARM** position.
2. Place the function selector lever in the **FLOOR** position.
3. Insert the probes of a voltmeter into the wire holes of the motor's two hardshell connectors and make contact with the wire terminals. Measure the voltage drop across motor.
4. With the engine running (battery voltage of approximately 14.2 volts), the voltage reading should be within specified range for each blower switch position as indicated in the Electrical Specifications chart in the Specifications portion of this section.

DIAGNOSIS AND TESTING (Continued)

Air Conditioning / Heater Electrical Schematic



WIRE COLORS	WIRE COLORS (CONT.)	SYMBOLS
BK — BLACK	O/BK — ORANGE/BLACK	△ CONNECTOR
BK/Y — BLACK/YELLOW	O/R — ORANGE/RED	● SPLICE
BR/O — BROWN/ORANGE	R/O — RED/ORANGE	⏏ GROUND
LB/O — LIGHT BLUE/ORANGE	Y — YELLOW	
LG/P — LIGHT GREEN/PURPLE	Y/R — YELLOW/RED	

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Blower Motor Current Draw Test

1. Separate the blower motor ground (black) wire at the blower motor resistor.
2. Connect the positive (+) ammeter lead to the female spade connector and the negative (-) ammeter lead to the resistor terminal.
3. Place the temperature selector lever in the mid-position and the function selector lever in a HEAT position to turn the blower on.
4. Turn the ignition switch to the RUN position.
5. With a fully charged battery, the blower motor current draw (amps) should be approximately as indicated for each blower speed in the Electrical Specifications chart in the Specifications portion of this section.

Vacuum System Tests

To test the air conditioning-heater control system, start the engine and move the function selector lever slowly from one position to another. A momentary hiss should be heard as the function selector lever is moved from one position to another indicating that vacuum is available at the control assembly. A continuous hiss at the control assembly indicates a major leak somewhere in the system. It does not necessarily indicate that the leak is at the control assembly.

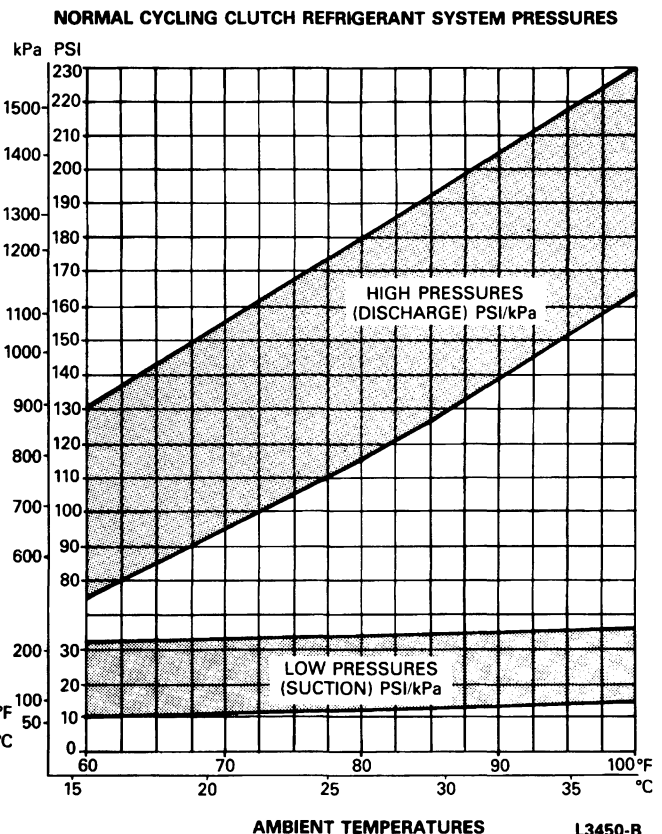
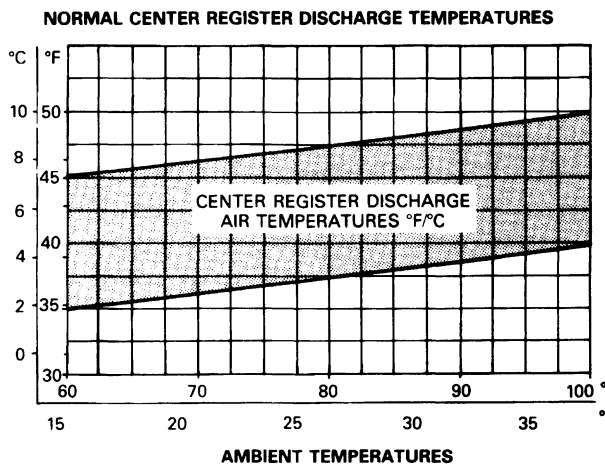
DIAGNOSIS AND TESTING (Continued)

If a momentary hiss cannot be heard when the function selector lever is moved from one position to another, check for a kinked, pinched or disconnected vacuum source hose. Also, inspect the check valve between the intake manifold and the vacuum reservoir to be sure it is working properly.

If a momentary hiss can be heard when the function selector lever is moved from one position to another, vacuum is available at the control assembly. Then, cycle the function selector through each position with the blower on HI and check the location(s) of the discharge air. The air flow schematic and vacuum control chart shown indicates which vacuum motors are actuated for each position of the function selector lever along with an air flow diagram of the system. The airflow diagram shows the position of each door when vacuum is applied and when there is no vacuum applied. With these charts, air flow for each position of the control assembly can be determined. If a vacuum motor fails to operate, the inoperative motor can readily be found because the airflow will be incorrect.

THESE CONDITIONAL REQUIREMENTS
FOR THE CYCLING CLUTCH SYSTEM
TESTS MUST BE SATISFIED TO
OBTAIN ACCURATE PRESSURE READINGS.

- STABILIZED PRESSURES
- STABILIZED IN CAR TEMPERATURES
@ 21° TO 27°C (70° TO 81°F)
- MAXIMUM A/C (RECIRCULATING AIR)
- MAXIMUM BLOWER SPEED
- 1500 ENGINE RPM
- COMPRESSOR CLUTCH ENGAGED



If a vacuum motor is inoperative, check the operation of the motor with Rotunda Vacuum Tester 021-00014 or equivalent. If the vacuum motor operates properly, the vacuum hose is probably pinched, kinked, disconnected or has a hole in it.

Refrigerant System

Diagnosis of refrigerant system performance must be done by analyzing the high and low pressure readings in the system. Compare the pressure readings to the chart shown to determine if the system pressures are normal. The conditional requirements for the refrigerant system tests must be satisfied to obtain accurate pressure readings.

NOTE: If conditional requirements are not satisfied, a normal system may appear to be functioning improperly. If they cannot be satisfied, pressure readings although inaccurate may be used to help determine the cause of a system problem.

DIAGNOSIS AND TESTING (Continued)

REFRIGERANT SYSTEM PRESSURE AND CLUTCH CYCLE TIMING EVALUATION CHART
FOR FIXED ORIFICE TUBE CYCLING CLUTCH SYSTEMS

NOTE: Normal system conditional requirements must be maintained to properly evaluate refrigerant system pressures.
Refer to charts applicable to system under test.

HIGH (DISCHARGE) PRESSURE	LOW (SUCTION) PRESSURE	CLUTCH CYCLE TIME			COMPONENT — CAUSES
		RATE	ON	OFF	
HIGH	HIGH	CONTINUOUS RUN			CONDENSER — Inadequate Airflow
HIGH	NORMAL TO HIGH				ENGINE OVERHEATING
NORMAL TO HIGH	NORMAL				AIR IN REFRIGERANT. REFRIGERANT OVERCHARGE (a) HUMIDITY OR AMBIENT TEMP. VERY HIGH (b).
NORMAL	HIGH				FIXED ORIFICE TUBE — Missing. O-Rings Leaking/Missing
NORMAL	HIGH	SLOW	LONG	LONG	CLUTCH CYCLING SWITCH — High Cut-In
NORMAL	NORMAL	SLOW OR NO CYCLE	LONG OR CONTINUOUS	NORMAL OR NO CYCLE	MOISTURE IN REFRIGERANT SYSTEM. EXCESSIVE REFRIGERANT OIL
		FAST	SHORT	SHORT	CLUTCH CYCLING SWITCH — Low Cut-In or High Cut-Out
NORMAL	LOW	SLOW	LONG	LONG	CLUTCH CYCLING SWITCH — Low Cut-Out
NORMAL TO LOW	HIGH	CONTINUOUS RUN			Compressor — Low Performance
NORMAL TO LOW	NORMAL TO HIGH				A/C SUCTION LINE — Partially Restricted or Plugged (c)
NORMAL TO LOW	NORMAL	FAST	SHORT	NORMAL	EVAPORATOR — Low Airflow
			SHORT TO VERY SHORT	NORMAL TO LONG	CONDENSER, FIXED ORIFICE TUBE, OR A/C LIQUID LINE — Partially Restricted or Plugged
			SHORT TO VERY SHORT	SHORT TO VERY SHORT	LOW REFRIGERANT CHARGE
			SHORT TO VERY SHORT	LONG	EVAPORATOR CORE — Partially Restricted or Plugged
NORMAL TO LOW	LOW	CONTINUOUS RUN			A/C SUCTION LINE — Partially Restricted or Plugged. (d) CLUTCH CYCLING SWITCH — Sticking Closed
LOW	NORMAL	VERY FAST	VERY SHORT	VERY SHORT	CLUTCH CYCLING SWITCH — Cycling Range Too Close
ERRATIC OPERATION OR COMPRESSOR NOT RUNNING		—	—	—	CLUTCH CYCLING SWITCH — Dirty Contacts or Sticking Open. POOR CONNECTION AT A/C CLUTCH CONNECTOR OR CLUTCH CYCLING SWITCH CONNECTOR. A/C ELECTRICAL CIRCUIT ERRATIC — See A/C Electrical Circuit Wiring Diagram
ADDITIONAL POSSIBLE CAUSE COMPONENTS ASSOCIATED WITH INADEQUATE COMPRESSOR OPERATION					
<ul style="list-style-type: none"> • COMPRESSOR CLUTCH Slipping • LOOSE DRIVE BELT • CLUTCH COIL Open — Shorted, or Loose Mounting • CONTROL ASSEMBLY SWITCH — Dirty Contacts or Sticking Open • CLUTCH WIRING CIRCUIT — High Resistance, Open or Blown Fuse • A/C HIGH PRESSURE CUT-OUT SWITCH — Dirty Contacts or Sticking Open (If So Equipped) 					
ADDITIONAL POSSIBLE CAUSE COMPONENTS ASSOCIATED WITH A DAMAGED COMPRESSOR					
<ul style="list-style-type: none"> • CLUTCH CYCLING SWITCH — Sticking Closed or Compressor Clutch Seized • SUCTION ACCUMULATOR DRIER — Refrigerant Oil Bleed Hole Plugged • REFRIGERANT LEAKS 					
(a) Compressor may make noise on initial run. This is slugging condition caused by excessive liquid refrigerant.					
(b) Compressor clutch may not cycle in ambient temperatures above 80°F depending on humidity conditions.					
(c) Low pressure reading will be normal to high if pressure is taken at accumulator and if restriction is downstream of service access valve.					
(d) Low pressure reading will be low if pressure is taken near the compressor and restriction is upstream of service access valve.					

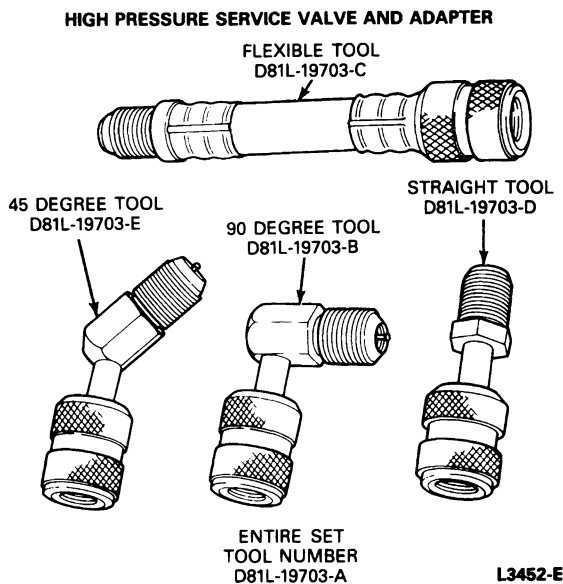
CCL 1941-B

DIAGNOSIS AND TESTING (Continued)

Once the problem is corrected, take additional pressure readings while meeting the conditional requirements for the pressure tests to be sure that the problem has been corrected.

The low-pressure service access standard gauge port is located on the suction line under the center of the cowl. A special Service Access Adapter D81L-19703-A or Motorcraft Tools YT-354 or 355 or equivalents are necessary to connect a manifold gauge set to the high pressure service access gauge port valve. The adapters contain a Schrader-type valve core to prevent accidental discharge of refrigerant if the service hose is inadvertently disconnected from the adapter. Refer to Section 12-03 for details regarding refrigerant system service and for procedures describing the use of the Special Tee Adapter D87P-19703-A.

NOTE: Whenever a refrigerant line is replaced, or service for a major component requires the opening of the system to the atmosphere, the suction accumulator / drier must be replaced.

**Excess Moisture**

One of the characteristics of an air conditioner is that it will remove moisture from air passing through the cooled evaporator core. This moisture (condensate) then runs off the evaporator core and is drained from the evaporator case. In some instances, leaves or other foreign material plug the drain and sometimes mechanical conditions such as a damaged drain tube prevent the condensate from draining from the evaporator case. If either of these conditions exists, condensate may drip from the evaporator case or be blown from the instrument panel registers. This cause of insufficient evaporator case drainage can best be eliminated by performing the following inspection and correction procedures.

1. Inspect the vehicle dash panel for missing grommets, plugs or seals. Also, inspect the tightness of the evaporator case-to-dash panel retaining nuts to correct a seal leak between the evaporator case and the dash panel.
2. Inspect for possible air leaks around the heater lines at the evaporator case and around the electrical connector at the bottom of the evaporator case. Seal any leaks around the refrigerant lines with insulating tape Motorcraft YZ-1 or Caulking Cord D6AZ-19560-A or equivalent.

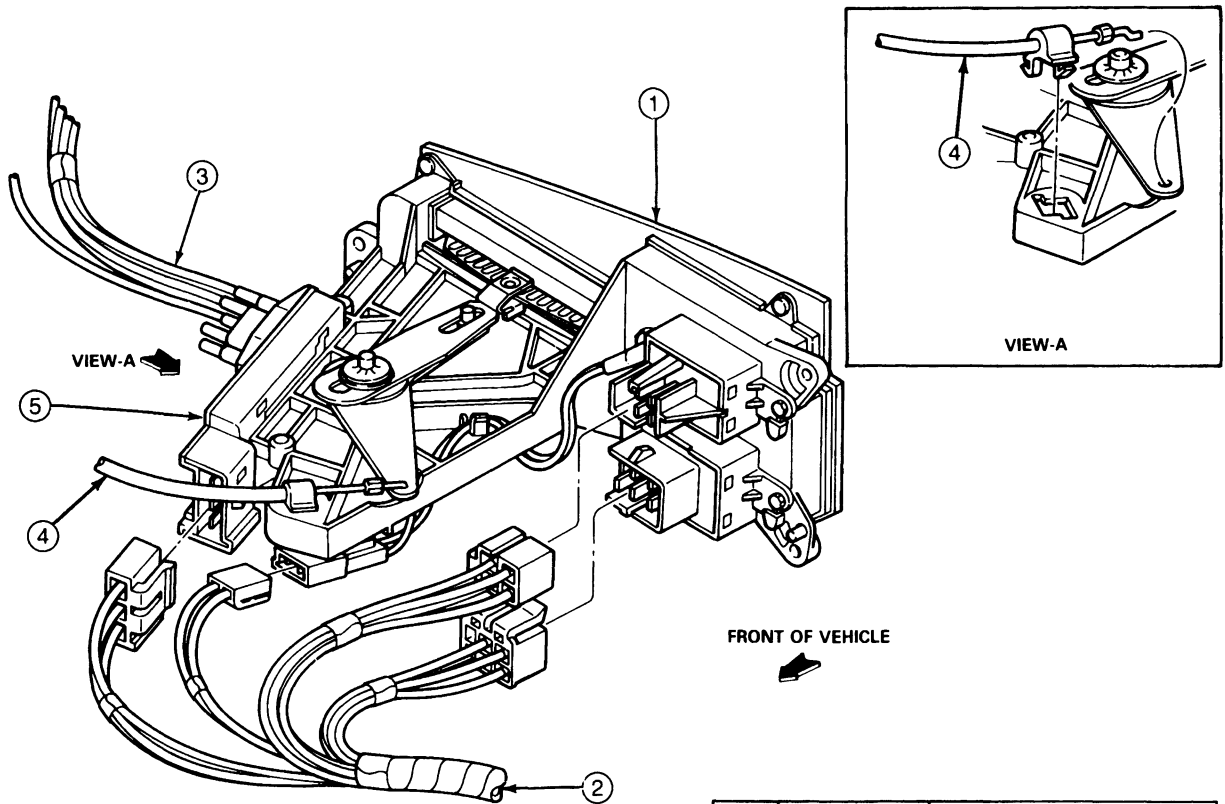
REMOVAL AND INSTALLATION**Control Assembly****Removal and Installation**

1. Remove trim applique.
2. Remove three screws retaining control assembly to mounting bracket.
3. Carefully pull control assembly from opening in mounting bracket.
4. Disconnect electrical wiring connector from blower switch, vacuum selector, and illumination bulb.
5. Remove push-on vacuum harness retaining clips from vacuum selector.
6. Disconnect vacuum harness from vacuum selector.
7. Remove temperature control cable from control assembly. Disconnect bullet-type cable retainer from the bracket using the Control Cable Removal Tool T83P-18532-AH or needlenose pliers to compress the retaining ears. Both cable "S" bends are removed from the bottom side of the levers by rotating cable wire 90 degrees to the lever.

For installation, follow removal procedures in reverse order.

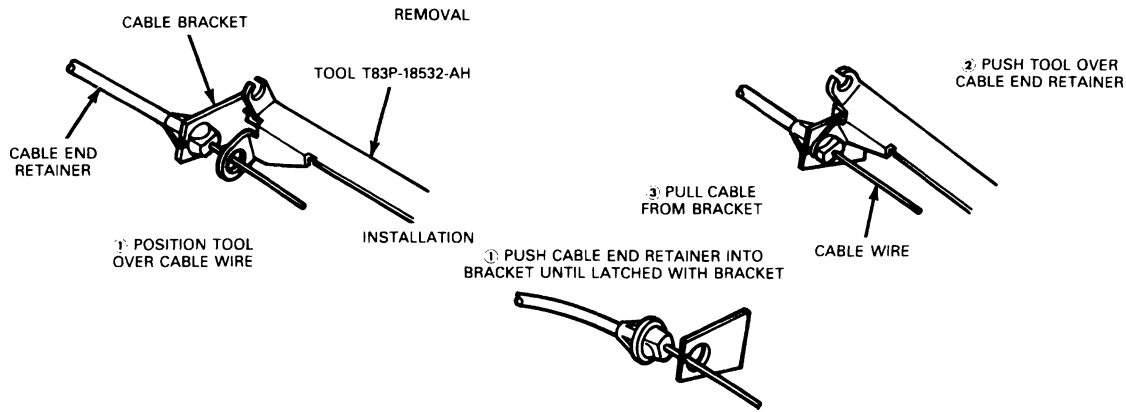
REMOVAL AND INSTALLATION (Continued)

Control Assembly, Rear View



ITEM	PART NUMBER	DESCRIPTION
1	18549/19980	CONTROL ASSEMBLY
2	14401	WIRING ASSEMBLY
3	—	VACUUM HARNESS
4	19D674	TEMP. CONTROL CABLE ASSY.
5	E8UH-19D961-AA	VACUUM SELECTOR VALVE

CCL 4190-A



CCL 4247-A

REMOVAL AND INSTALLATION (Continued)**Blower Switch****Removal and Installation**

1. Remove knob from blower switch.
2. Remove trim applique.
3. Remove four screws retaining control assembly mounting bracket to instrument panel.
4. Carefully remove mounting bracket and control assembly from opening in instrument panel.
5. To remove blower switch, disconnect wire harness connector from blower switch and remove switch mounting bracket from control assembly (one screw).

For installation, follow removal steps in reverse order.

3. Connect vacuum harness to selector valve and install two pushnuts.
4. Connect wire harness connector to selector.
5. Position control assembly and bracket in instrument panel and install three retaining screws.
6. Install instrument panel trim panel.

Instrument Panel

Removal and installation of several components and assemblies described in this section require the removal and installation of the instrument panel. For instructions and illustrations, refer to Section 01-12B.

Vacuum Selector Valve**Removal**

1. Remove instrument panel trim panel.
2. Remove three screws retaining control assembly mounting bracket to instrument panel.
3. Carefully remove mounting bracket and control assembly from opening in instrument panel.
4. Disconnect wire harness connector from vacuum selector valve.
5. Remove two push-on vacuum harness retainer clips from vacuum selector and disconnect harness from valve.
6. Remove two screws retaining vacuum selector valve to control assembly.

Installation

1. Position temperature lever at left side of slot and function selector lever approximately 9.5mm (3/8 inch) from left side of slot.
2. Position vacuum selector valve on control assembly, engaging selector lever arms with selector valve. Install two retaining screws.

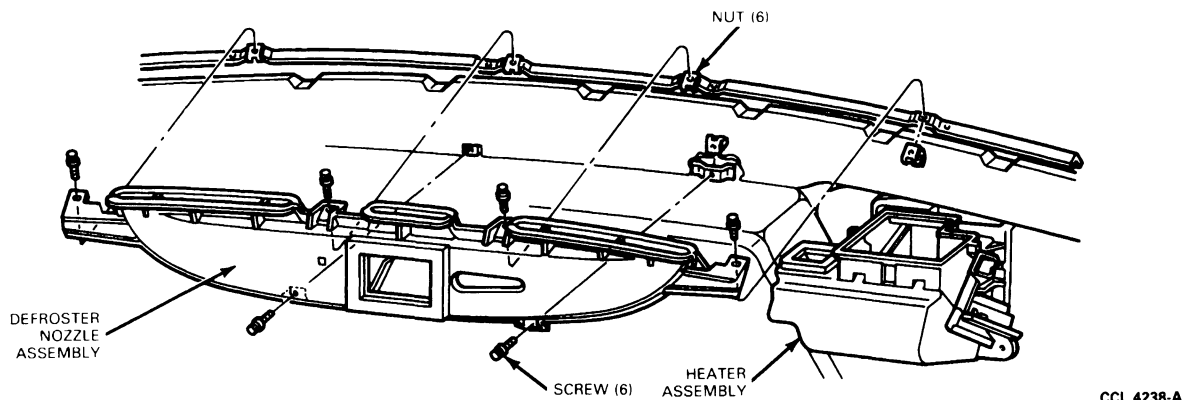
Defroster Nozzle

To remove the defroster nozzle, it is first necessary to remove the instrument panel, heater ducts and register ducts. Refer to the heater and register duct illustrations. Refer to Section 01-12B for instrument panel removal and installation.

Removal

1. Remove the instrument panel. Refer to the procedures in Section 01-12B.
2. Remove the plenum assembly as described in this section.
3. Remove the defroster nozzle mounting screws (four screws at the cowl top and two screws attached to instrument panel brackets).
4. Remove the defroster nozzle assembly.

For installation, follow removal steps in reverse order.

REMOVAL AND INSTALLATION (Continued)**Defroster Nozzle Assembly Installation**

CCL 4238-A

Right, Center and Left Register Assembly Removal

Refer to Section 12-02A.

Air Ducts

Remove instrument panel. Refer to Section 01-12B.

Left or Right Register Duct**Removal**

1. Remove the instrument panel. Refer to the procedures in Section 01-12B.
2. Remove the register duct mounting bolts and remove the duct.

Installation

1. Position the register duct and align the retainer holes.
2. Install the register mounting bolts.

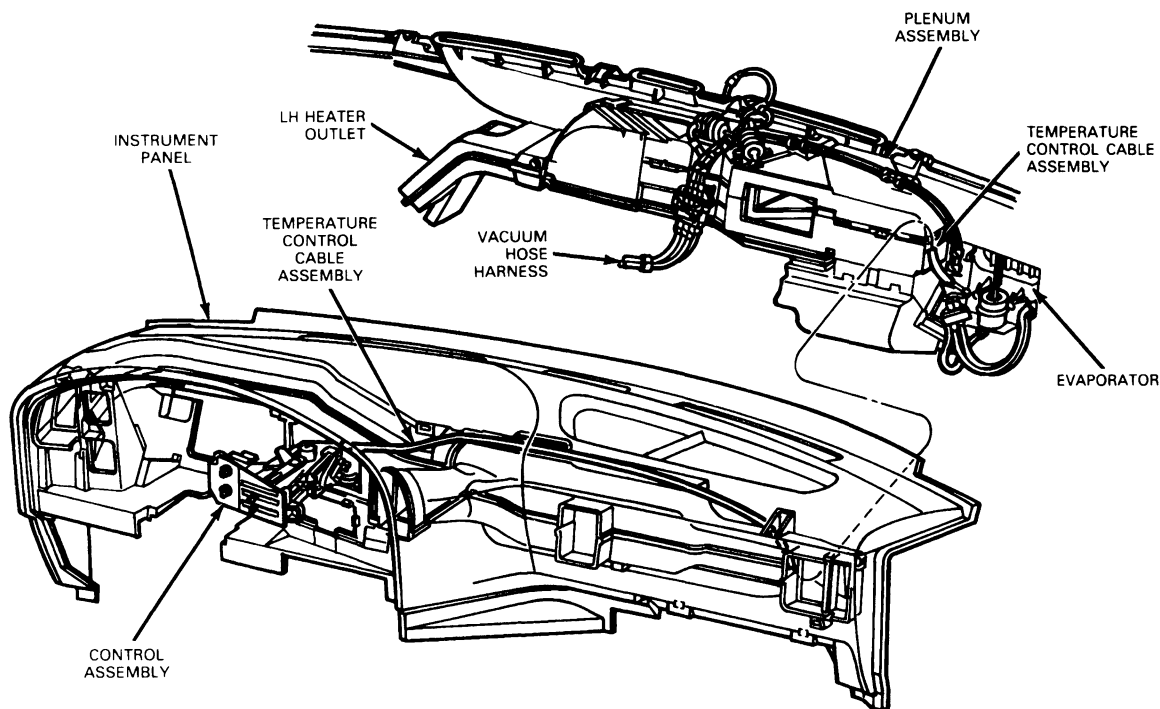
3. Install the instrument panel. Refer to Section 01-12B.

Plenum Chamber

The plenum chamber is located under the instrument panel on top of the heater core housing. For servicing the plenum chamber, vacuum harness, and plenum doors, it is necessary to remove the instrument panel. It is not required to remove the instrument panel to service the vacuum motors attached to the plenum.

Removal

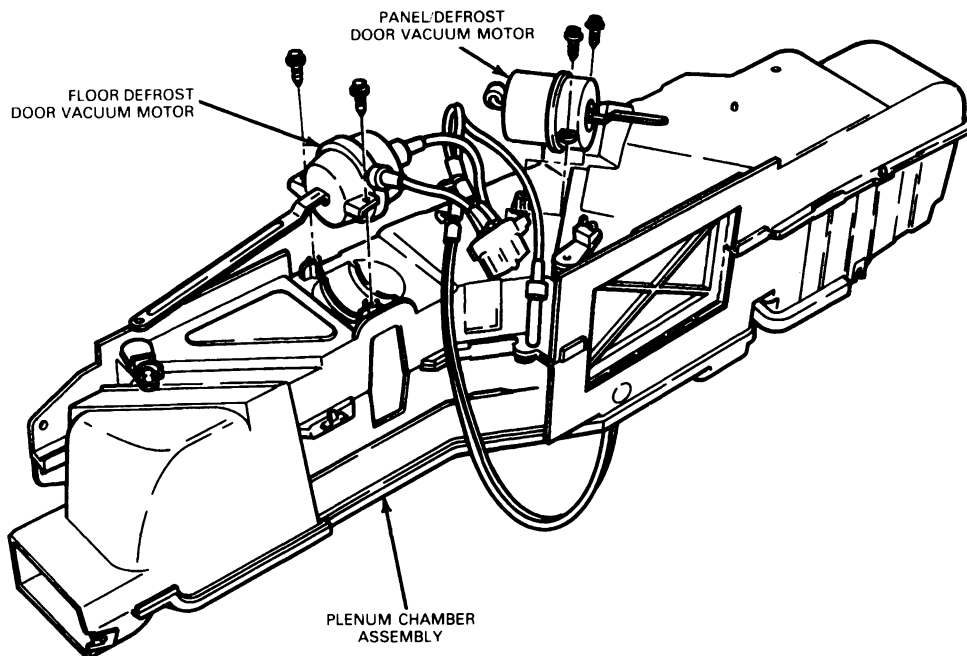
1. Disconnect the vacuum hoses from the heat-defrost vacuum motor and the air conditioner-heat vacuum motor.
2. Separate the plenum from the heater housing, center register duct, and heater air outlet duct and remove the plenum.
3. Remove the panel / defrost door and floor / defrost door vacuum motors from the plenum.

REMOVAL AND INSTALLATION (Continued)**Plenum Chamber Installation**

CCL 4237-A

Installation

1. Install heat-defrost and air conditioner-heat door vacuum motors on plenum.
2. Position plenum to center register duct, heater air outlet duct and evaporator-heater housing. Make sure clip on plenum is hooked over flange on evaporator-heater housing.
3. Install one retainer to attach center register duct and one retainer to attach heater air outlet duct to plenum.
4. Connect the blue vacuum hose to the top (end) of the air conditioner-heat door vacuum motor.
5. Connect the yellow vacuum hose to the top (end) of the heat-defrost door vacuum motor. Connect the red vacuum hose to the side of the heat-defrost door vacuum motor.
6. Install the instrument panel. Refer to Section 01-12B.
7. Check system for proper operation.

REMOVAL AND INSTALLATION (Continued)**Vacuum Motor Installation**

CCL 4223-A

**Outside/Recirculating Air Door Vacuum Motor
On Evaporator Case****Removal and Installation**

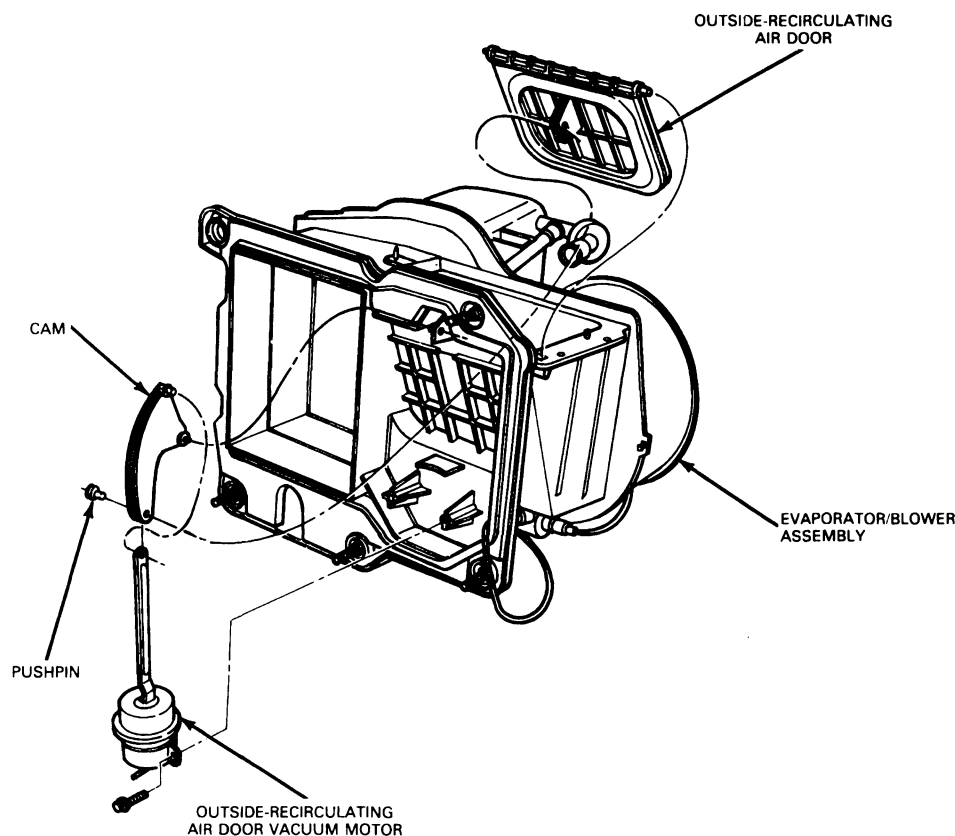
1. Remove two screws retaining motor to evaporator housing.
2. Disconnect the vacuum hose from outside-recirc. vacuum motor and remove motor and bracket.

3. Lift the vacuum motor until its arm is out of the channel which retains the arm to the pin. Slide the arm off the pin on the cam. Remove the motor.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Outside / Recirculating Air door



CCL 4224-A

Clutch Cycling Pressure Switch

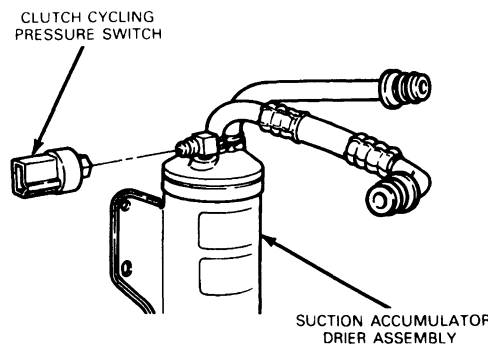
The clutch cycling pressure switch is attached to the suction accumulator / drier located in the engine compartment. In the A/C position, the pressure switch senses pressure in the drier and electrically controls the cycling of the clutch assembly to prevent the core from freezing the condensation which occurs. If allowed to build up, the ice would block airflow. The cut-in pressure of the compressor clutch is approximately 43.5 lbs (clutch is operative) and the cut-out pressure is approximately 24.5 lbs (clutch is inoperative).

Removal

1. Remove electrical connector from switch. Unscrew pressure switch from top of suction accumulator / drier.

Installation

1. Lubricate O-ring which is installed over switch threads. Use refrigerant oil.
2. Screw pressure switch onto top of suction accumulator / drier. Do not exceed specified torque limits. Tighten to 7-13 N·m (5-10 ft·lb). Install electrical connector.



CCL 4241-A

Blower Motor and Wheel Assembly

Removal and Installation

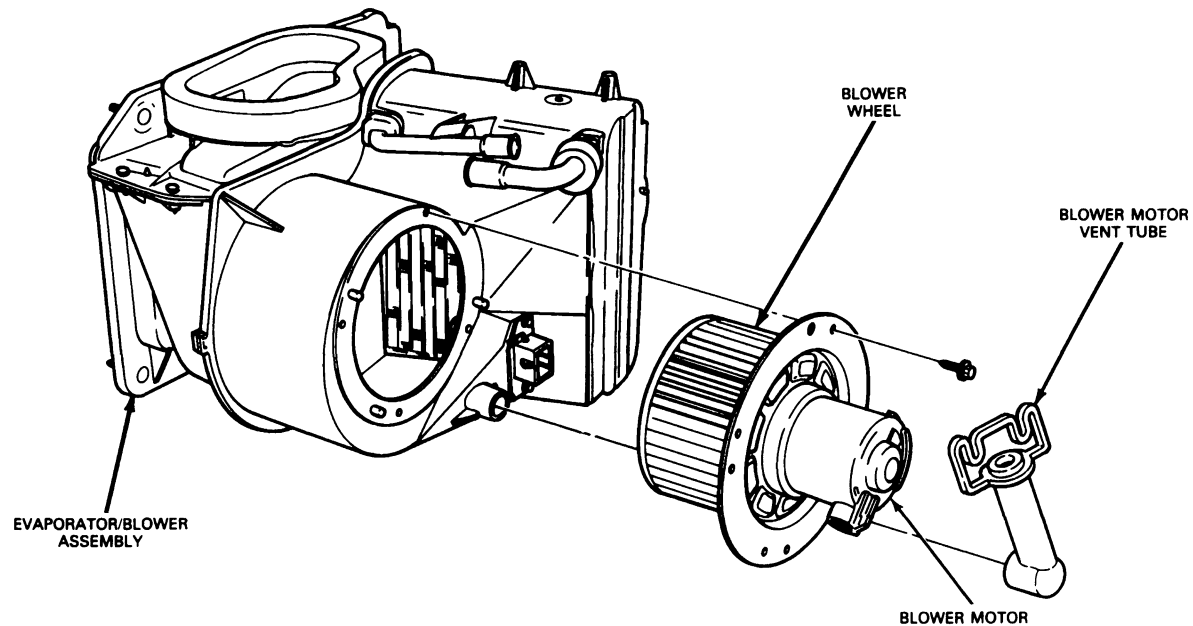
1. Disconnect blower motor electrical connector.
2. Remove four screws retaining blower motor mounting plate to the evaporator case assembly.

REMOVAL AND INSTALLATION (Continued)

3. Remove motor and wheel assembly from evaporator case. Align the flat spot on the motor mounting plate with the accumulator / drier to provide clearance with the accumulator / drier.

4. If old wheel is to be used on new motor, position it on the motor shaft so that distance from mounting to base of wheel is same as previous installation.

For installation, follow removal steps in reverse order.

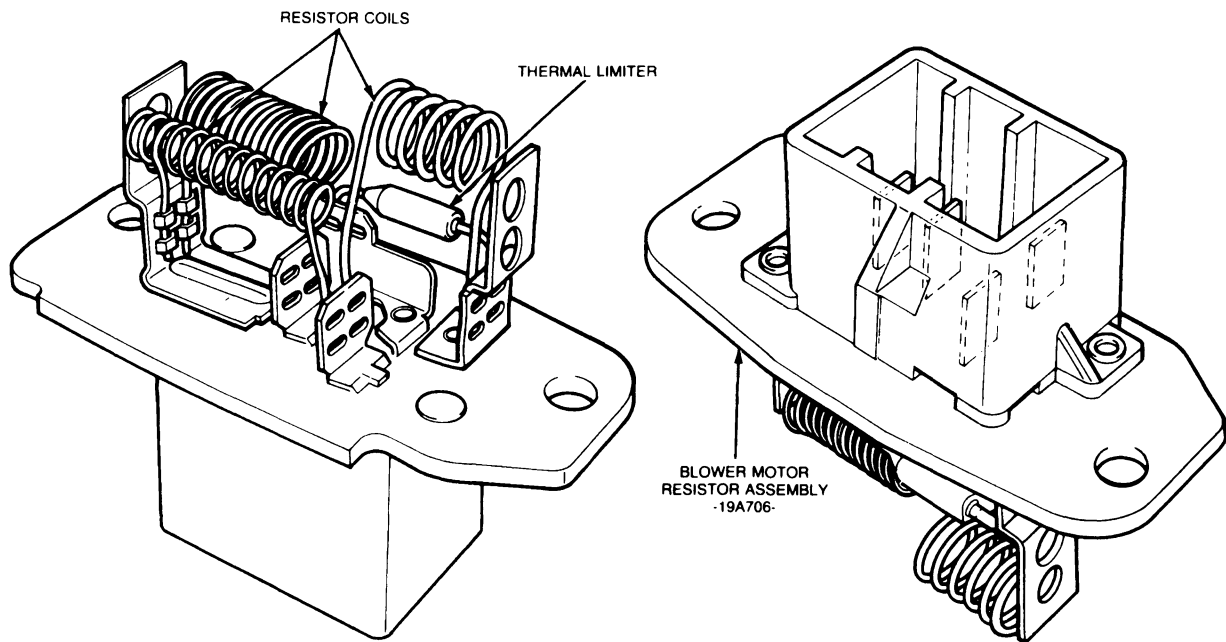
Blower Motor Installation

CCL 4252-B

Resistor Assembly**Removal and Installation**

1. Disconnect electrical connector from resistor located on the evaporator case in the engine compartment.
2. Remove two screws from old resistor on front face of air conditioner blower evaporator-heater cover and remove resistor.

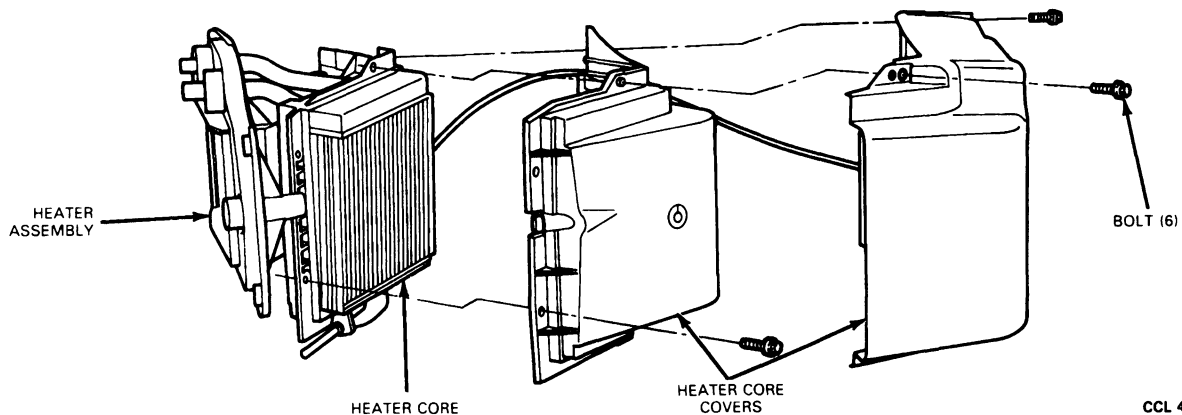
3. Install new resistor to evaporator-heater cover with two screws and connect electrical connector.

REMOVAL AND INSTALLATION (Continued)**Blower Motor Resistor Assembly**

CCL 2733-A

Heater Core and Seal Assembly**Removal**

1. Remove the inlet and outlet hoses from the heater core in engine compartment. Plug hoses with a 15.875mm (5/8-inch) diameter plug.
2. Remove the snap in modesty panel that runs around the lower edge of the instrument panel.
3. Remove the six screws from the heater core covers located on both sides of the case underneath the instrument panel. Remove cover.
4. Remove heater core and seal from the case.

Heater Core and Covers

CCL 4240-A

Installation

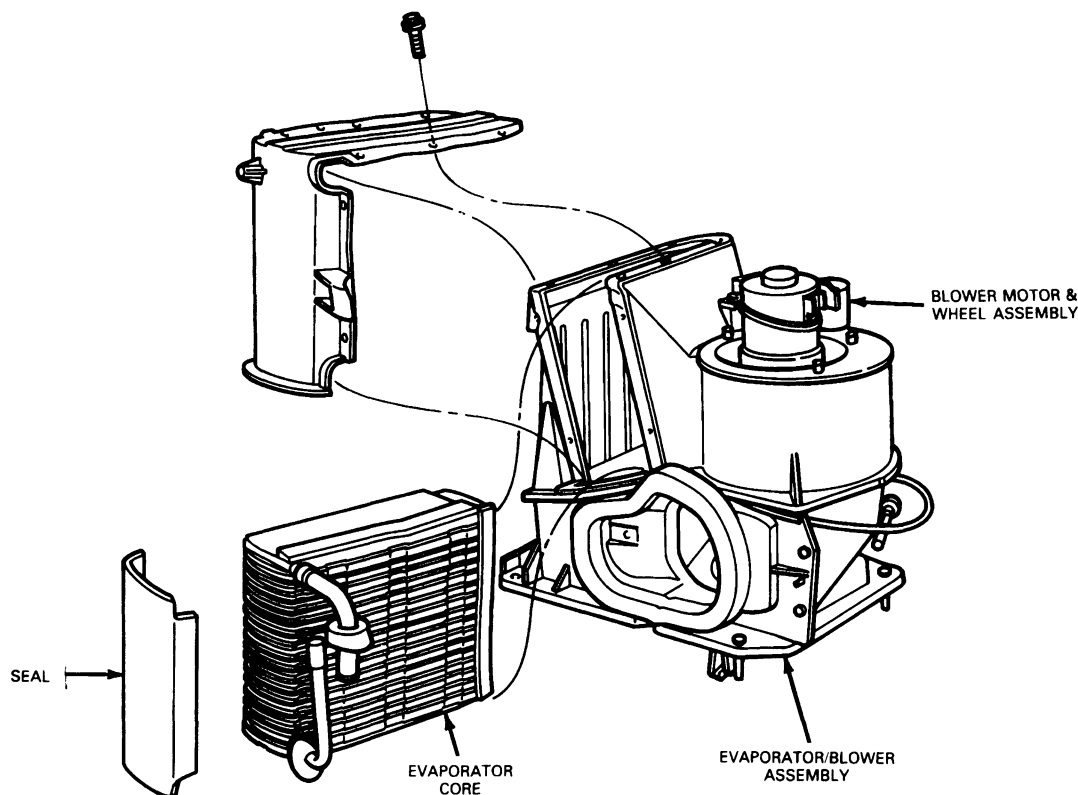
1. Position the heater core and seal assembly in the heater case.
2. Position heater covers and install the six retaining screws.
3. Install the modesty panel on the instrument panel.

REMOVAL AND INSTALLATION (Continued)

4. Remove plugs from hoses.
5. Install inlet and outlet hoses to heater core.

6. Fill the cooling system to specifications. Refer to the Powertrain / Drivetrain Manual, Section 03-03.

Evaporator Core Assembly



CCL 4268-B

Evaporator Core

Removal

CAUTION: Replacement of a refrigerant line or a major component such as an evaporator core requires replacement of the suction accumulator / drier.

1. Discharge the refrigerant from the air conditioning system. Refer to the procedures in Section 12-03.
2. Disconnect and remove the auxiliary battery (if equipped).
3. Disconnect the electrical connector and vacuum hoses from the manifold absolute pressure (MAP) sensor.
4. Disconnect the evaporator outlet line from the suction accumulator / drier.
5. Remove the screw that attaches the liquid line to the evaporator case and disconnect the liquid line from the evaporator inlet.

6. Remove the evaporator support bracket by removing the bolt from the fender apron extension and the two screws from the evaporator case.
7. Remove the seven screws from the evaporator cover and remove the cover.
8. Remove the evaporator and seal assembly.

Installation

When installing the evaporator core and seal assembly, make sure all new O-ring seals are used and positioned properly in their respective location.

CAUTION: Use care not to damage or bend fins when handling evaporator core.

1. Position the evaporator and seal assembly into the evaporator case.
2. Position the evaporator cover on the evaporator case.
3. Position the evaporator support bracket into its mounting position and install the attaching bolt and two screws.

REMOVAL AND INSTALLATION (Continued)

4. Connect the evaporator liquid line to the evaporator core.
5. Connect the evaporator outlet line to the suction accumulator / drier.
6. Install the seven screws that attach the evaporator cover to the evaporator case.
7. Connect the electrical connector and vacuum lines to the manifold absolute pressure (MAP) sensor.
8. Install the auxiliary battery (if equipped).
9. Recharge the air conditioning system. Refer to the procedures in Section 12-03.

Fixed Orifice Tube

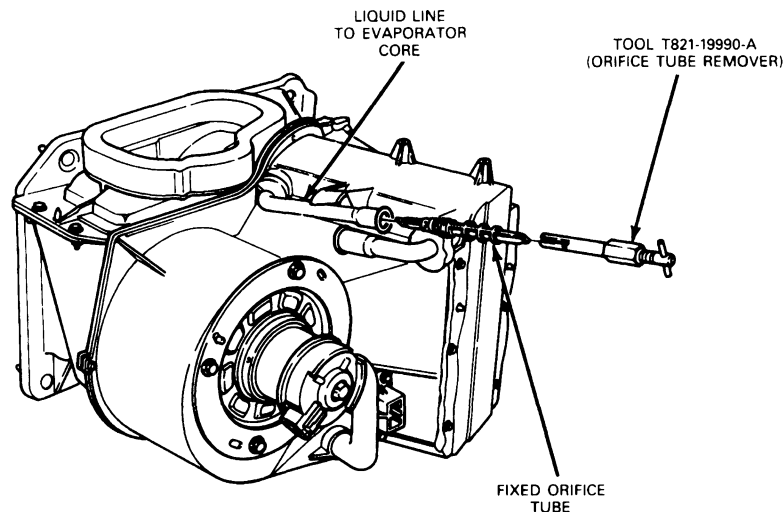
The fixed orifice tube is constructed with a plastic body, two screens and a small brass tube down the center of the orifice body. Two O-rings are around the orifice tube body to seal against leakage around the body.

CAUTION: Do not attempt to remove the fixed orifice tube with pliers or by twisting tube. To do so will break the fixed orifice tube body in the evaporator core tube. Use only the recommended tool and follow the recommended service procedures.

Fixed Orifice Tube Removal**Removal**

1. Discharge refrigerant from air conditioning system. Observe all safety precautions. Refer to Section 12-03.
2. Remove the screw that attaches the liquid line to the evaporator case.
3. Disconnect liquid line from evaporator core. Cap liquid line to prevent entry of dirt and excessive moisture.
4. Squirt a small amount of clean refrigerant oil into evaporator core inlet tube to lubricate tube and orifice O-ring during removal of the fixed orifice tube from evaporator core tube.
5. Engage Fixed Orifice Tube Remover / Installer T83L-19990-A (Motorcraft YT-1008) with the two tangs on the fixed orifice tube.

CAUTION: Do not twist or rotate the fixed tube in the evaporator core tube as it may break off the evaporator core tube.



CCL 4242-A

6. Hold the T-handle of Fixed Orifice Tube T83L-19990-A or Motorcraft YT-1008 to keep it from turning and run the nut on tool down against evaporator core tube until the orifice is pulled from tube.
7. If the fixed orifice tube breaks in the evaporator core tube, it must be removed from the tube with Broken Orifice Tube Extractor T83L-19990-B or Motorcraft YT-1009.

8. To remove a broken orifice tube, insert screw end of extractor T83L-19990-B or Tool YT-1009, into evaporator core tube and thread screw end of tool into brass tube in center of fixed orifice tube. Then, pull fixed orifice tube from evaporator core tube.

REMOVAL AND INSTALLATION (Continued)

9. If only the brass center tube is removed during Step 7, insert the screw end of T83L-19990-B Tool YT-1009 into evaporator core tube and screw end of tool into fixed orifice tube body. Then, pull fixed orifice tube body from the evaporator core tube.

Installation

1. Lubricate O-rings on fixed orifice tube body liberally with clean refrigerant oil.
2. Place fixed orifice tube in Fixed Orifice Tube Remover / Replacer T83L-19990-A and insert fixed orifice tube into evaporator core tube until orifice is seated at the stop.
3. Remove tool from fixed orifice tube.
4. After checking liquid line for a missing or damaged spring lock coupling garter spring and replacing or repairing, as necessary, install two new specified O-rings lubricated with clean refrigerant oil into spring lock coupling male fitting. Insert male fitting into inlet tube until spring lock is fully engaged.
5. Install the screw that attaches the liquid line to the evaporator case.
6. Leak test, evacuate and charge system. Refer to Section 12-03. Observe all safety precautions.

Condenser Assembly Installation

7. Check system for proper operation.

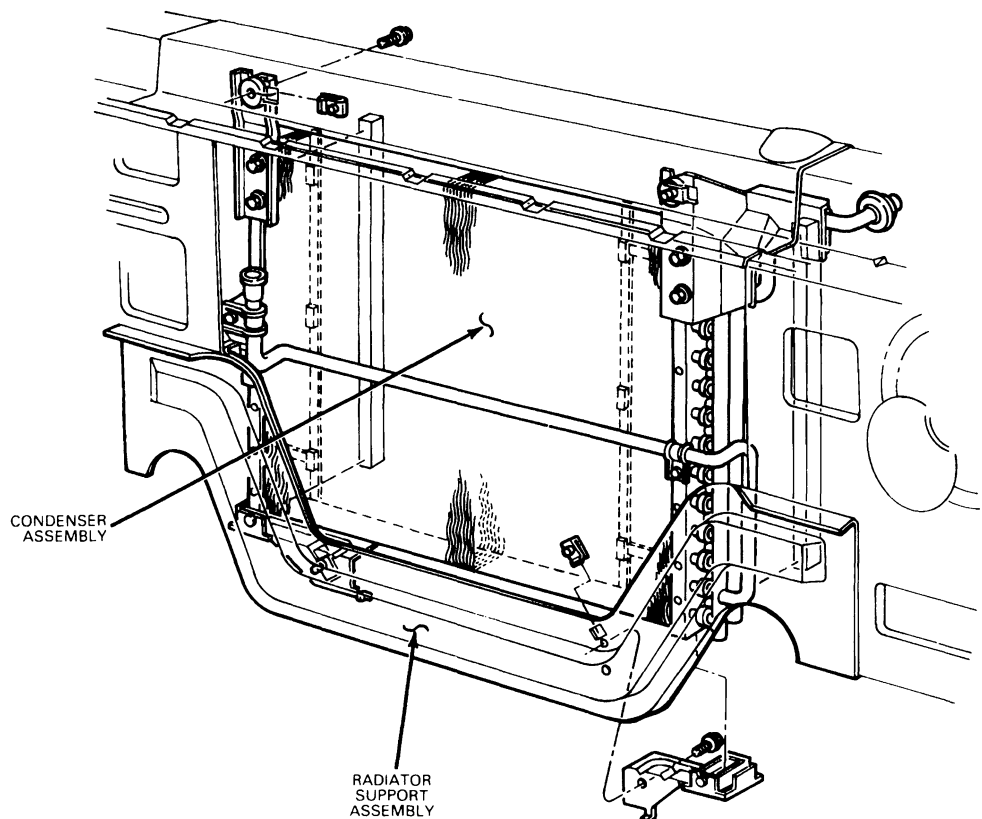
Condenser Assembly

CAUTION: Replacement of a refrigerant line or a major component such as a condenser requires replacement of the suction accumulator/drier.

The condenser assembly is mounted forward of the radiator on the radiator support.

Removal

1. Discharge refrigerant from system following recommended procedures. Refer to Section 12-03. Observe all safety precautions.
2. Disconnect compressor discharge line and liquid line from condenser using the spring-lock coupling tool. Cap refrigerant lines to prevent entry of excessive moisture and dirt.
3. Remove two screws retaining hood latch to radiator support and position hood latch out of way.
4. Remove nine screws retaining top edge of radiator grille to radiator support.
5. Remove one screw retaining center area of grille to grille center support.



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REMOVAL AND INSTALLATION (Continued)

6. Remove one screw retaining grille center support to radiator support.
7. Working under vehicle, reposition splash shield and remove two condenser lower retaining nuts.
8. Remove two bolts retaining the top of condenser to radiator upper support.
9. Remove four bolts retaining each end of radiator upper support to radiator side supports.
10. Carefully pull top edge of grille forward and remove radiator upper support.
11. Lift condenser from vehicle.

Installation

1. If the condenser is to be replaced, add one fluid ounce of clean refrigerant oil to the condenser.
2. Position condenser to vehicle and install two condenser lower retaining nuts.
3. Position radiator upper support to vehicle using care not to damage radiator grille.
4. Install four bolts retaining each end of radiator upper supports to side supports.
5. Install two bolts retaining top end of condenser to radiator upper support.
6. Install one screw retaining grille center support to radiator support.
7. Install nine screws retaining top edge of grille.
8. Install one screw retaining center area of grille to grille center support.
9. Connect compressor discharge line and liquid line top condenser. Use new O-rings lubricated with clean refrigerant oil.

NOTE: Service parts are available for O-rings and garter springs.

10. Install hood latch and adjust latch.
11. Leak test, evacuate and charge system. Refer to Section 12-03. Observe all safety precautions.
12. Check system for proper operation.

Suction Accumulator / Drier

Replace the accumulator / drier when:

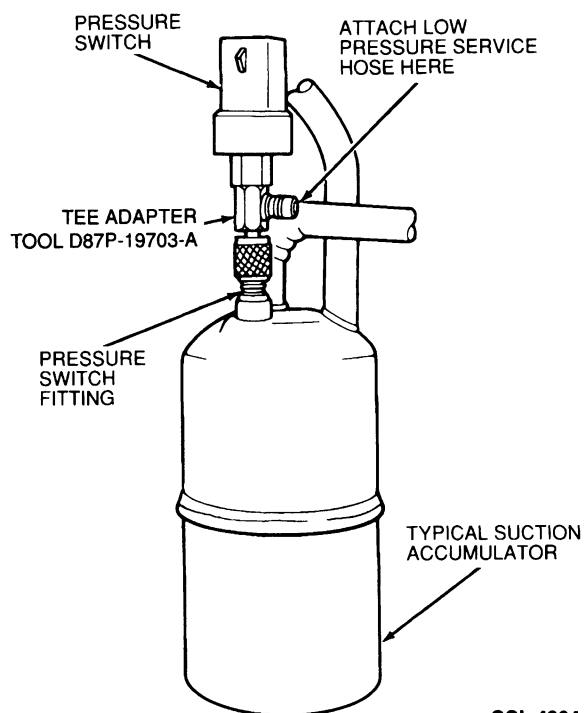
- The accumulator / drier is restricted, plugged or perforated.
- The system has been left open for more than 24 hours (system completely discharged).
- There is evidence of moisture in the system (i.e. internal corrosion of metal lines or the refrigerant oil is thick and dark).
- A component such as a condenser, evaporator refrigerant line, or a seized compressor is replaced. Flush system and replace orifice tube when replacing a seized or damaged compressor.

- There is more than five ounces of compressor oil in it, indicating that the bleed hole is clogged. (Be sure to make this check if the compressor is replaced for lack of performance or seizure.)

CAUTION: The suction accumulator / drier must be replaced whenever a condenser, evaporator core, refrigerant line, seized compressor or damage to some other major component requires opening of the refrigerant circuit in order to service the difficulty.

Do not replace the accumulator / drier every time:

- There is a loss of refrigerant charge.
- A component (except as described above) is changed.
- A dent is found in the outer shell of the accumulator / drier.

**Removal**

1. Discharge refrigerant from air conditioning system. Refer to Section 12-03. Observe all safety precautions.
2. Disconnect electrical connector from pressure switch.
3. Remove pressure switch by unscrewing it from suction accumulator.
4. Disconnect suction line from suction accumulator / drier using Spring Lock Coupling Tool.
5. Disconnect the evaporator core outlet tube from the suction accumulator / drier.
6. Remove the engine vacuum reservoir.

REMOVAL AND INSTALLATION (Continued)

7. Remove the three accumulator / drier mounting bolts and remove the assembly.

Installation

1. Place the accumulator / drier into its mounting position and install the three mounting bolts.
2. Install the engine vacuum reservoir.
3. Connect the evaporator core outlet tube to the accumulator / drier.
4. Connect the suction line to the accumulator / drier.
5. Install the clutch cycling pressure switch onto the accumulator / drier.
6. Connect the electrical connector to the clutch cycling pressure switch.
7. Leak test, evacuate and charge the A/C system as explained in Section 12-03.

Compressor Clutch and Field Coil

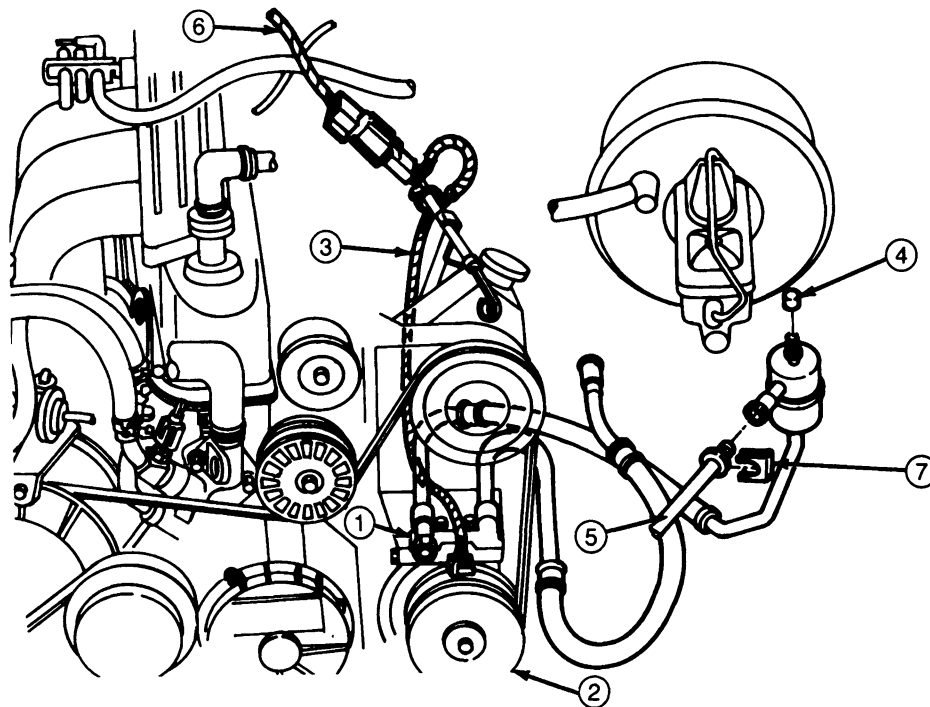
Refer to Section 12-03F and 12-03C for information on the FS-6 and FX-15 compressor clutch and field coil assemblies.

Heater and Air Conditioner Tube and Hose Routing

The following illustrations show heater hose and air conditioner line routing for the 4.9L (300 CID), 5.0L (302 CID), 5.8L (351 CID), 7.5L (460 CID) gasoline engines and 7.3L (447 CID) diesel engine.

Compressor Assembly

Refer to Section 12-03F for compressor removal and installation procedures.

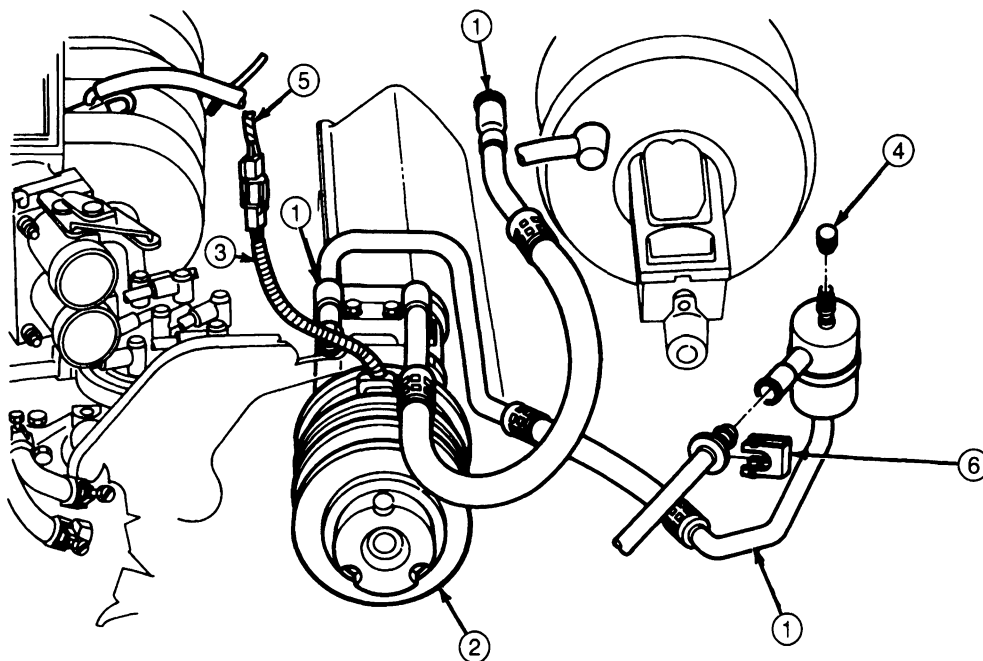
REMOVAL AND INSTALLATION (Continued)**Heater Hose and Air Conditioner Line Routing, 4.9L Engine**

ITEM	BASIC PART NUMBER	DESCRIPTION	ITEM	BASIC PART NUMBER	DESCRIPTION
1.	19D734	MANIFOLD AND TUBE ASSY.	4.	19D702	CHARGING VALVE CAP ASSY.
2.	19D629	COMPRESSOR AND CLUTCH ASSY.	5.	19710	CONDENSER LINE
3.	19D887	WIRING ASSY.	6.	12A581	WIRING ASSY.
			7.	19E746	SPRING LOCK COUPLING CLIP

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REMOVAL AND INSTALLATION (Continued)

Heater Hose and Air Conditioner Line Routing, 5.0L and 5.8L Engines

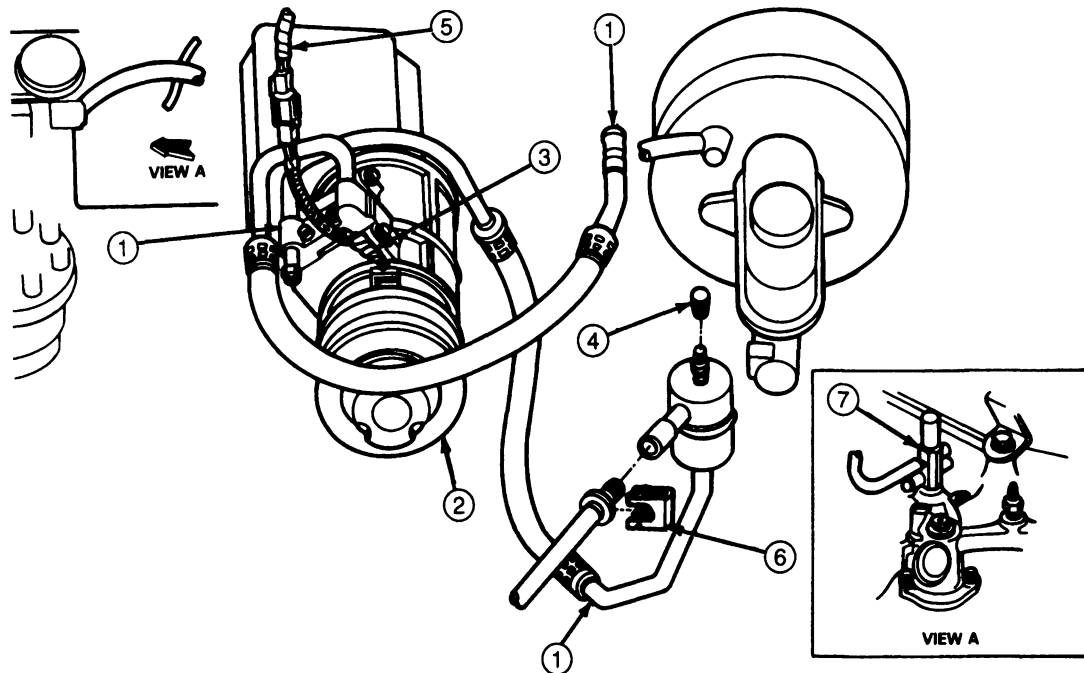


ITEM	BASIC PART NUMBER	DESCRIPTION	ITEM	BASIC PART NUMBER	DESCRIPTION
1.	19D734	MANIFOLD AND TUBE ASSY.	4.	19D702	CHARGING VALVE CAP ASSY.
2.	19D629	COMPRESSOR AND CLUTCH ASSY.	5.		WIRING ASSY.
3.	19D887	WIRING ASSY.	6.	19E746	SPRING LOCK COUPLING CLIP

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REMOVAL AND INSTALLATION (Continued)

Heater Hose and Air Conditioner Line Routing, 7.5L Engine

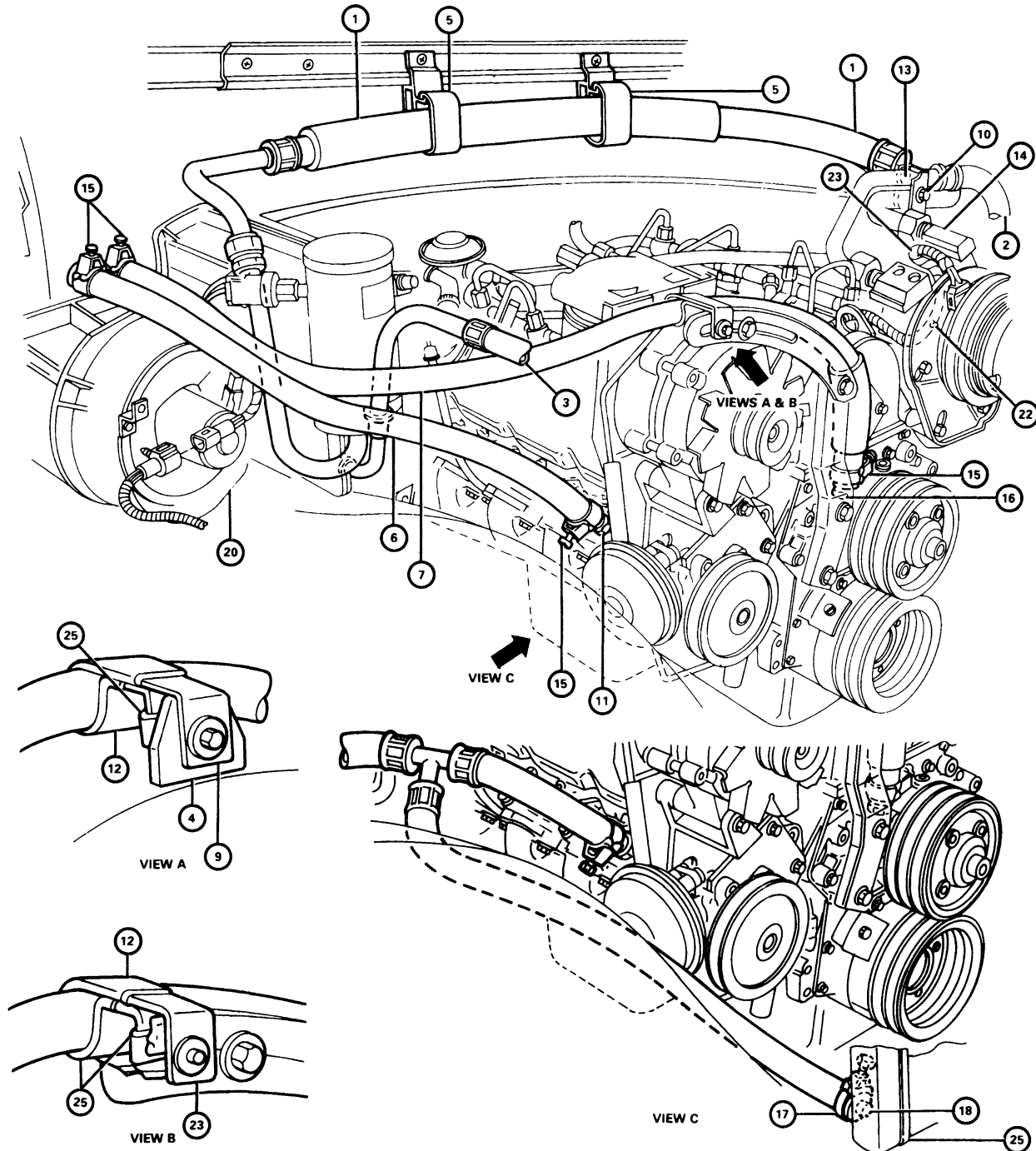


ITEM	BASIC PART NUMBER	DESCRIPTION	ITEM	BASIC PART NUMBER	DESCRIPTION
1.	19D734	MANIFOLD AND TUBE ASSY.	5.		
2.	19D629	COMPRESSOR AND CLUTCH ASSY.	6.	19D746	WIRING ASSY.
3.	19D887	WIRING ASSY.	7.		SPRING LOCK COUPLING CLIP
4.	19D702	CHARGING VALVE CAP ASSY.			INTAKE MANIFOLD VACUUM FITTING

CCL 4272-B

REMOVAL AND INSTALLATION (Continued)

Heater Hose and Air Conditioner Line Routing, 7.3L Diesel Engine



ITEM DESCRIPTION

1. SUCTION HOSE ASSY. - 19N617
2. DISCHARGE HOSE ASSY. - 19972
3. LIQUID LINE - 19N651
4. ALTERNATOR ADJUSTMENT BRACKET (REF.)
5. CLIP - 19N704 (2 REQ'D)
6. HOSE (FOR VEHICLES WITH C-6 OR MANUAL TRANSMISSION) - 381260-S360A
7. HOSE ASSY. (FOR ALL VEHICLES) - 18C266
8. HEATER HOSE ASSY. (FOR VEHICLES WITH E40D TRANSMISSION) - 18C266
9. SCREW & WASHER ASSY - N606678-S2
10. SCREW - 611058-S2
11. HEATER COOL FLOW CONTROL ASSY - 18D406
12. BRACKET ASSY - 18D331
13. A/C TUBE SUPPORT CLIP - 19B532

ITEM DESCRIPTION

14. A/C COMPRESSOR & CLUTCH ASSY - 19D629
15. CLAMP - 390761 OR 389628 (4 REQ'D)
16. HEATER HOSE CONNECTOR - 389766-S100
17. HOSE CLAMP - 389772-S100
18. HEATER HOSE BYPASS FITTING - 18C603
19. EXISTING SCREW
20. EVAPORATOR ASSY. (REF.)
21. SUPPORT BRACKET (REF.)
22. LOCATOR TO BE INSTALLED IN BRACKET (REF.)
23. ALTERNATOR EAR (REF.)
24. SPRING NUT (PART OF 18D331 BRACKET ASSY) (REF.)
25. RADIATOR (REF.)

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SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

BLOWER MOTOR CURRENT DRAW AND VOLTAGE DROP		
Switch Setting	Amps.	Volts
Low	6.0	5.0
Medium Low	8.0	7.0
Medium High	15.0	10.0
High	25.0	12.8
Control Assembly, Illumination	One ICP-161 Bulb	
Blower Circuit System Protection	35 Amp Fuse in Fuse Panel Thermal Limiter in Blower Resistor Circuit (Integral with Resistor)	


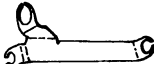
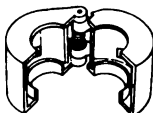
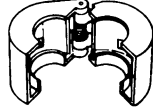
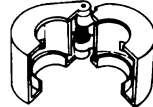
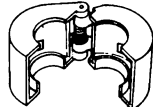
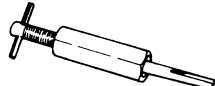
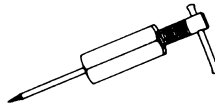
REFRIGERANT

Description	Specification
Clutch Cycling Control	Close Max 52 psi Open Min 23 psi
System Protection, High Pressure Relief Valve	Opens 3103kPa (450 psi)
Capacity (Front System Only)	3 Lbs. 7 Oz. \pm 1 Oz. 55 Oz. \pm 1 Oz. 1.559 Kg \pm 0.02835 Kg.
Capacity (Front and Auxiliary System)	4 Lbs. 7 Oz. \pm 1 Oz. 71 Oz. \pm 1 Oz. 2.013 Kg \pm 0.02835 Kg.
Type: Refrigerant 12 (R-12) ESA-M17B2A	Dichlorodifluoromethane CCL ₂ F ₂ Ford D4AZ-19B519-A Motorcraft YN1-AA 14 Oz. Can YN-7 30 Lb. Container

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
Suction Hose to Evaporator Core	41-47	30-35
Liquid Line to Expansion Valve	14-20	10-15
Heater Hose Clamps	1.35-2.03	12-18 In-Lb
Condenser to Mounting Bracket	17-24	12-18
Condenser Mounting Bracket to Radiator Support	17-24	12-18
Compressor to Bracket	28-43	20-32
Compressor Bracket to Support to Engine (4.9L)	62-88	45-65
Compressor Adjusting Bracket to Support Bracket (4.9L)	41-61	30-45
Compressor Bracket to Engine (8-Cylinder)	62-88	45-65
Idler Pulley to Bracket (8-Cylinder)	41-61	30-45
Compressor Brace to Engine	41-61	30-45
Compressor Brace to Compressor	28-43	20-32
Evaporator Case to Dash Panel	3.38-4.51	30-40 In-Lb
Defrost Nozzle to Instrument Panel Opening	1.02-1.69	9-15 In-Lb
Control Assembly to Support Bracket	1.12-1.69	10-15 In-Lb
Control Support Bracket to Instrument Panel	1.92-2.48	17-22 In-Lb

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number / Description	Illustration
T63L-8620-A Belt Tension Gauge	 T63L-8620-A
T83P-18532-AH Heater Control Cable Disconnect Tool	 T83P-18532-AH
T81P-19623-G2 Spring Lock Coupling Tool — 1/2 Inch	 T81P-19623-G2
T83P-19623-C Spring Lock Coupling Tool — 5/8 Inch	 T83P-19623-C
T81P-19623-G1 Spring Lock Coupling Tool — 3/8 Inch	 T81P-19623-G1
T85L-19623-A Spring Lock Coupling Tool — 3/4 Inch	 T85L-19623-A
T83L-19990-A Fixed Orifice Tube Remover/Replacer	 T83L-19990-A
T83L-19990-B Broken Orifice Tube Remover/Replacer	 T83L-19990-B

Tool Number	Description
D81L-19703-A	Service Access Adapter
D87P-19703-A	Tee Adapter

**SPECIAL SERVICE TOOLS/EQUIPMENT
(Continued)****MOTORCRAFT**

Tool Number	Description
YT-371	Belt Tension Gauge
YT-354	Service Access Adapter
YT-202	Flame Type Leak Detector
YT-227	Dial Thermometer
YT-204	Safety Shield Goggles
YT-288	Electronic Leak Detector
YT-201	Manifold Gauge Set

ROTUNDA EQUIPMENT

Tool Number	Description
023-00006	Flame Type Leak Detector
023-00007	Dial Thermometer
063-00003	Safety Shield Goggles
055-00015	Electronic Leak Detector
063-00010	Manifold Gauge Set
021-00014	Vacuum Tester

SECTION 12-03C Compressor and Clutch, FX-15

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
FX-15 Compressor	12-03C-1	Clutch Field Coil	12-03C-5
DIAGNOSIS AND TESTING		Clutch Hub and Pulley	12-03C-4
Compressor External Leak Test	12-03C-2	Manifold and Hose Assembly	12-03C-3
Compressor Manifold Leak Test	12-03C-2	Shaft Seal	12-03C-6
Compressor Rotating Torque Check	12-03C-3	SPECIAL SERVICE TOOLS/EQUIPMENT	12-03C-10
REMOVAL AND INSTALLATION		SPECIFICATIONS	12-03C-9
Adding Refrigerant Oil	12-03C-9	VEHICLE APPLICATION	12-03C-1

VEHICLE APPLICATION

F-Series with 4.9L, 5.0L, 5.8L, 7.5L, 7.3L; Bronco with 4.9L, 5.0L, 5.8L; Econoline with 7.5L and 7.3L MFI Engines

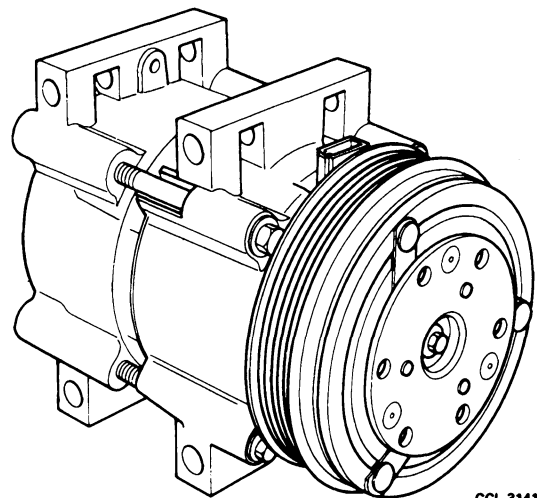
DESCRIPTION AND OPERATION

FX-15 Compressor

The FX-15 is a swashplate design ten-cylinder aluminum compressor utilizing the tangential design mount. The compressor mainshaft is driven by a belt from the engine crankshaft pulley. A one-piece lip-type seal (replaceable from the front of the compressor) is used to seal it at the shaft opening in the assembly. Five double-acting pistons, positioned axially around the compressor shaft, operate within the cylinder assembly. The pistons are actuated by a swashplate that is pressed on the compressor shaft. The swashplate changes the rotating action of the shaft to provide a reciprocating driving force to each of the five pistons. This driving force is applied, through shoes, to the midpoint of each of the double end pistons.

Reed-type discharge valves are assembled on the valve plate which is located with the suction reed valve between the cylinder assembly and the head at each end of the compressor. The heads are connected to each other by gas-tight passageways through the cylinder assembly which direct the refrigerant gas to the suction and discharge ports located in the rear head.

A magnetic clutch is used to drive the compressor shaft. When voltage is applied to the clutch field coil, the clutch plate and hub assembly (which is solidly coupled to the compressor shaft) is drawn rearward by magnetic force toward the pulley which rotates freely on the compressor front head casting. The magnetic force locks the clutch plate and hub assembly and the pulley together as one unit. The compressor shaft then turns with the pulley. When voltage is removed from the clutch field coil, springs in the clutch plate and hub assembly move the clutch plate away from the pulley. The clutch plate hub assembly and compressor shaft cease to rotate.



CCL 3141-A

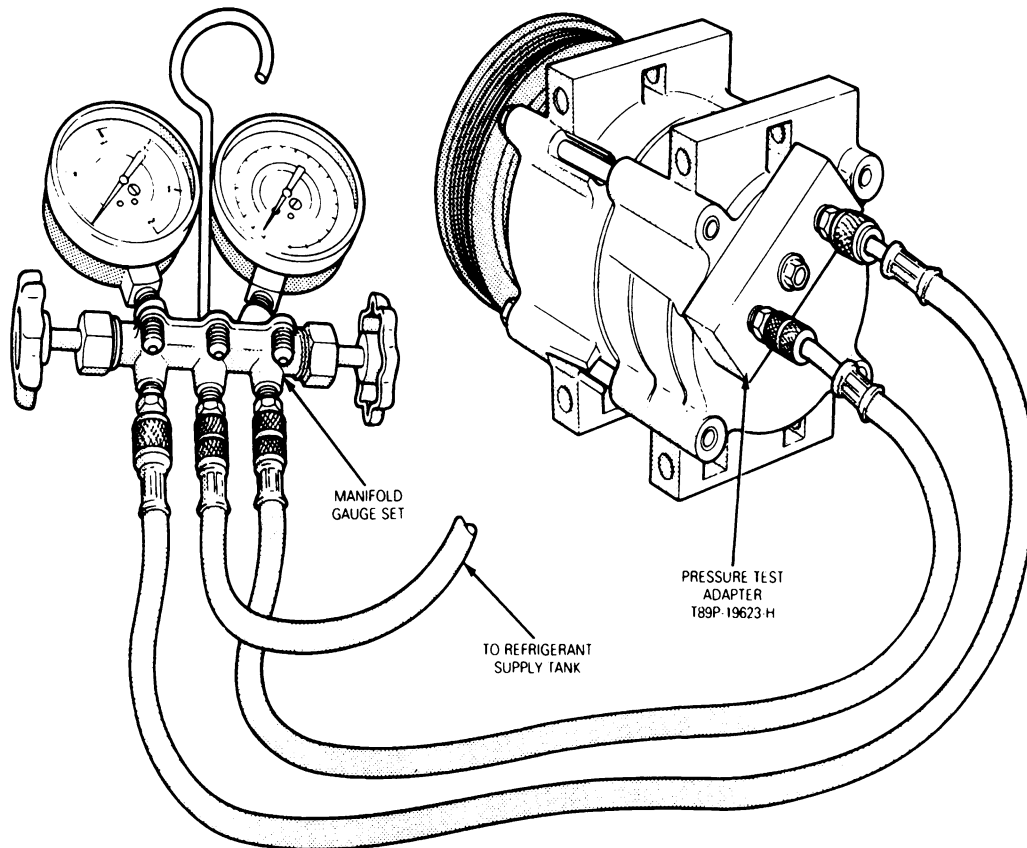
DIAGNOSIS AND TESTING**Compressor Manifold Leak Test**

1. Tighten the manifold retaining bolt to 18-23 N·m (13-17 ft·lb).
2. Add refrigerant to the system if necessary.
3. Leak test the manifold O-ring seals using Rotunda Electronic Leak Detector 055-00015 or equivalent.
4. If no leaks are found, the manifold O-ring seals are good.
5. If a leak is found at the manifold and the manifold attaching bolt is tightened to 18-23 N·m (13-17 ft·lb), install new manifold O-ring seals as outlined. Then, repeat the leak test.

Compressor External Leak Test

1. If the compressor is on the vehicle, discharge the system following the recommended service procedure. Refer to Section 12-03. Remove the compressor from the vehicle. Observe all safety precautions.
2. Remove the manifold retaining bolt and remove the manifold from the rear head of the compressor. Install Pressure Test Adapter T89P-19623-H on the rear head of the compressor using the existing manifold attaching bolt.
3. Connect the high and low pressure lines of a manifold gauge set to the corresponding fittings on the Pressure Test Adapter.

4. Attach the center hose of the manifold gauge set to a refrigerant container standing in an upright position.
5. Using the clutch hub, hand-rotate the compressor shaft ten revolutions to distribute the oil inside the compressor.
6. Open the low pressure gauge valve, the high pressure gauge valve and the valve on the refrigerant container to allow the refrigerant vapor to flow into the compressor.
7. Using Rotunda Electronic Leak Detector 055-00015 or equivalent check for leaks at the compressor shaft seal and the compressor center seal.
8. If a shaft seal leak is found, install a new shaft seal as described in this section. If an external leak is found at the center joint of the compressor, install a new compressor assembly.
9. When the leak test is completed, close the manifold gauge valves (both high and low) as well as the valve on the refrigerant container.
10. Slowly remove the gauge set hoses from the pressure test adapter. (Allow the refrigerant to escape from the compressor).
11. Install the compressor on the vehicle.
12. Leak test, evacuate and charge the system following the recommended procedures. Refer to Section 12-03. Observe all safety precautions.

DIAGNOSIS AND TESTING (Continued)**Connecting Gauge Set to Check for Leaks**

CCL 3302-A

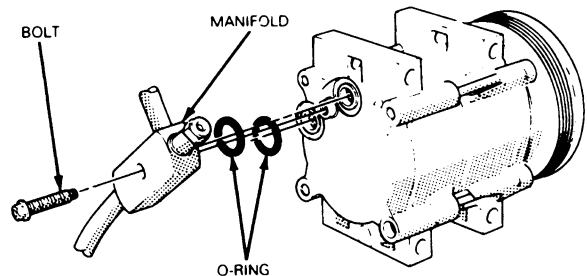
Compressor Rotating Torque Check

The rotational torque of a used compressor should be checked if excessive compressor drag is suspected.

1. Discharge refrigerant system following recommended service procedures. Refer to Section 12-03. Observe all safety precautions.
2. Remove refrigerant hose and manifold assembly from compressor. Use care not to allow dirt to enter compressor.
3. Remove the compressor from the vehicle. With the compressor clutch disengaged, rotate the compressor shaft and note the torque required to rotate the shaft one complete revolution. This is not the starting torque. Rotational torque should not exceed 10 N·m (7 ft-lb).
4. If the rotational torque exceeds specification, replace the compressor assembly.
5. If the rotational torque is less than specified, excessive drag does not exist in the compressor. Install the manifold and hose assembly and leak test, evacuate and charge the system.
6. Check the system for proper operation.

REMOVAL AND INSTALLATION**Manifold and Hose Assembly****Removal**

1. Discharge the refrigerant from the system following the recommended procedures. Refer to Section 12-03. Remove bolt attaching manifold and hose / tube assembly to the rear head of the compressor.



CCL 3303-A

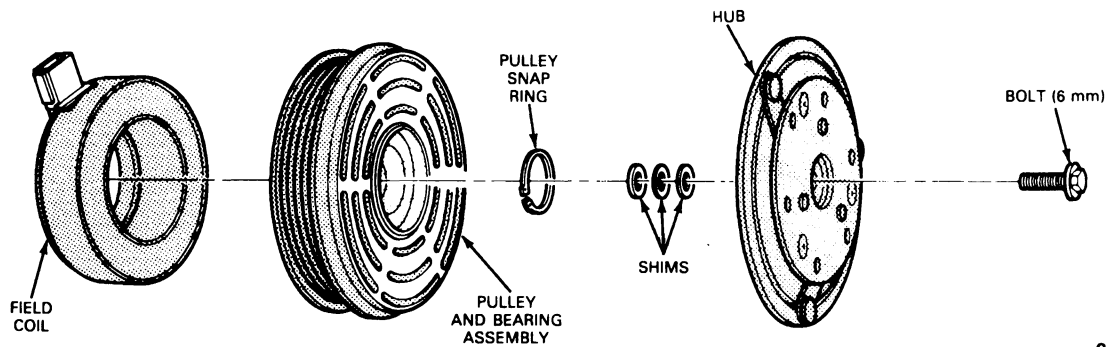
2. Disconnect other ends of suction and discharge lines. Remove any bracket attachments and remove manifold and nose / tube assembly from vehicle.

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Lubricate new O-rings with clean refrigerant oil and position them in the O-ring grooves of the compressor rear head.
2. Position manifold and hose / tube assembly to rear head of compressor making sure manifold pilots are positioned in compressor port openings. Install manifold attaching bolt and tighten bolt to 18-23 N·m (13-17 ft-lb).
3. Connect other ends of suction and discharge lines using new lubricated O-rings. Install bracket attachments disconnected during removal.
4. Leak test, evacuate and charge the system following the recommended procedures. Refer to Section 12-03. Observe all safety precautions.

Clutch Hub and Pulley

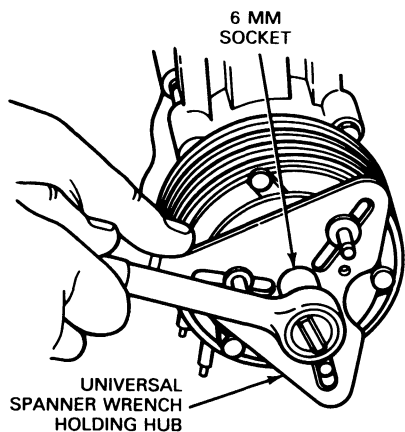
A disassembled view of the clutch assembly and related parts is shown in the illustration.



CCL 3304-C

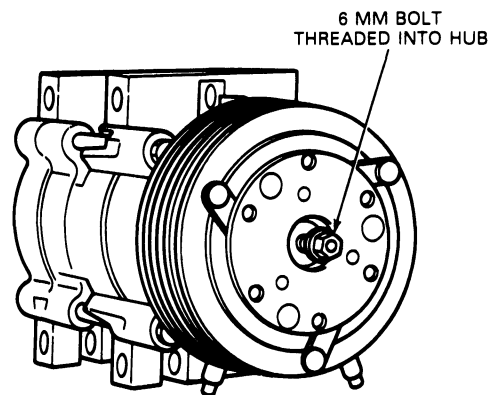
Removal

1. Remove the clutch hub retaining bolt. Use Spanner Wrench T70P-4067-A.



L7341-A

2. Pull clutch hub and shims from compressor shaft. If hub cannot be pulled from compressor shaft, screw an 6mm bolt into the shaft hole of the clutch hub to force the hub from the shaft.

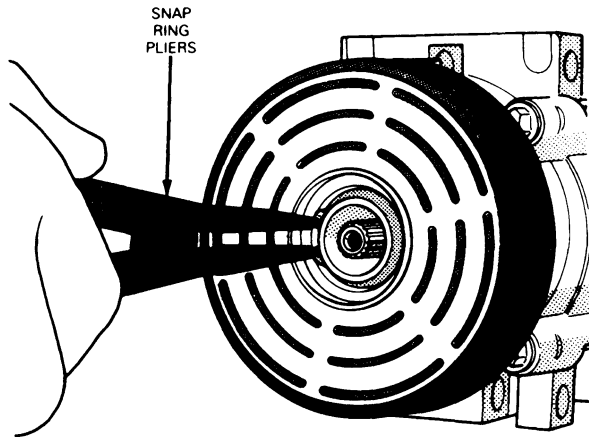


L7342-A

3. Remove pulley retaining snap ring.

REMOVAL AND INSTALLATION (Continued)

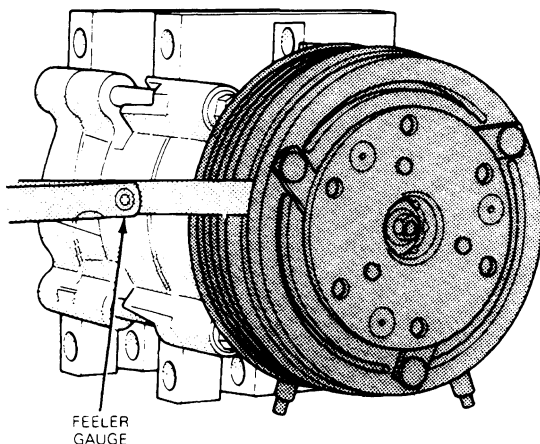
4. Pull the pulley and bearing assembly from compressor.



CCL 3307-A

Installation

1. Clean pulley bearing surface of compressor head to remove any dirt or corrosion.
2. Install pulley and bearing assembly on compressor. The bearing is a slip-fit on the compressor head and, if properly aligned, it should slip on easily.
3. Install pulley retaining snap ring with bevel side of snap ring out.
4. Place one nominal thickness spacer shim inside the hub spline opening and slide the hub on the end of the compressor shaft.
5. Thread a new 6mm hub retaining bolt into end of compressor shaft. Tighten hub retaining bolt to 11-13 N·m (8-10 ft-lb). DO NOT USE AIR TOOLS.
6. Check clutch air gap between clutch hub and pulley mating surfaces with a feeler gauge. The air gap should be between 0.45 and 0.85mm (0.018 and 0.033 inch). Check at three locations equally spaced around the pulley.



CCL 3308-A

7. If clutch air gap is not within 0.45 to 0.85mm (0.018 to 0.033 inch), repeat Steps 4 through 6 with various thickness shims until air gap is within specified limits.
8. When installing a new clutch, cycle it ten times at idle to burnish the clutch and prevent slippage.

Clutch Field Coil

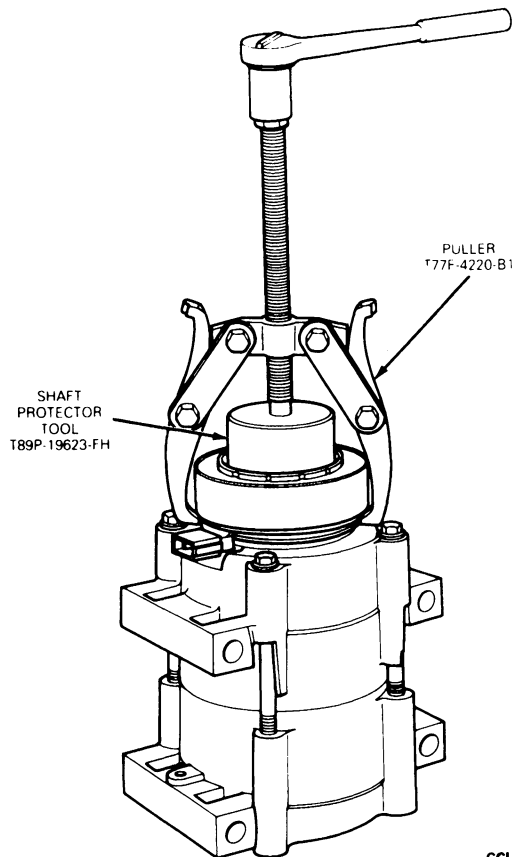
NOTE: The clutch field coil is pressed on the front head of the compressor. Special service tools are required to remove and install the coil.

Removal

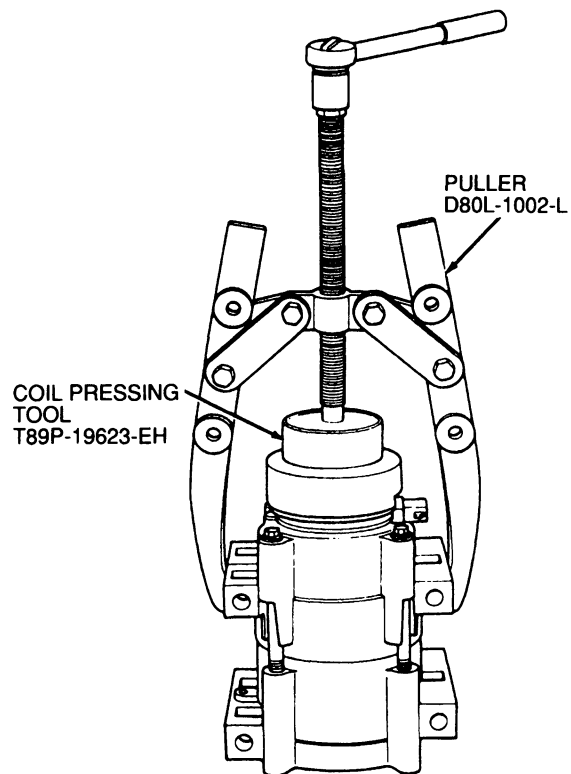
1. Remove the compressor from the vehicle following the recommended service procedure.
2. Remove the clutch hub and pulley as described in this section.
3. Install Shaft Protector Tool T89P-19623-FH on the nose opening of the compressor.
4. Install 2-Jaw Puller T77F-4220-B1 on the compressor. Place the tip of the puller forcing screw in the center pilot of the shaft protector and the jaws of the puller around the back edge of the field coil.

REMOVAL AND INSTALLATION (Continued)

5. Tighten the puller forcing screw to pull the coil from the compressor head. **DO NOT USE AIR TOOLS.**

**Installation**

1. Clean the coil mounting surface on the front head to remove any dirt or corrosion.
2. With the compressor in a vertical position (nose up), place the field coil in position on the compressor front head. Make sure the coil electrical connector is positioned correctly.
3. Place the Coil Pressing (Installer) Tool T89P-19623-EH in position over the compressor nose and to the inner radius of the field coil.
4. Position 2-Jaw Puller Tool D80L-1002-L or equivalent on the compressor and the coil pressing tool. The jaws of the puller should be firmly engaged with the rear side of the compressor front mounts. The forcing screw must be piloted on the center mark of the pressing tool.



5. Tighten the forcing screw with a hand wrench until the coil is pressed on the compressor front head. **DO NOT USE AIR TOOLS.** Check to make sure that the field coil bottoms against the head at all points around the coil outer diameter.
6. Install the clutch pulley and hub on the compressor as outlined. Adjust the air gap, as necessary.
7. Install the compressor on the vehicle following the recommended service procedure.

Shaft Seal

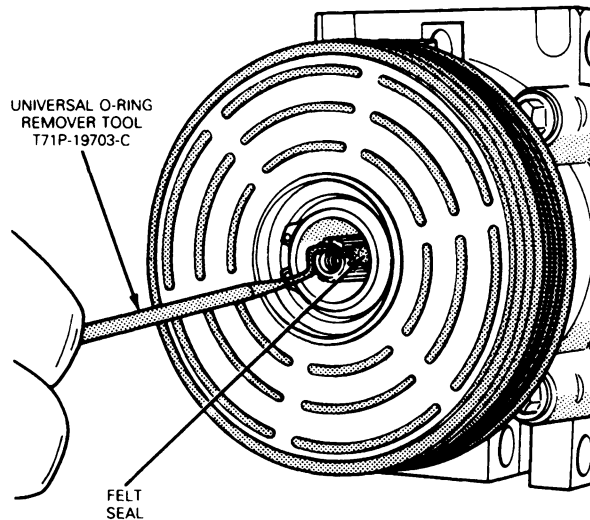
The refrigerant system must be discharged and the compressor must be removed from the vehicle prior to replacing the compressor shaft seal. Refer to Section 12-03.

Removal

1. Remove clutch hub from compressor as outlined.

REMOVAL AND INSTALLATION (Continued)

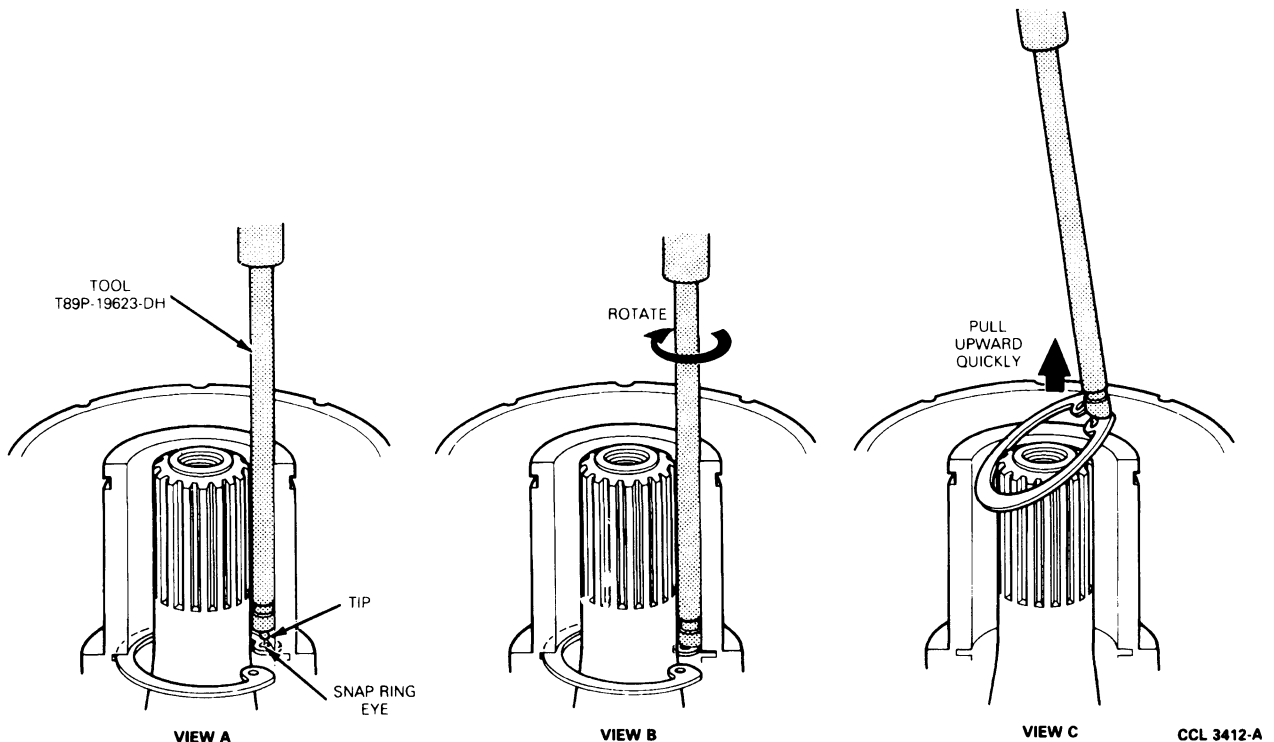
2. Remove shaft seal felt from nose of compressor with O-ring Remover T71P-19703-C.



CCL 3309-A

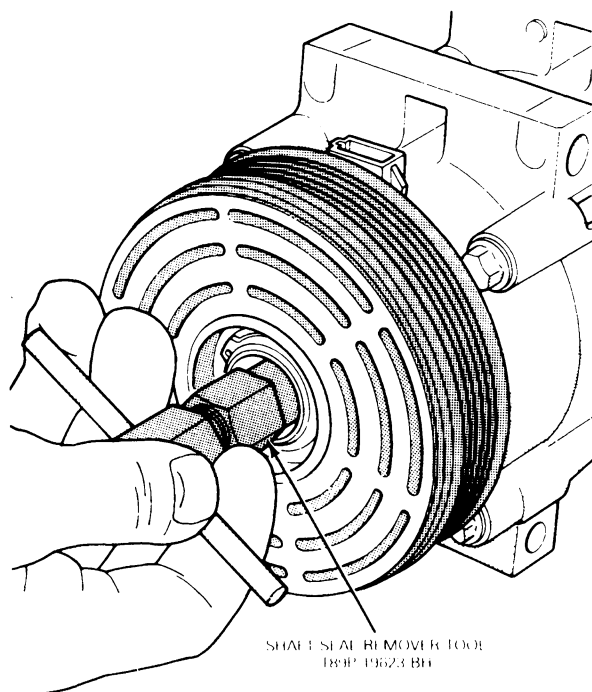
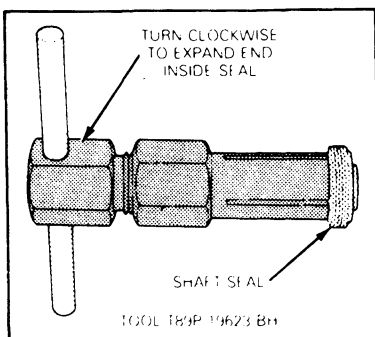
3. Blow any debris from inside the compressor nose with **low pressure** compressed air. Then clean the inside and outside nose area of the compressor with a lint free cloth to remove any oil and dirt.
4. Remove shaft seal retaining snap ring from inside compressor nose with Snap Ring Remover T89P-19623-DH as described in the following steps. Refer to the illustration.
5. Insert the tip of the Snap Ring Remover T89P-19623-DH into one of the snap ring eyes (View A).
6. Rotate the snap ring remover to position the tool tip and the snap ring eye closest to the compressor shaft (View B).
7. Pull the snap ring remover up quickly while keeping the tool shaft against the side of the nose opening and remove the snap ring (View C).

Snap Ring Removal



REMOVAL AND INSTALLATION (Continued)

8. Position Shaft Seal Remover Tool T89P-19623-BH over compressor shaft and push tool into nose of compressor and down against shaft seal. Engage end of tool with internal diameter of shaft seal. While holding the hex part of the tool, turn tool handle clockwise to expand tool tip inside seal inner radius. Then, pull shaft seal from the compressor with the tool.



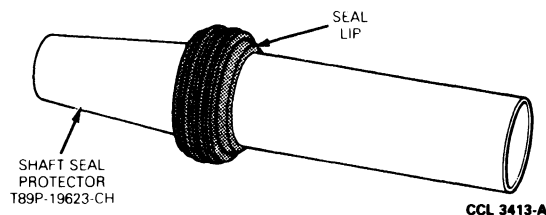
CCL 3310-A

Installation

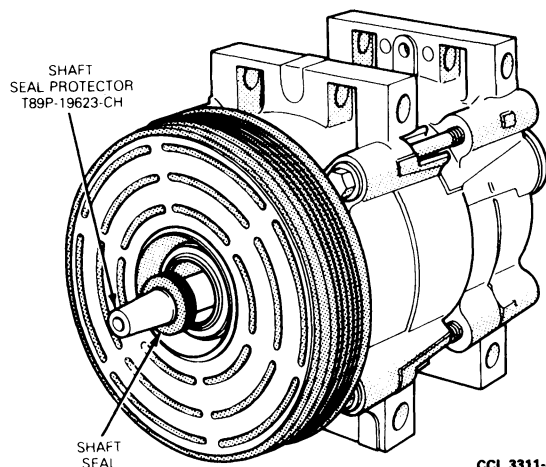
1. Obtain a new Shaft Seal Kit (Basic Part No. 19D665). Carefully remove the contents of the kit from the package. A plastic shaft seal protector is included with each kit. Inspect the protector for any burrs or other damage. Do not use the protector if it is damaged. Obtain another shaft seal kit, if necessary, and use the protector from it.
2. Using a clean lint free cloth, clean the compressor shaft and the seal pocket inside the compressor nose.

CAUTION: Do not allow any dirt or foreign materials to enter the compressor.

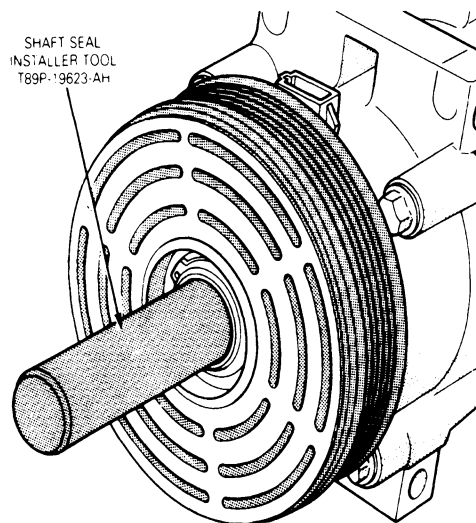
3. Dip the shaft seal protector and shaft seal in clean refrigerant oil (E73Z-19577-A). Position the shaft seal on the protector with the lip of the seal pointing toward the large end of the protector.



4. Place the shaft seal protector with shaft seal over the end of the compressor shaft.



5. Using Shaft Seal Installer Tool T89P-19623-AH, slowly push seal down shaft protector onto compressor shaft until seated.



CCL 3312-A

REMOVAL AND INSTALLATION (Continued)

6. Remove installer tool and shaft protector from compressor shaft.
7. Place a new shaft seal retaining snap ring into the compressor nose opening and seat the snap ring into the groove.
8. Leak test the shaft seal installation after rotating the compressor shaft about ten revolutions with the clutch hub. Refer to Compressor External Leak Test.
9. Install a new shaft seal felt in nose of compressor.
10. Install clutch hub on compressor as outlined.
11. Check and adjust the air gap as necessary.

Adding Refrigerant Oil

The FX-15 compressor uses a unique high-quality refrigerant oil (E73Z-19577-A), Motorcraft Part Number YN-9 or an equivalent refrigerant oil meeting Ford specification ESH-M2C31-A2. An oil charge of 207 ml (7 oz) is used in a new system. It is extremely important that only the specified type and quantity of refrigerant oil be used in the FX-15 compressor. If there is a surplus of oil in the system, it will circulate with the refrigerant, reducing the cooling capacity of the system. Using too little oil or oil not meeting the Ford specification will result in poor lubrication of the compressor.

When replacing a component of the refrigerant system, the procedures in this section must be followed to ensure that the total oil charge in the system is correct after the new part is installed.

When the compressor is operated, oil gradually leaves the compressor and is circulated through the system with the refrigerant. Eventually, a balanced condition is reached in which a certain amount of oil is retained in the compressor and a certain amount is continually circulated. If a component of the system is removed after the system has been operated, some oil will go with it. To maintain the original total oil charge, add oil as required to the new replacement part.

The procedures for replacing oil are as follows:

During Compressor Replacement

A new service replacement FX-15 compressor contains 207 ml (7 oz) of refrigerant oil. Prior to installing the replacement compressor, drain the refrigerant oil from the removed compressor into a calibrated container. Then, drain the refrigerant oil from the new compressor into a clean calibrated container.

- If the amount of oil drained from the removed compressor was between 90 and 148 ml (3 and 5 oz), pour the same amount of clean refrigerant oil into the new compressor.
- If the amount of oil that was removed from the old compressor is greater than 148 ml (5 oz), pour 148 ml (5 oz) of clean refrigerant oil into the new compressor.

- If the amount of refrigerant oil that was removed from the old compressor is less than 90 ml (3 oz), pour 90 ml (3 oz) of clean refrigerant oil into the new compressor.

NOTE: The suction accumulator-drier and orifice tube should also be replaced when the compressor is replaced.

During Component Replacement

When replacing other components of the air conditioning system, measured quantities of the specified refrigerant oil should be added to the component to ensure that the total oil charge in the system is correct before the system is operated.

Clean refrigerant oil should be poured directly into the replacement components as follows:

- Evaporator core: add 90 ml (3 oz).
- Condenser: add 30 ml (1 oz).
- Accumulator: drain oil from removed accumulator / drier. Add same amount plus 60 ml (2 oz) of clean refrigerant oil to new accumulator.

If any other component such as an orifice tube or a hose is replaced, no additional refrigerant oil is necessary unless a hose bursts with a fully charged system. Then, the addition of refrigerant oil may be necessary with the amount to be determined by the technician. The suction accumulator-drier should also be replaced under these circumstances.

SPECIFICATIONS**COMPRESSOR SPECIFICATIONS**

Description	Specification
TYPE	SWASHPLATE, 5 DOUBLE ACTING PISTONS — AXIAL TYPE
DISPLACEMENT	10.4 CID (170cc)
CYLINDER BORE (Dia.)	29.0mm
STROKE	25.7mm
ROTATION	CLOCKWISE
ROTATIONAL TORQUE (Maximum, manifold removed)	10 N·m — (7 Ft-Lb)
REFRIGERANT OIL Ford Specification	ESH-M2C31-A2
Capacity (System Total)	207 ml (7 ounces) 295 ml (10 ounces) with auxiliary A/C
Part Number	E73Z-19577-A Motorcraft YN-9
MAGNETIC CLUTCH Air Gap Between Pulley and Hub	0.45mm-0.85mm (0.018-0.033 Inch)
Current Draw	4.36 Amps @ 12.8 volts
Run-Out (Maximum)	0.02 Inch-Radial or Axial

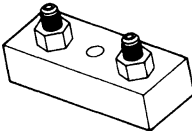




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SPECIFICATIONS (Continued)**COMPRESSOR SPECIFICATIONS (Cont'd)**

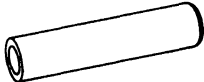
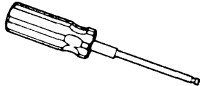


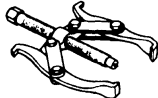
Description	Specification
TORQUE LIMITS Hose & Manifold Assy. to Compressor Bolt	18 N-m (13-17 Ft-Lb)
Clutch Hub Bolt	11-13 N-m (8-10 Ft-Lb)

TL5735A

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number/ Description	Illustration
T89P-19623-H Pressure Test Adapter	 T89P-19623-H
T70P-4067-A Spanner Wrench	 T70P-4067-A
T71P-19703-C O-Ring Tool	 T71P-19703-C
T89P-19623-BH Shaft Seal Remover Tool	 T89P-19623-BH
T89P-19623-CH Shaft Protector Tool	 T89P-19623-CH

(Continued)

Tool Number/ Description	Illustration
T89P-19623-AH Seal Installer Tool	 T89P-19623-AH
T89P-19623-DH Snap Ring Remover	 T89P-19623-DH
T89P-19623-FH Shaft Protector Tool	 T89P-19623-FH
T89P-19623-EH Coil Pressing (Installer) Tool	 T89P-19623-EH
T77F-4220-B1 2-Jaw Puller	 T77F-4220-B1

Tool Number	Description
D80-1002-L	2-Jaw Puller

ROTUNDA EQUIPMENT

Model	Description
055-00015	Electronic Leak Detector

SECTION 12-03D Air Conditioning, Heater System, Side Mounted Auxiliary

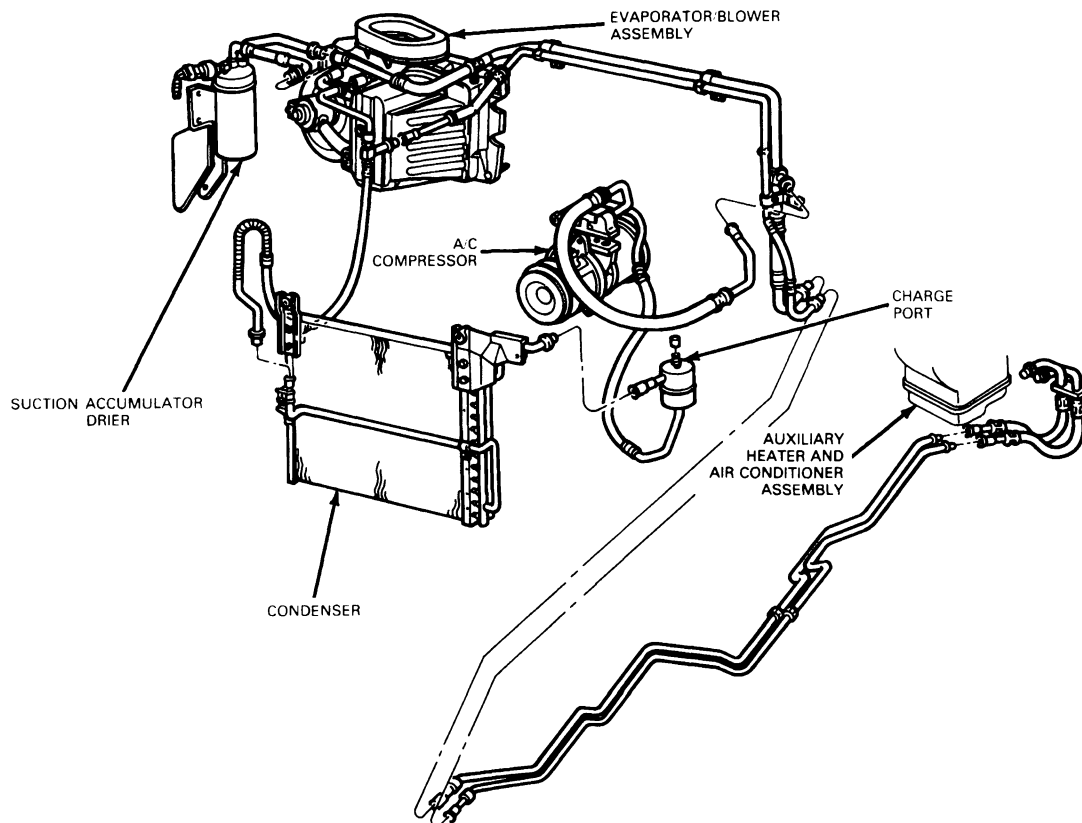
SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Auxiliary System	12-03D-3	Auxiliary Heater and Air Conditioner Assembly	12-03D-11
Control Assembly	12-03D-2	Blower Motor and Wheel Assembly	12-03D-14
DIAGNOSIS AND TESTING		Blower Motor Resistor	12-03D-15
Blower Motor Voltage Test	12-03D-8	Evaporator Core and Seal	12-03D-16
Refrigerant System	12-03D-10	Function Door and Vacuum Motor	12-03D-18
Vacuum System Tests	12-03D-10	Heater Core and Seal	12-03D-13
REMOVAL AND INSTALLATION		Rear Control Assembly	12-03D-10
Air Conditioner Overhead Register and Louver Assembly	12-03D-11	Thermostatic Expansion Valve (TXV)	12-03D-17
Air Conditioner-Heater Lines and Tubes	12-03D-19	SPECIFICATIONS	12-03D-25
		VEHICLE APPLICATION	12-03D-1

VEHICLE APPLICATION

E-150-250-350 Vehicles

DESCRIPTION AND OPERATION

An auxiliary climate control system is available as an option on Econoline vehicles. The system is offered as both a combination air conditioning and heating system or as a heating system only.

DESCRIPTION AND OPERATION (Continued)**Air Conditioning System with Auxiliary Heat and A/C**

CCL 4245-A

Control Assembly

From the location of the front control assembly in the instrument panel, the driver and front seat passenger have access to the function and temperature settings on the main system as well as the separate switches that control the blower motor speed for both the front and auxiliary systems.

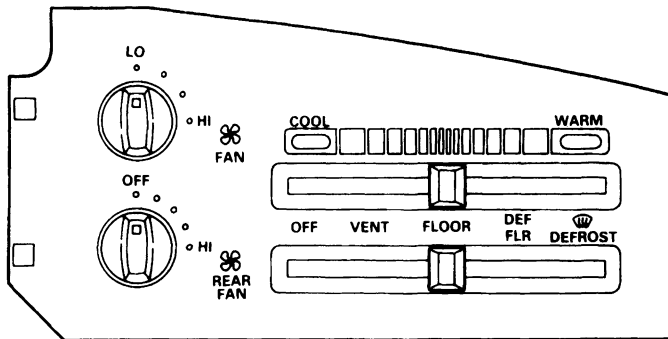
There are three combinations of front control assemblies available for Econoline vehicles with auxiliary heating and / or air conditioning:

- Auxiliary heating with front blower control only
- Auxiliary air conditioning and heating with front blower control only
- Auxiliary air conditioning and heating with front and rear blower control

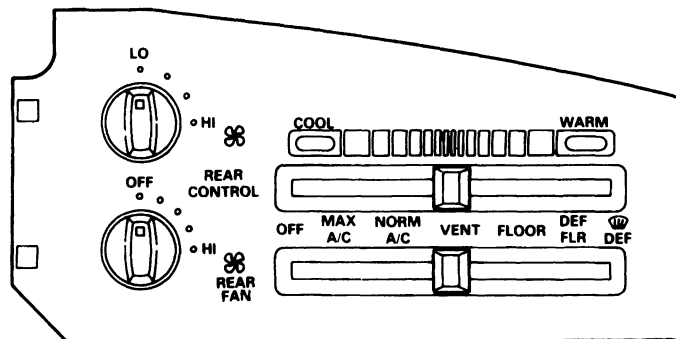
On systems that have front blower control only, the following settings for the blower motor are provided: OFF, LOW, MED LOW, MED HIGH and HIGH.

DESCRIPTION AND OPERATION (Continued)

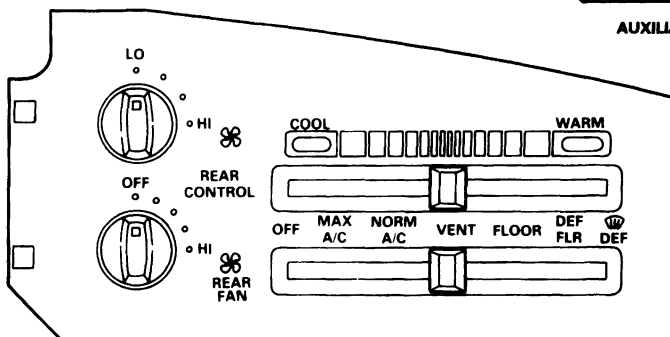
Systems that have both front and rear blower control capabilities use both front and rear blower control assemblies. These systems provide the following settings for the blower motor: OFF, REAR CONTROL, MED LOW, MED HIGH and HIGH. By setting the front blower switch to the REAR CONTROL position, the auxiliary blower motor can be controlled by the blower switch in the rear control assembly.



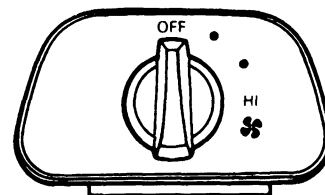
AUXILIARY HEATING WITH FRONT BLOWER CONTROL ONLY



AUXILIARY A/C AND HEATING WITH FRONT BLOWER CONTROL ONLY



AUXILIARY A/C AND HEATING WITH FRONT AND REAR BLOWER CONTROL



REAR CONTROL ASSEMBLY

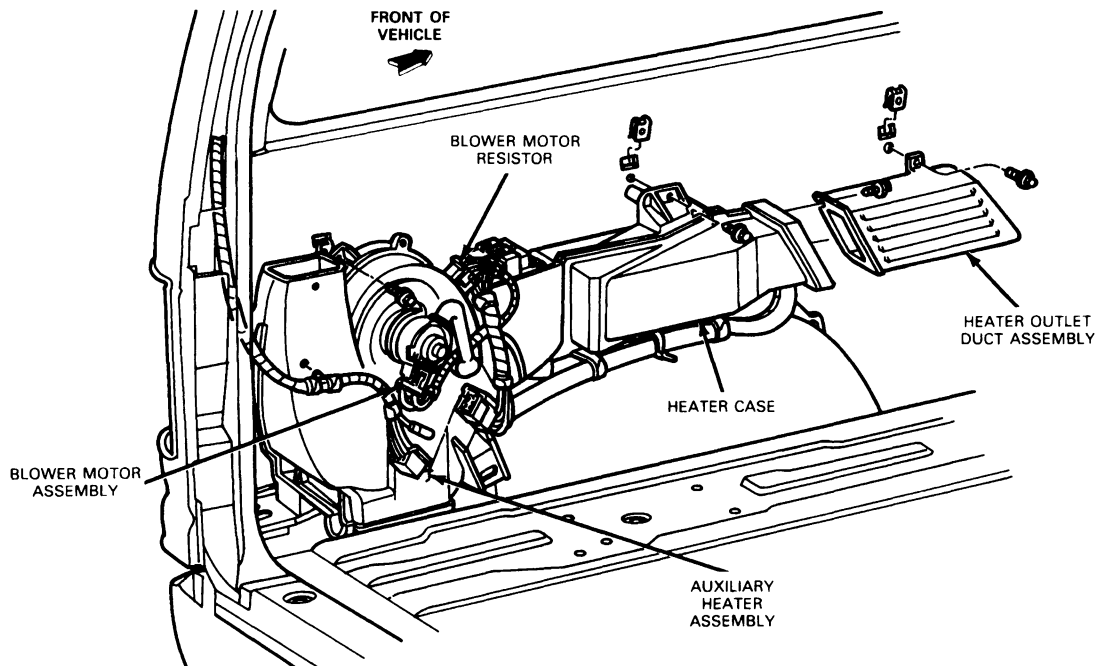
CCL 4294-A

Auxiliary System

The auxiliary system is a blow-through design that directs air through the heater core or the evaporator core (if equipped). A vacuum actuated mode control door determines the direction of air flow through either the heater or evaporator core.

DESCRIPTION AND OPERATION (Continued)**Auxiliary Heater and Air Conditioner Assembly**

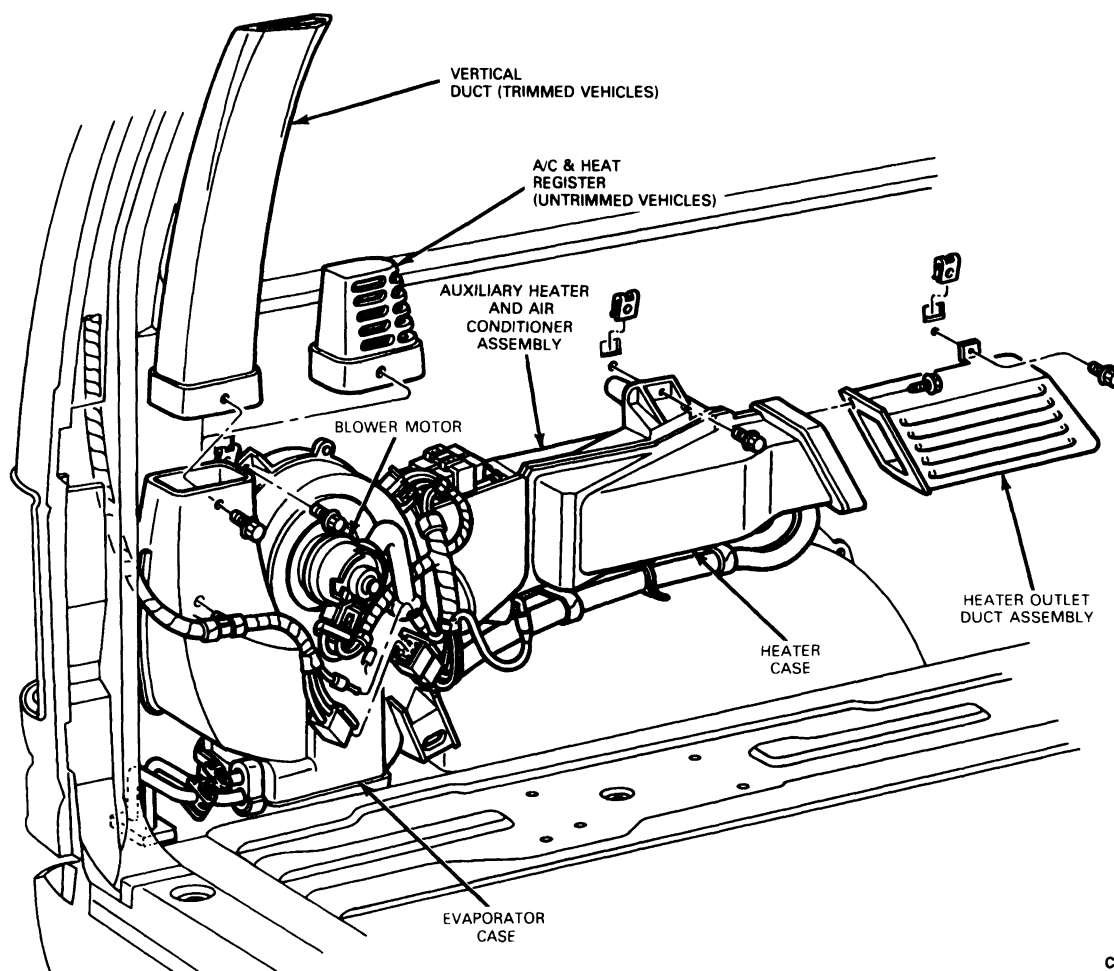
The auxiliary heater and air conditioner assembly is a one-piece unit with both air conditioning and heating capabilities. The interior components of the system are mounted on the left side of the vehicle, between the side windows and floorpan, behind the left rear wheel well. All components, including the blower motor and wheel, resistor, wiring grommet and seal, heater core and seal, evaporator core and seal (if equipped), and thermostatic expansion valve (if equipped) are serviceable from the inside of the vehicle. To remove any of the components, it is necessary to remove the third and fourth bench seats, the bolster panel, and the upper and lower trim panels on the left side (if equipped).

Auxiliary Heater Assembly

CCL 4285-A

DESCRIPTION AND OPERATION (Continued)

Auxiliary Heater and Air Conditioner Assembly

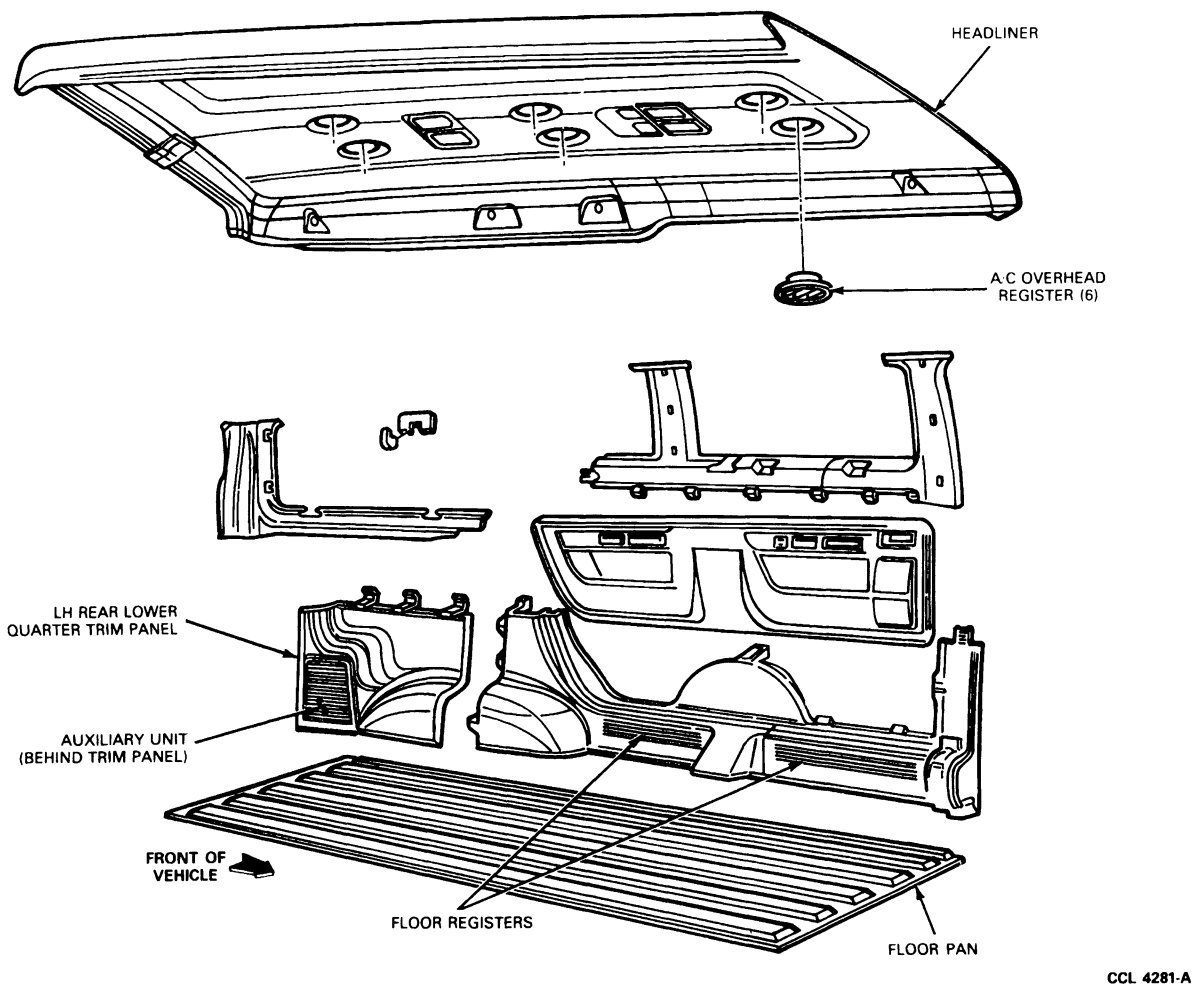


CCL 4246-A

Trimmed vehicles with auxiliary air conditioning and heating capabilities have a vertical duct that supplies air to the integral headliner air conditioning duct. Air is supplied to the passengers through six adjustable registers. The heater floor duct is integral to the quarter trim panel and has four fixed registers for optimum heater air distribution. The trim panel connects directly to the auxiliary heater and air conditioner assembly housing.

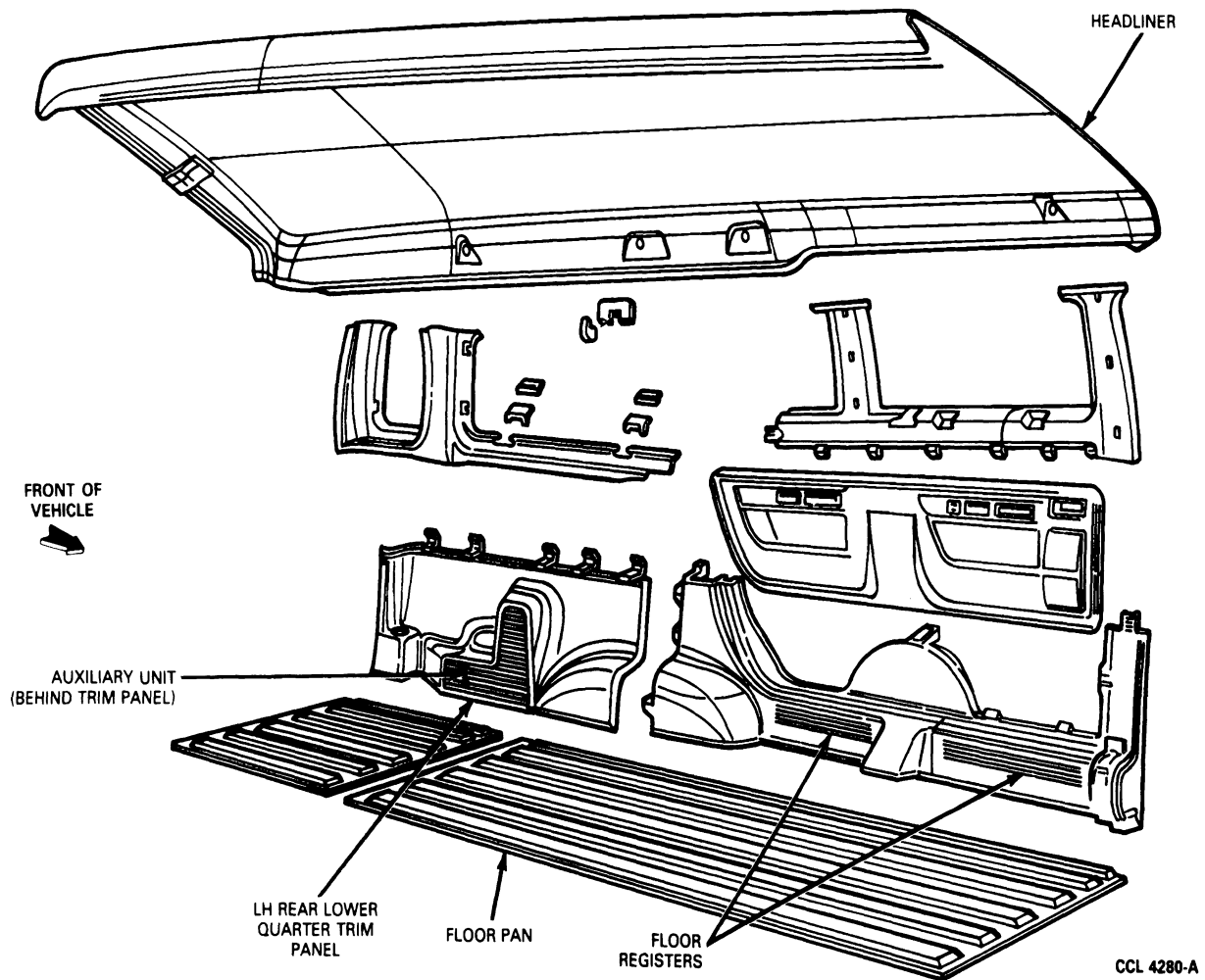
DESCRIPTION AND OPERATION (Continued)

Auxiliary Air Conditioning and Heating Trim and Registers



Untrimmed vehicles with both auxiliary air conditioning and heating capabilities do not have overhead registers, heater floor ducts or floor registers. The same auxiliary heater and air conditioner assembly is used, but a unique air conditioner and heater register that attaches directly to the auxiliary heater and air conditioner assembly housing is used for air distribution. Air conditioned and heated air is distributed through this register.

Trimmed vehicles with auxiliary heating only (no air conditioning) do not have overhead registers. Heated air is directed through the heater floor duct and the four fixed registers located in the quarter trim panel.

DESCRIPTION AND OPERATION (Continued)**Auxiliary Heating Only, Trim and Registers**

Mode selection for the auxiliary system is controlled by the mode lever in the front control assembly. When the mode lever is in the MAX A/C, NORM A/C or VENT positions, air is directed to the overhead air conditioning duct and registers for trimmed vehicles, or the air conditioning and heat register located on the auxiliary heater and air conditioner assembly for untrimmed vehicles.

When the mode lever is in the FLOOR, MIX or DEFROST modes, air is directed to the heater floor duct and registers for trimmed vehicles, or the heater register located on the auxiliary heater assembly for untrimmed vehicles.

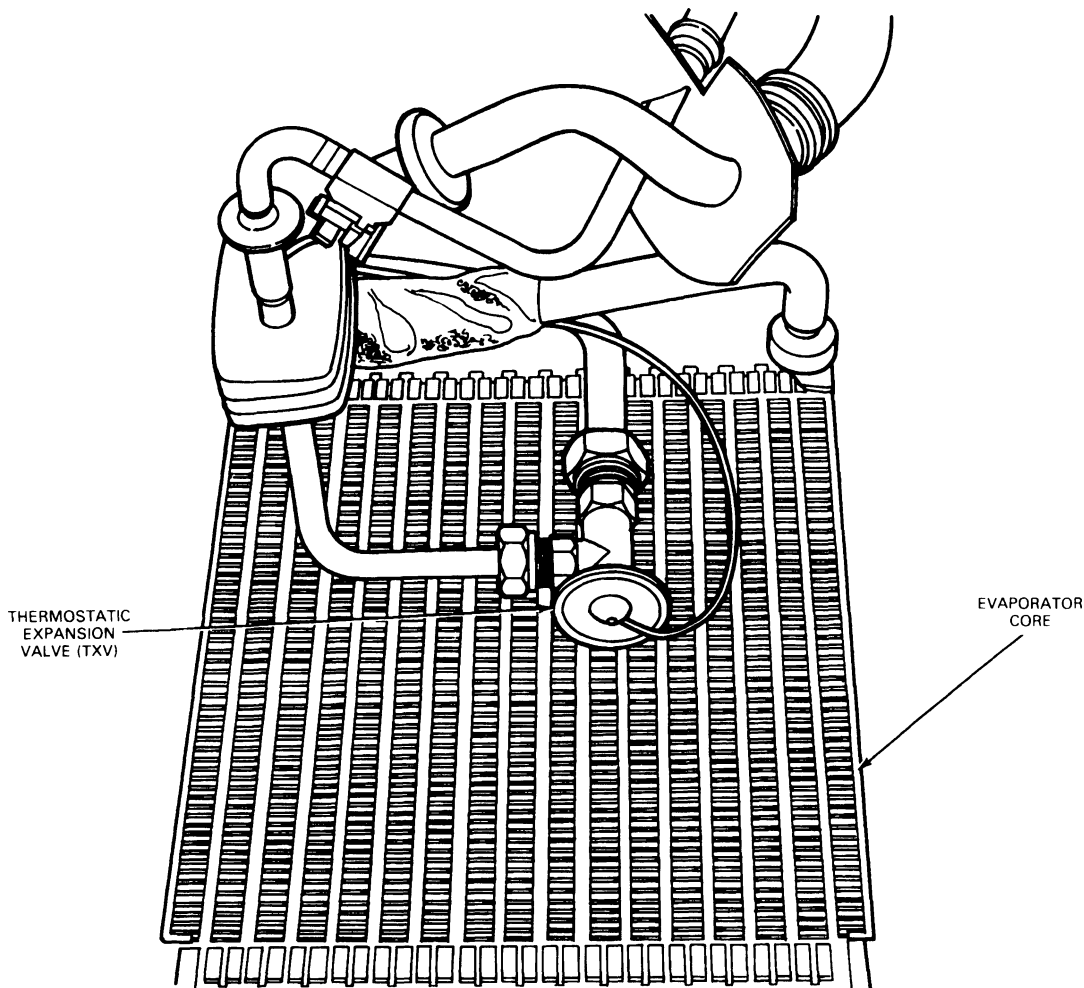
Thermostatic Expansion Valve (TXV)

A thermostatic expansion valve (TXV) automatically regulates the flow of refrigerant into the evaporator core in the auxiliary heater and air conditioner assembly. It also is the dividing point in the system between high and low pressure refrigerant.

The temperature sensing bulb, clamped to the suction (outlet) tube on the evaporator, measures the temperature of the refrigerant in the suction tube and transmits the temperature variation to the expansion valve. This temperature variation regulates refrigerant flow to the evaporator core. When the bulb senses a high temperature, the valve opens and floods refrigerant through the evaporator core. When the bulb senses a low temperature, the valve starts closing to shut off the refrigerant to the evaporator core.

DESCRIPTION AND OPERATION (Continued)

Thermostatic Expansion Valve (TXV)



CCL 4282-A

DIAGNOSIS AND TESTING

Blower Motor Voltage Test

All auxiliary system blower motor electrical circuits use ground side switching to control the blower motor speed. When performing blower motor voltage tests on a system using ground side switching, the voltage reading must be taken at the ground side of the motor (between the motor and the resistor assembly), otherwise the voltage reading will be battery voltage.

Test Procedure

1. Insert the probes of the voltmeter into the wire holes of the blower motor hardshell connectors and make contact with the wire terminals.
2. Measure the voltage drop across the motor.

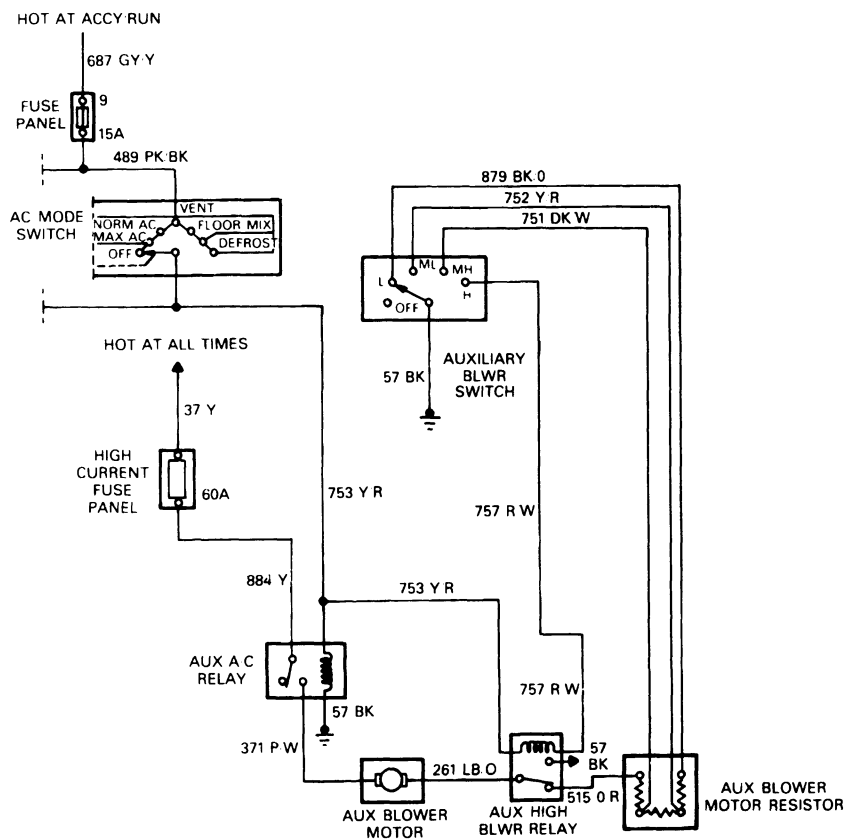
3. With the engine running (battery voltage approximately 14.2 volts), the voltage reading should be within the range specified for each switch position shown in the Electrical Specifications chart in the Specifications portion of this section.

Blower Motor Current Draw Test

1. Separate the blower motor ground (orange) wire from the blower motor resistor.
2. Connect the positive (+) ammeter lead to the female spade connector on the motor wire and the negative (-) ammeter lead to the blower motor resistor.

DIAGNOSIS AND TESTING (Continued)

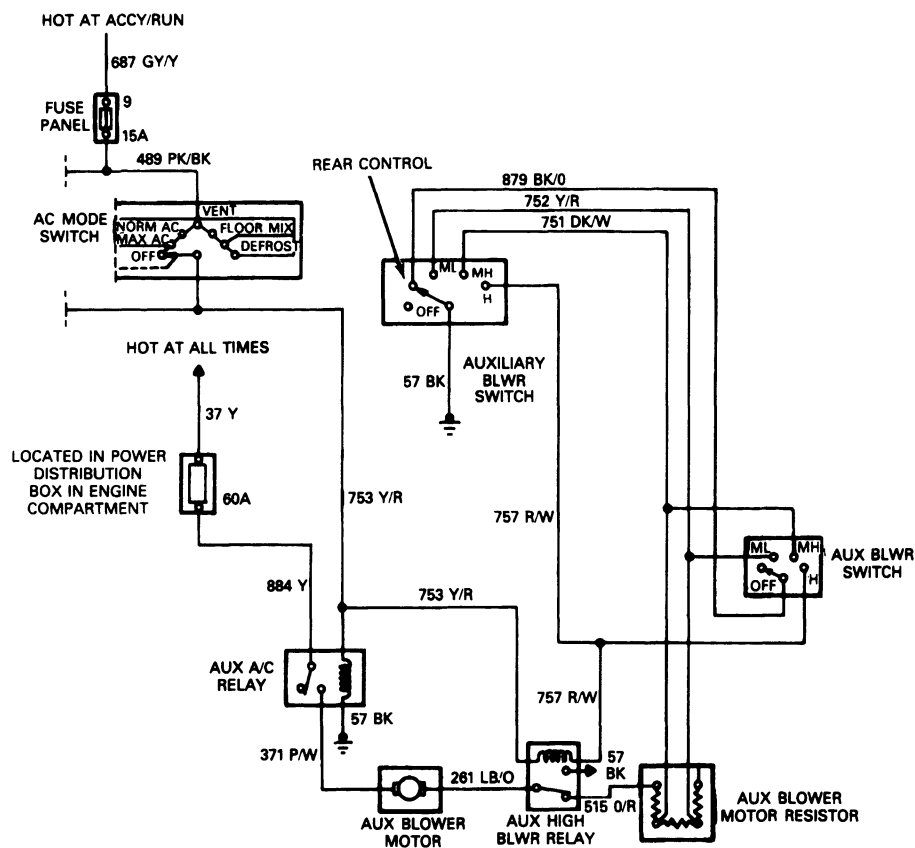
3. With a fully charged battery, operate the blower in each switch position and record the current draw (amps). The current draw for each switch position should approximate the values shown in the Electrical Specifications chart in the Specifications portion of this section.

Auxiliary Heater System Wiring Diagram

CCL 4292-A

DIAGNOSIS AND TESTING (Continued)

Auxiliary Air Conditioning Heater System Wiring Diagram

**Vacuum System Tests**

Vacuum is used to control the auxiliary mode door operation. Refer to Section 12-03B for vacuum system information.

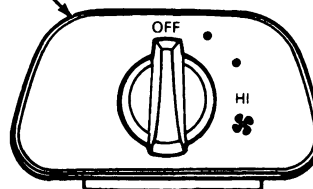
Refrigerant System

Refer to the refrigerant system tests in Section 12-03, for refrigerant system diagnosis.

REMOVAL AND INSTALLATION**Rear Control Assembly****Removal and Installation**

- Using a screwdriver, carefully pry the rear control assembly out of the headliner.

REAR CONTROL ASSEMBLY

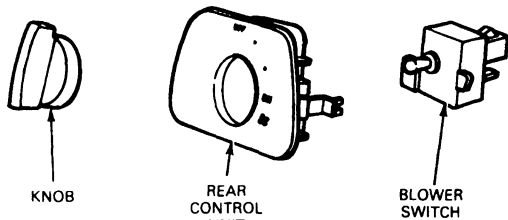


CCL 4279-A

- Disconnect the electrical connector from the rear control blower switch.

REMOVAL AND INSTALLATION (Continued)

3. If necessary, remove the knob from the rear control blower switch and remove the switch from the rear control unit.

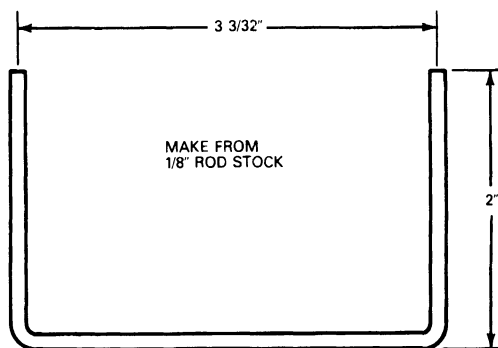


CCL 4231-A

For installation, follow removal steps in reverse order.

Air Conditioner Overhead Register and Louver Assembly**Removal and Installation**

1. If a spanner wrench of suitable size is available, use it to rotate the register and louver assembly until the louver retainer ears align with the front to rear centerline of the vehicle. If a spanner wrench is not available, a piece of 1/8-inch diameter rod stock may be made locally into a tool with the dimensions called out in the following illustration.

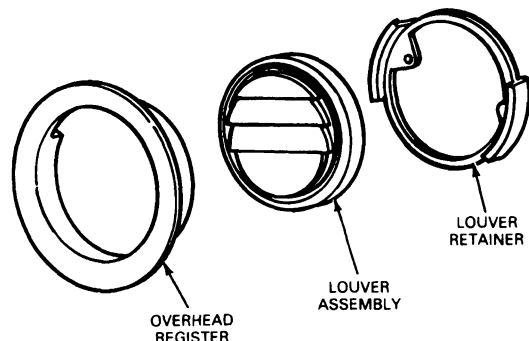


CCL 4315-A

2. For accessibility, open the register louvers to expose the holes in the retainer ears. Insert the open ends of the fabricated tool into the holes in the retainer ears; then, rotate the register and louver assembly into its removable position.

3. While pushing the assembly rearward, pull downward on the front of the register. A slight twisting motion may be needed to properly align the retainer ears with the clearance openings in the headliner.

CAUTION: Do not use a screwdriver to pry the assembly out of the opening in the headliner. It could result in damage to the headliner or register assembly.



CCL 4227-A

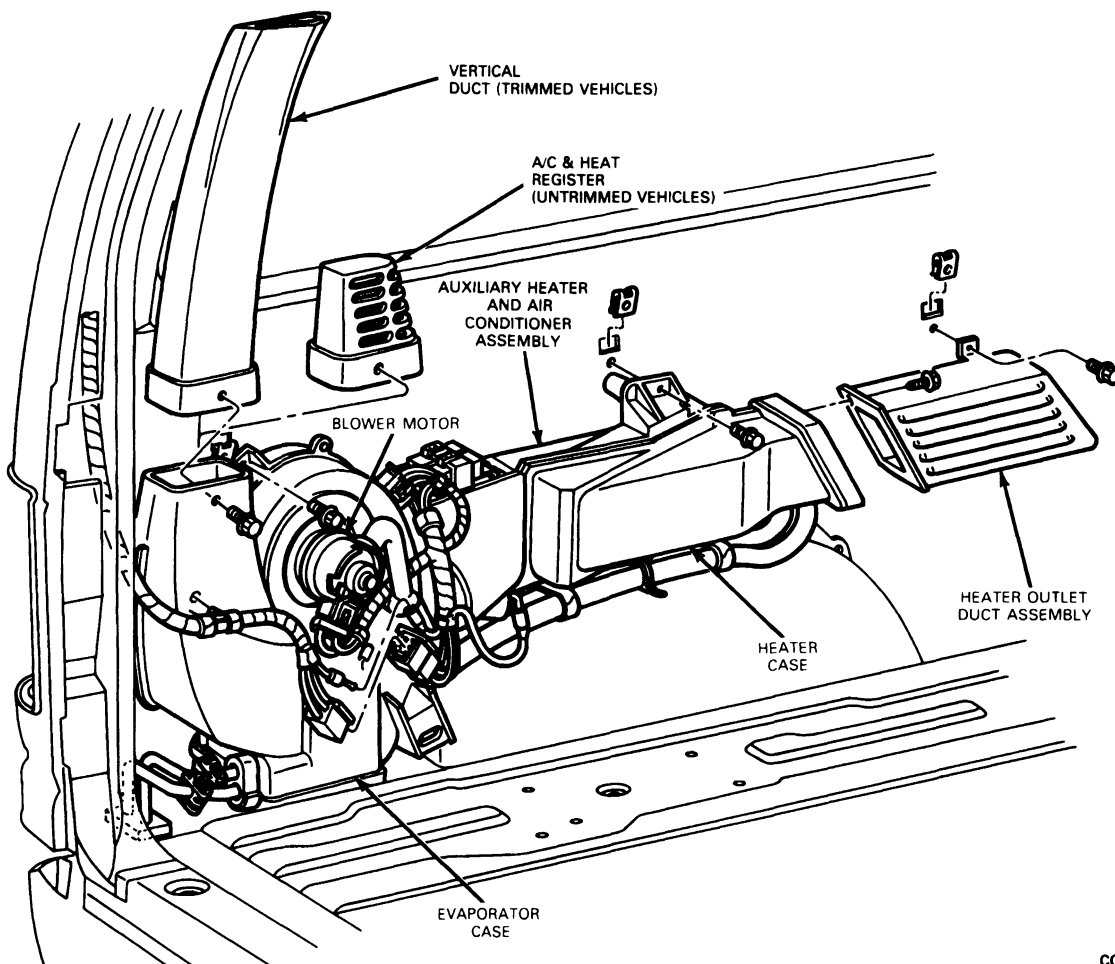
For installation, follow removal steps in reverse order.

Auxiliary Heater and Air Conditioner Assembly**Removal**

1. Remove the third, fourth and fifth bench seats (if equipped).
2. Remove the left center bolster trim panel, left lower front trim panel, left rear lower and upper trim panels (if equipped).
3. Discharge the air conditioning system. Refer to the procedures in Section 12-03.
4. Working under the vehicle, disconnect the heater hoses from the underbody heater tubes and plug the hoses.
5. Cap the line and fittings to prevent the entrance of dirt and moisture.
6. Disconnect the main wiring harness and vacuum line from the auxiliary heater and air conditioner assembly.
7. If equipped, remove the mounting screw from the auxiliary heater and air conditioner assembly vertical duct. Lift the duct into the headliner and remove it by pulling it down and away from the auxiliary case assembly.
8. Remove the two auxiliary heater and air conditioner assembly mounting screws, then pull the unit away from the sheet metal to clear the dowel alignment pin.

REMOVAL AND INSTALLATION (Continued)

9. Lift the auxiliary heater and air conditioner assembly out of the vehicle while guiding the heater hoses out from below the underbody.



CCL 4246-A

Installation

1. Place the auxiliary heater and air conditioner assembly into the vehicle while guiding the heater hoses and air conditioner lines through the holes in the floor panel.
2. Make sure that the heater hoses, air conditioner lines and drain seals are positioned properly.
3. Align the auxiliary heater and air conditioner assembly with the dowel alignment pin. Install the two auxiliary heater and air conditioner assembly mounting screws.
4. Place the vertical duct (if equipped) into its mounting position and install the mounting screw.
5. Connect the main wiring harness and vacuum line to the auxiliary heater and air conditioner assembly.
6. Connect the air conditioner suction line and the air conditioner liquid line to the underbody air conditioner lines.
7. Connect the heater tubes under the vehicle to the heater hoses connected to the auxiliary unit.
8. Fill the cooling system to specification and check for coolant leaks. Refer to the Powertrain/Drivetrain Manual, Section 03-03.
9. Leak-test, evacuate and charge the refrigerant system following the recommended service procedures, if equipped with auxiliary air conditioning. Refer to Section 12-03.
10. Install the left rear lower and upper trim panels, left lower front trim panel and the left center bolster trim panel (if equipped).

REMOVAL AND INSTALLATION (Continued)

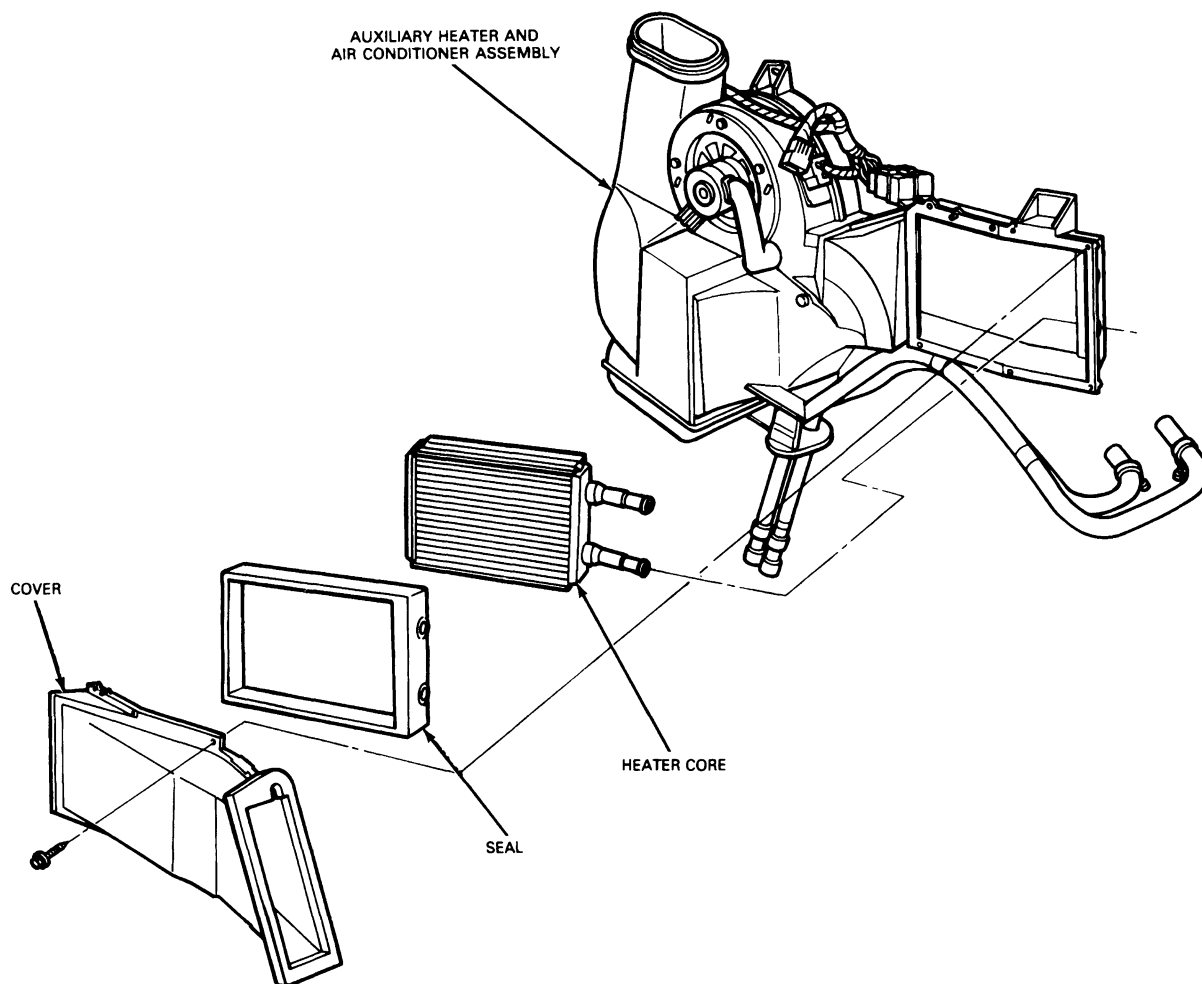
11. Install the third, fourth and fifth bench seats (if equipped).

Heater Core and Seal**Removal**

1. Remove the third, fourth and fifth bench seats (if equipped).
2. Remove the left center bolster trim panel, left lower front trim panel, left rear lower and upper trim panels (if equipped).
3. Remove the six heater core cover mounting screws and remove the cover.
4. Clamp off the heater hoses that connect to the heater core to prevent coolant from spilling when the heater core is removed.
5. Loosen the clamps that secure the heater hoses to the heater core and disconnect the heater core from the heater hoses.
6. Remove the heater core.
7. Remove the heater core seal from the heater core.

Installation

1. Install the heater core seal onto the heater core.
2. Connect the heater core to the heater hoses, making sure to install the inlet and outlet hoses in their proper positions.
3. Tighten the heater hose inlet and outlet clamps.
4. Unclamp the heater hoses.
5. Place the heater core and seal into the auxiliary heater and air conditioner assembly.
6. Install the heater core cover and six mounting screws.
7. Fill the cooling system to specification and check for leaks. Refer to the Powertrain / Drivetrain Manual, Section 03-03.
8. Install the left lower and upper trim panels, left lower front trim panel and the left center bolster trim panel (if equipped).
9. Install the third, fourth and fifth bench seats (if equipped).

REMOVAL AND INSTALLATION (Continued)**Auxiliary Heater Core Installation**

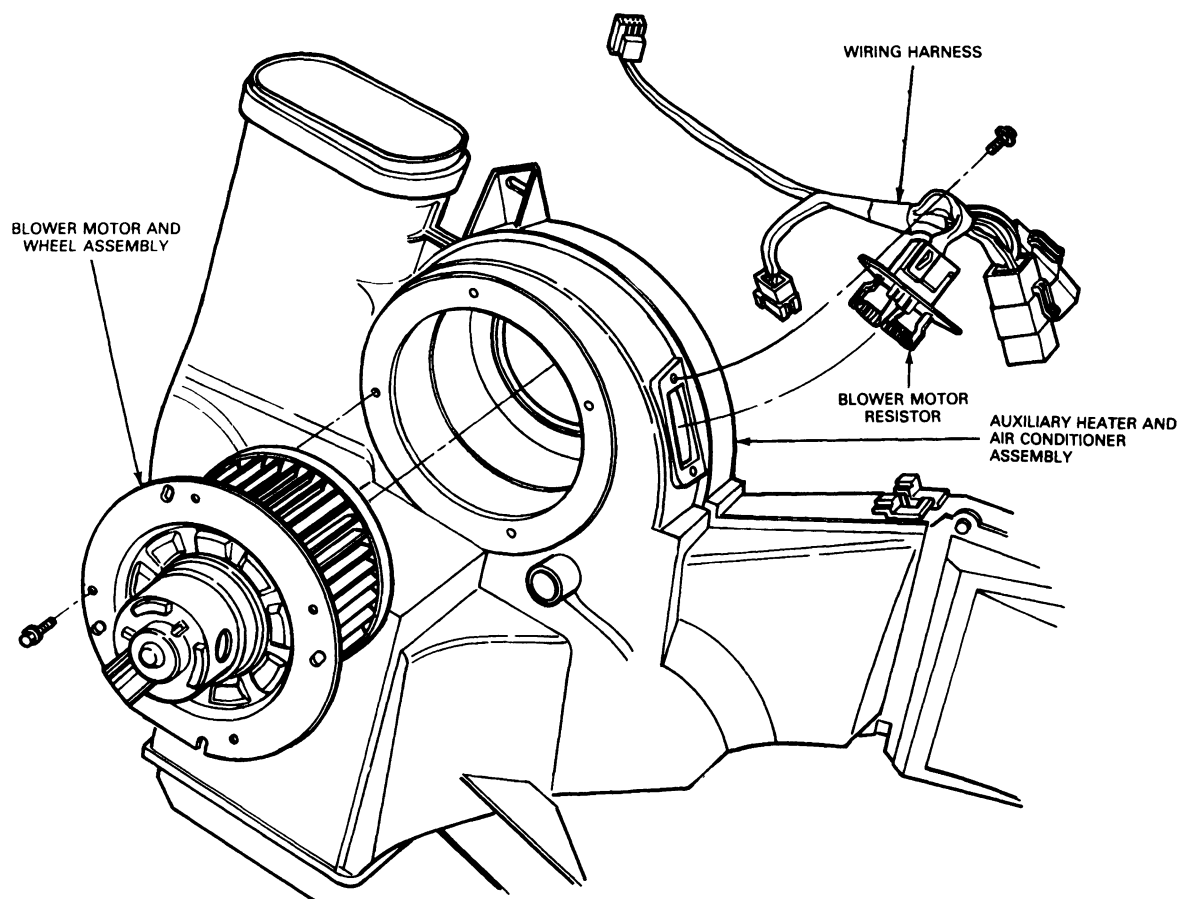
CCL 4233-A

Blower Motor and Wheel Assembly**Removal and Installation**

1. Remove the third, fourth and fifth bench seats (if equipped).
2. Remove the left center bolster trim panel, left lower front trim panel, left rear lower and upper trim panels (if equipped).

3. Disconnect the blower motor vent tube from the auxiliary unit housing.
4. Disconnect the blower motor electrical connector.
5. Remove the blower motor and wheel assembly mounting screws and remove the assembly.

For installation, follow removal steps in reverse order.

REMOVAL AND INSTALLATION (Continued)**Auxiliary Blower Motor, Wheel and Resistor Installation**

CCL 4226-A

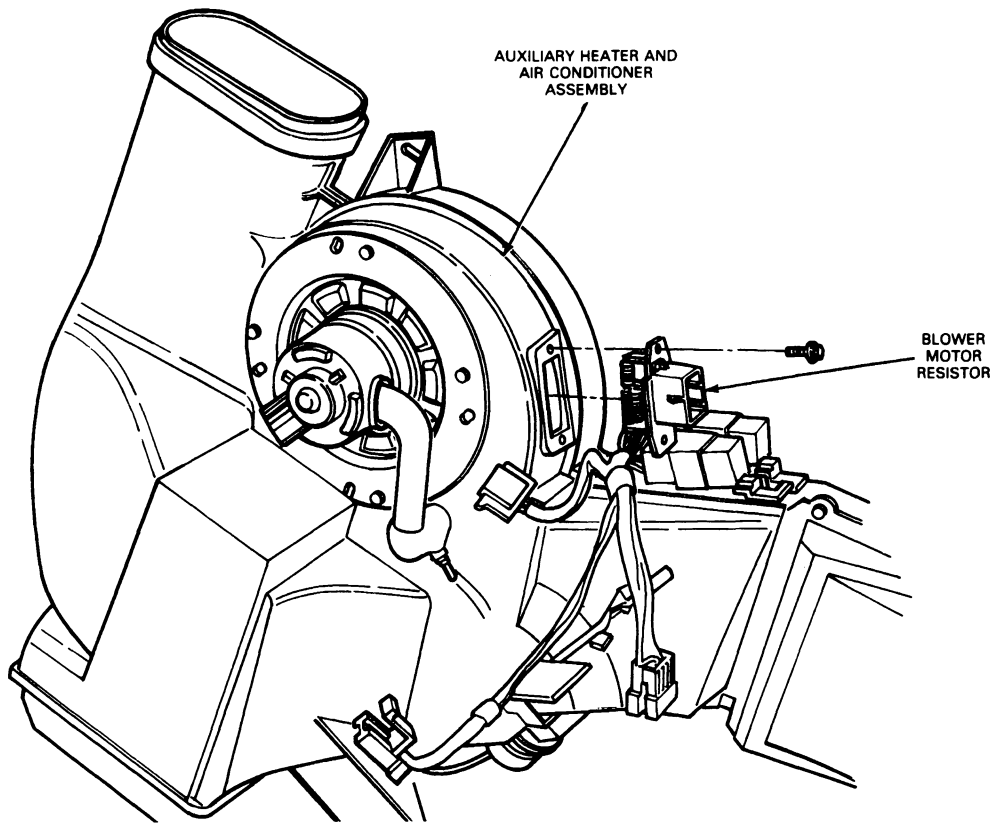
Blower Motor Resistor**Removal and Installation**

1. Remove the third, fourth and fifth bench seats (if equipped).
2. Remove the left center bolster trim panel, left lower front trim panel, left rear lower and upper trim panels (if equipped).
3. Disconnect the blower motor resistor electrical connector.

REMOVAL AND INSTALLATION (Continued)

4. Remove the blower motor resistor mounting screws and remove the resistor.

For installation, follow removal procedures in reverse order. Check blower motor operation prior to installing trim.



CCL 4230-A

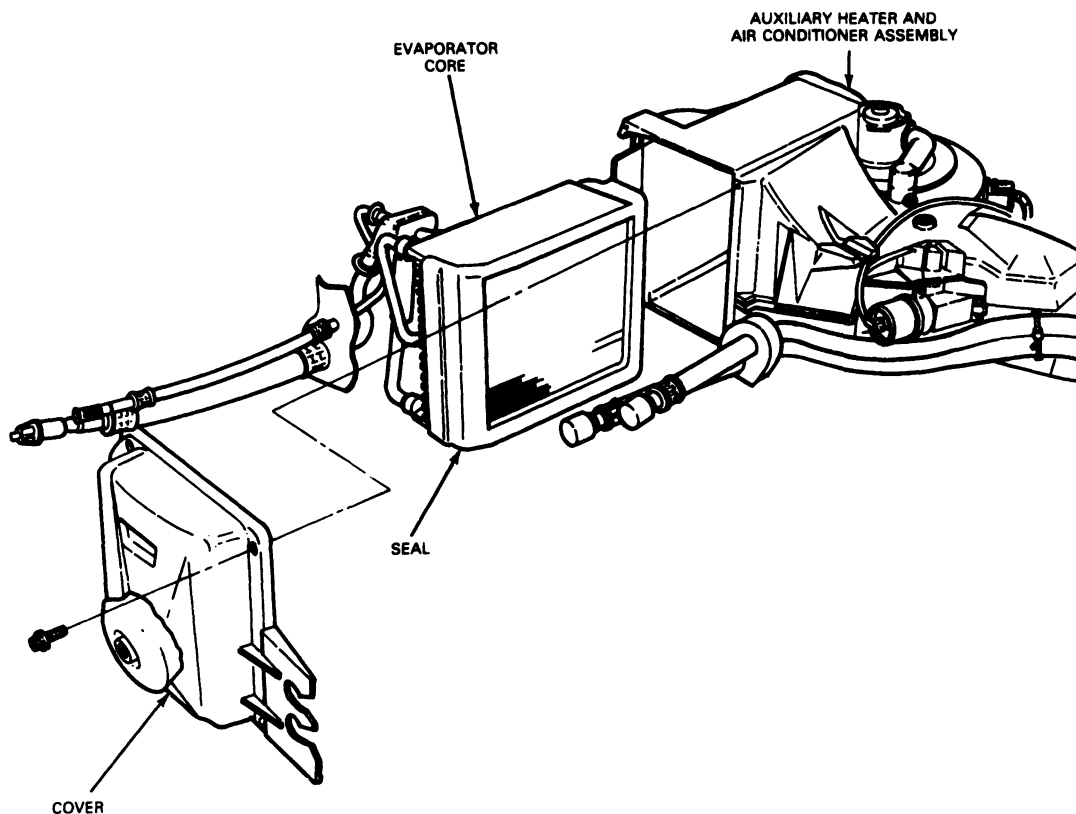
Evaporator Core and Seal**Removal**

1. Remove the auxiliary heater and air conditioning assembly as described in this section.
2. Remove the four screws from the evaporator cover and remove the cover.
3. Remove the evaporator core and seal.

Installation

1. Install the evaporator core and seal into the auxiliary heater and air conditioner assembly, making sure to align the evaporator tubes' seal in the side of the case.

2. Place the evaporator cover into its mounting position and install the four mounting screws.
3. Install the auxiliary heater and air conditioning assembly as described in this section.

REMOVAL AND INSTALLATION (Continued)**Evaporator Core Installation**

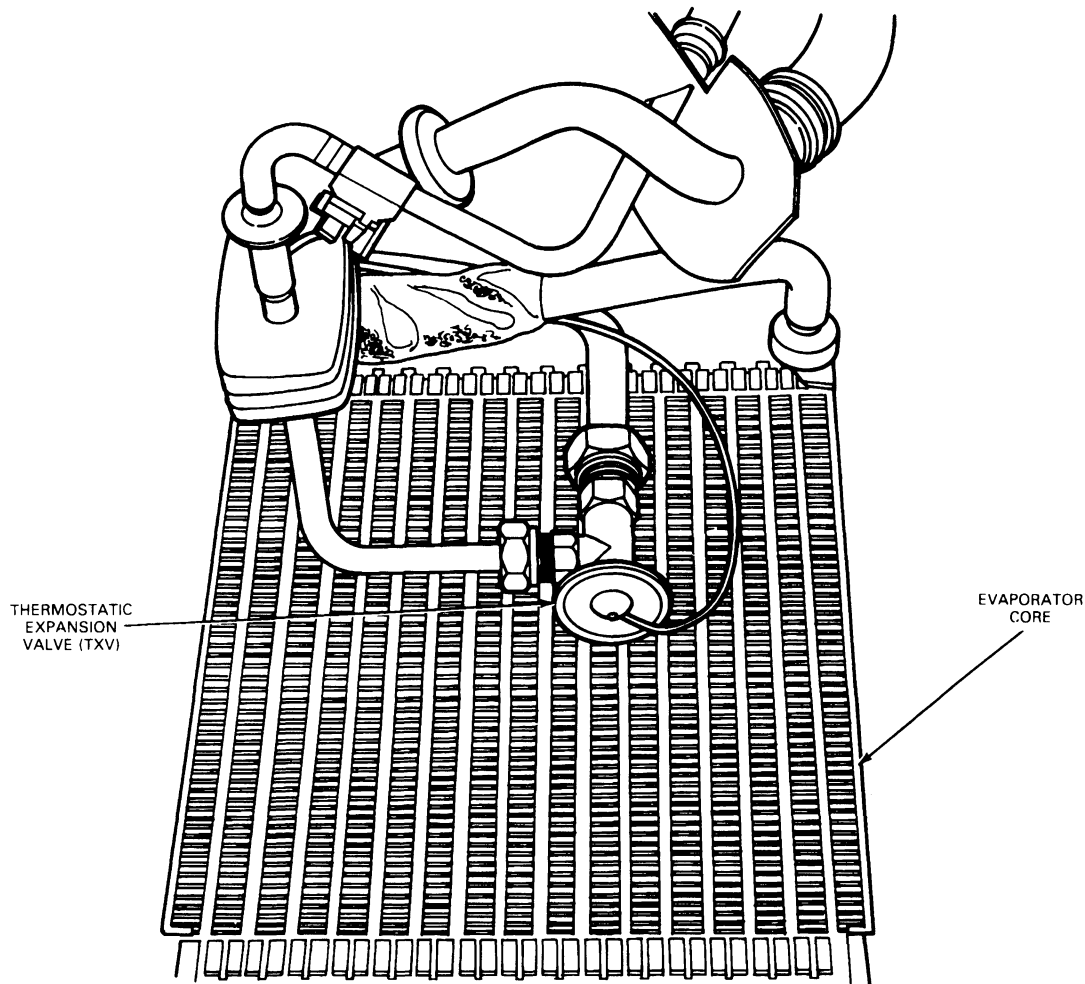
CCL 4229-A

Thermostatic Expansion Valve (TXV)**Removal and Installation**

1. Remove the evaporator core and seal as described in this section.
2. Using a backup wrench to prevent damage, disconnect the air conditioner liquid jumper line tube-O connection from the TXV.

3. Using a backup wrench to prevent damage, disconnect the TXV from the evaporator inlet tube-O connection. Remove the TXV.

For installation, follow removal steps in reverse order.

REMOVAL AND INSTALLATION (Continued)**Thermostatic Expansion Valve (TXV) Installation**

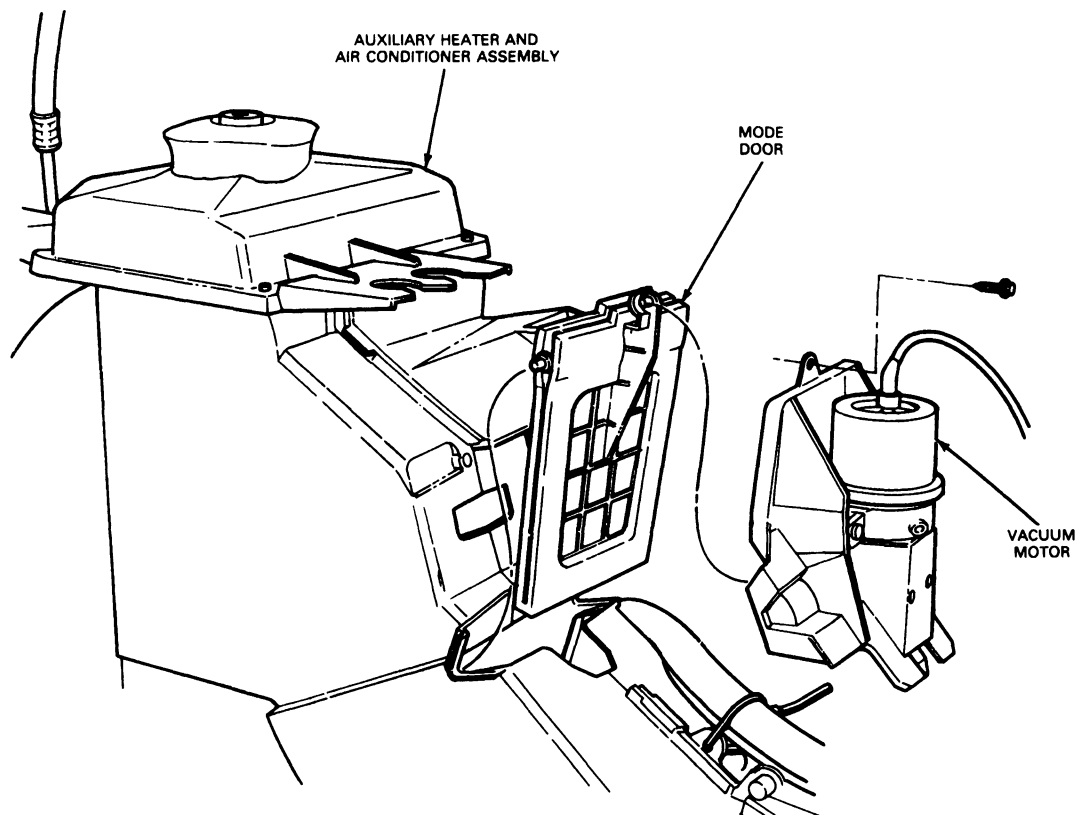
CCL 4282-A

Function Door and Vacuum Motor**Removal and Installation**

1. Remove the auxiliary heater and air conditioning assembly as described in this section.
2. Remove the screw that attaches the mode door vacuum motor base to the auxiliary unit housing.

3. Unsnap the vacuum motor mounting base from the auxiliary unit housing. Remove the vacuum motor and mode door as an assembly.
4. Disconnect the mode door from the vacuum motor.

For installation, follow removal steps in reverse order.

REMOVAL AND INSTALLATION (Continued)**Vacuum Motor and Door Installation**

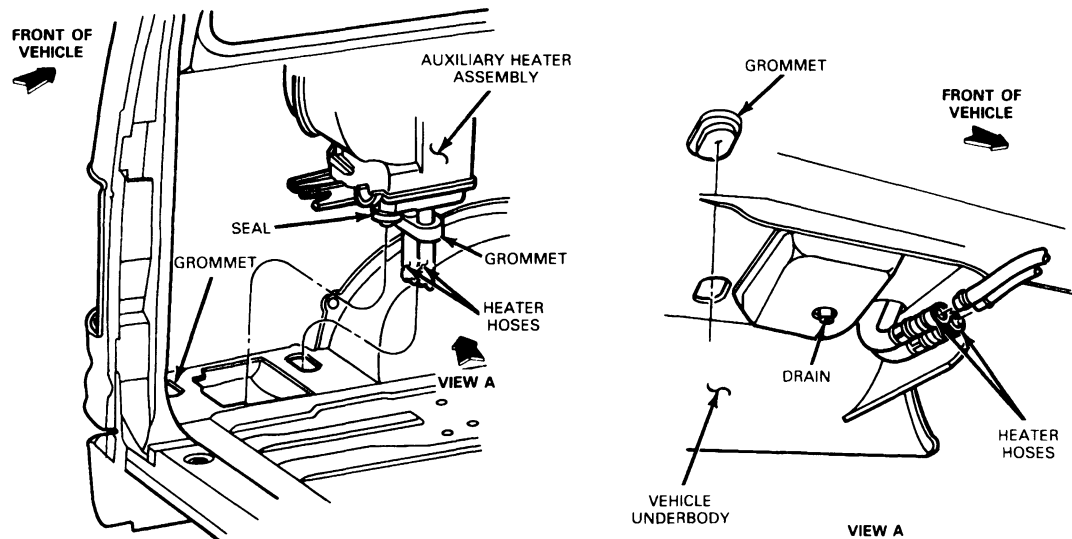
CCL 4228-A

Air Conditioner-Heater Lines and Tubes**Removal and Installation**

Refer to the following illustrations when removing and installing auxiliary air conditioner lines and heater tubes.

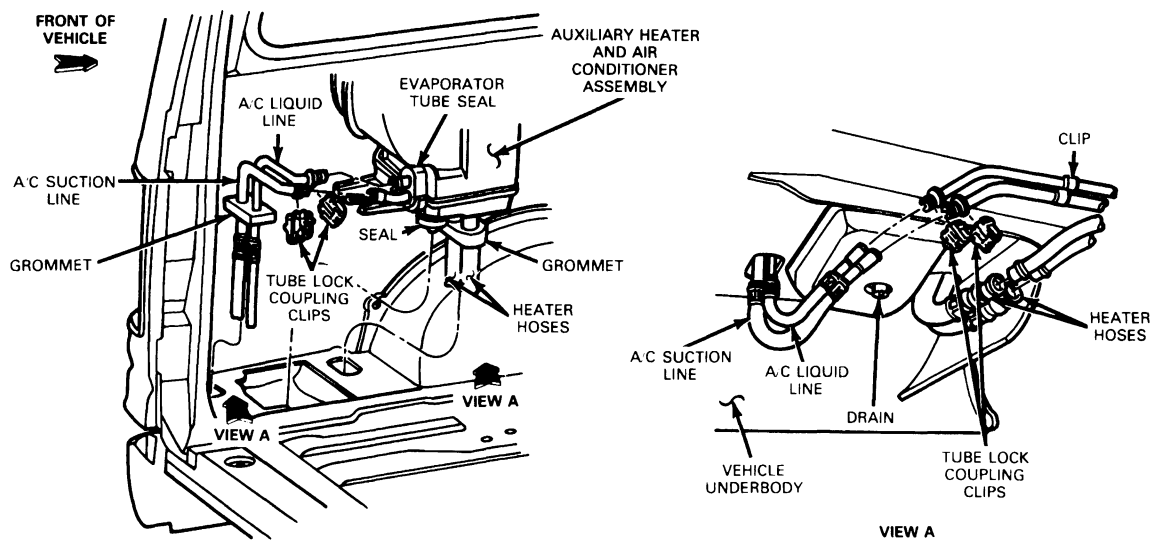
REMOVAL AND INSTALLATION (Continued)

Heater Tubes Auxiliary Unit to Vehicle Underbody



CCL 4284-A

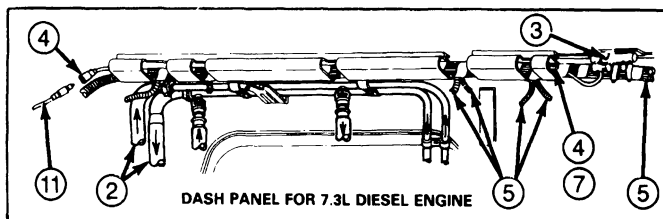
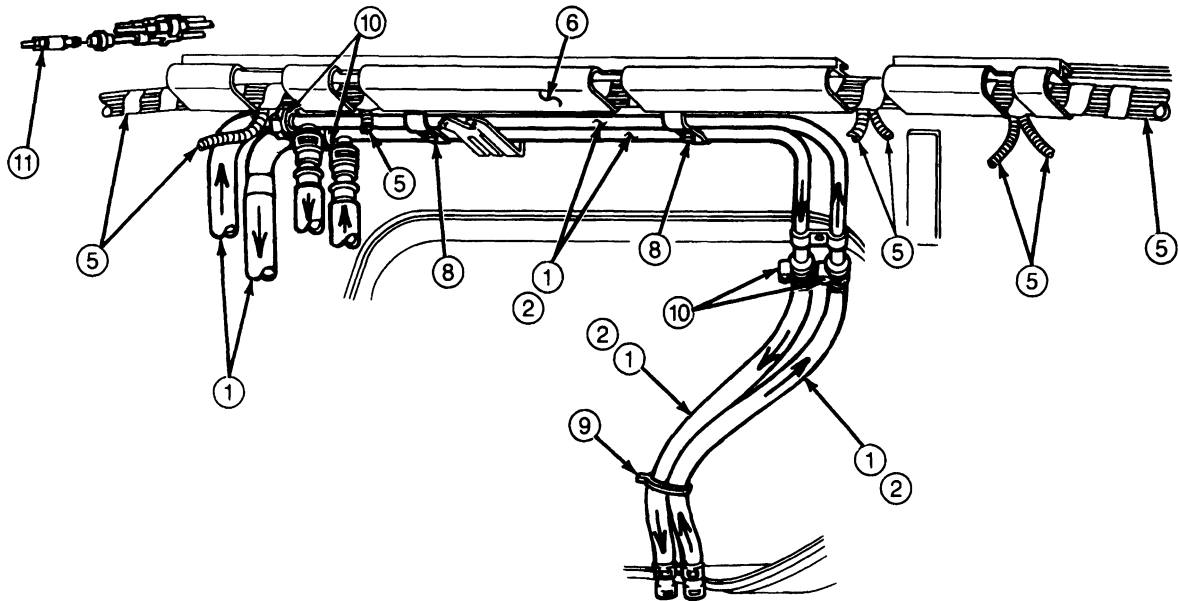
Air Conditioner Lines and Heater Tubes Auxiliary Unit to Vehicle Underbody



CCL 4283-A

REMOVAL AND INSTALLATION (Continued)

Dash Panel Heater Tubes, Auxiliary Heat Only



DASH PANEL FOR 4.9L, 5.0L, 5.8L & 7.5L GAS ENGINES

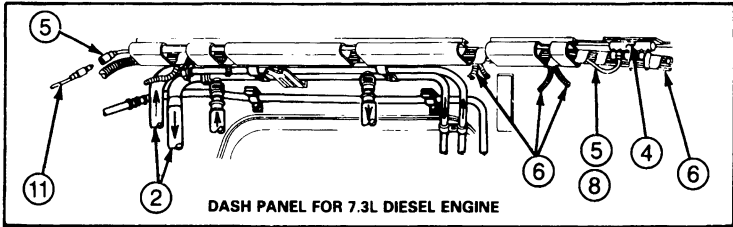
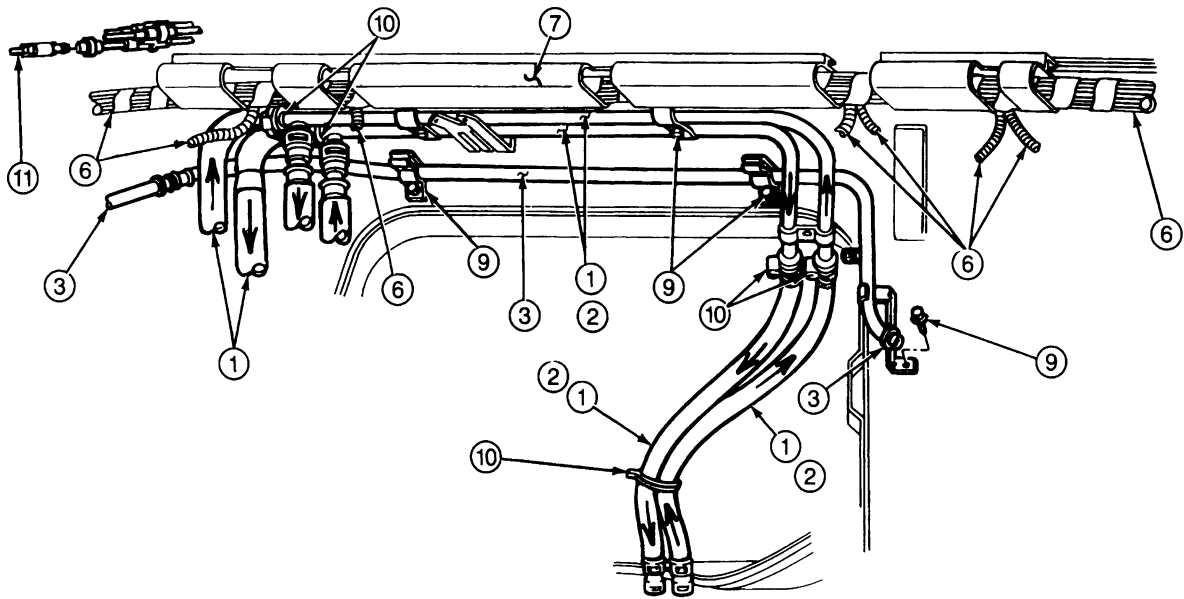
DASH PANEL FOR 7.3L DIESEL ENGINE

ITEM	BASIC PART NUMBER	DESCRIPTION	ITEM	BASIC PART NUMBER	DESCRIPTION
1.	18C553	HOSE AND TUBE ASSEMBLY (4.9L, 5.0L, 5.8L, 7.5L GASOLINE ENGINES)	5.	12A581	WIRING ASSEMBLY SHIELD
2.	18C553	HOSE AND TUBE ASSEMBLY (7.3L DIESEL ENGINE)	6.		ROUTE ITEM "4" THROUGH SHIELD AS SHOWN
3.		VACUUM FITTING (7.3L DIESEL ENGINE)	7.		SCREW (2 REQ'D.)
4.		A/C VACUUM HOSE ASSEMBLY (7.3L DIESEL ENGINE)	8.	N803818-S35	STRAP
			9.		CLAMPS
			10.		VACUUM HOSE FITTING
			11.		

CCL 4287-B

REMOVAL AND INSTALLATION (Continued)

Dash Panel Air Conditioner Lines and Heater Tubes, Auxiliary Air Conditioning and Heat

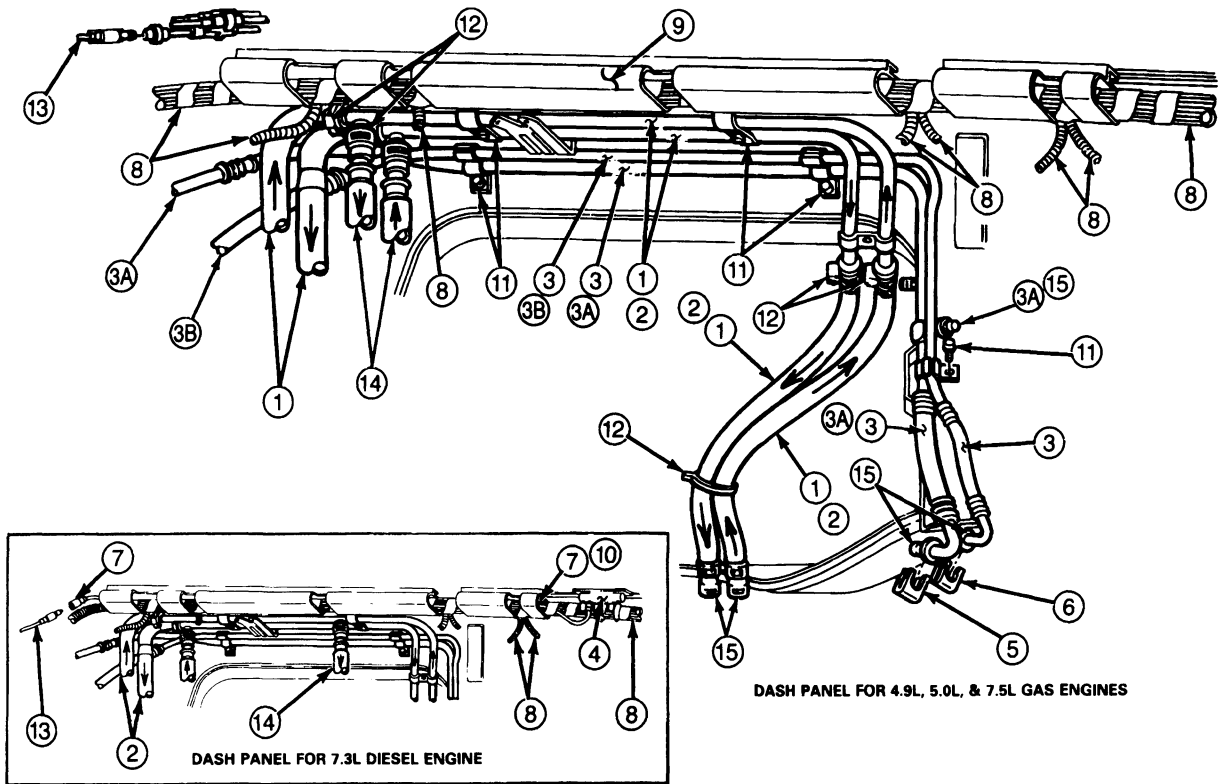


DASH PANEL FOR 4.9L, 5.0L, 5.8L & 7.5L GAS ENGINES

ITEM	BASIC PART NUMBER	DESCRIPTION	ITEM	BASIC PART NUMBER	DESCRIPTION
1.	18C553	HOSE AND TUBE ASSEMBLY (4.9L, 5.0L, 5.8L, 7.5L GASOLINE ENGINES)	6.	12A581	WIRING ASSEMBLY SHIELD
2.	18C553	HOSE AND TUBE ASSEMBLY	7.	REF.	ROUTE ITEM "5" THROUGH SHIELD AS SHOWN
3.	19N617	HOSE AND TUBE ASSEMBLY (SUCTION LINE)	8.	REF.	SCREW (5 REQ'D.)
4.	REF.	(7.3L DIESEL ENGINE) A/C VACUUM HOSE FITTING	9.	N803818-S55	STRAP/CLAMPS PIA 18C533
5.	REF.	A/C VACUUM HOSE (7.3L DIESEL ENGINE) PIA 125B1, G LEVEL	10.	REF.	VACUUM HOSE FITTING PIA
			11.		EVAPORATOR ASSEMBLY

CCL 4288-B

REMOVAL AND INSTALLATION (Continued)

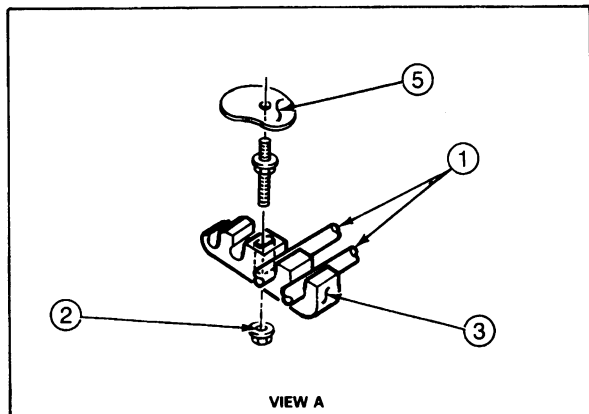
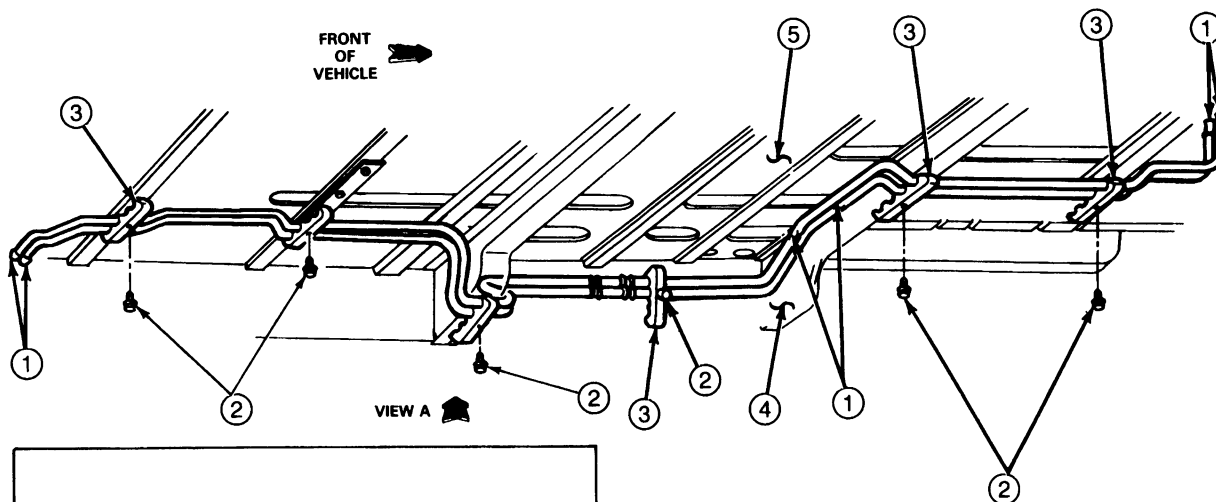


ITEM	BASIC PART NUMBER	DESCRIPTION	ITEM	BASIC PART NUMBER	DESCRIPTION
1.	18C553	HOSE AND TUBE ASSEMBLY (4.9L, 5.0L, 5.8L, 7.5L GASOLINE ENGINES)	6.	19E746	CLIP - A/C TUBE LOCK COUPLING
2.	18C553	HOSE AND TUBE ASSEMBLY (7.3L DIESEL ENGINE)	7.		A/C VACUUM HOSE ASSEMBLY (7.3L DIESEL ENGINE)
3.	19E558	TUBE ASSEMBLY	8.	12A581	WIRING ASSEMBLY SHIELD
3A.	19N617	HOSE ASSEMBLY (SUCTION LINE)	9.		ROUTE ITEM "7" THROUGH SHIELD AS SHOWN
3B.	19N651	TUBE ASSEMBLY (LIQUID LINE)	10.		SCREW (5 REQD.)
4.		*VACUUM FITTING (7.3L DIESEL ENGINE)	11.	N803818-S55	STRAP CLAMPS
5.	19E746	CLIP - A/C TUBE LOCK COUPLING	12.		VACUUM HOSE FITTING
			13.		HEATER HOSES
			14.		A/C LINES
			15.		

CCL 4286-B

REMOVAL AND INSTALLATION (Continued)

Vehicle Underbody Heater Tubes, Auxiliary Heat Only



ITEM	BASIC PART NUMBER	DESCRIPTION
1.	18B402	HEATER TUBE ASSY
2.	55917-S2	SCREW
3.	18N332	CLIP
4.	REF.	LH FRAME RAIL
5.	N807204-S36B	STUD (4 REQ'D)
6.	N621905-S36	NUT (4 REQ'D)
7.	18N332	CLIP
8.	55919	SCREW
9.	REF.	UNDERBODY

CCL 4289-B

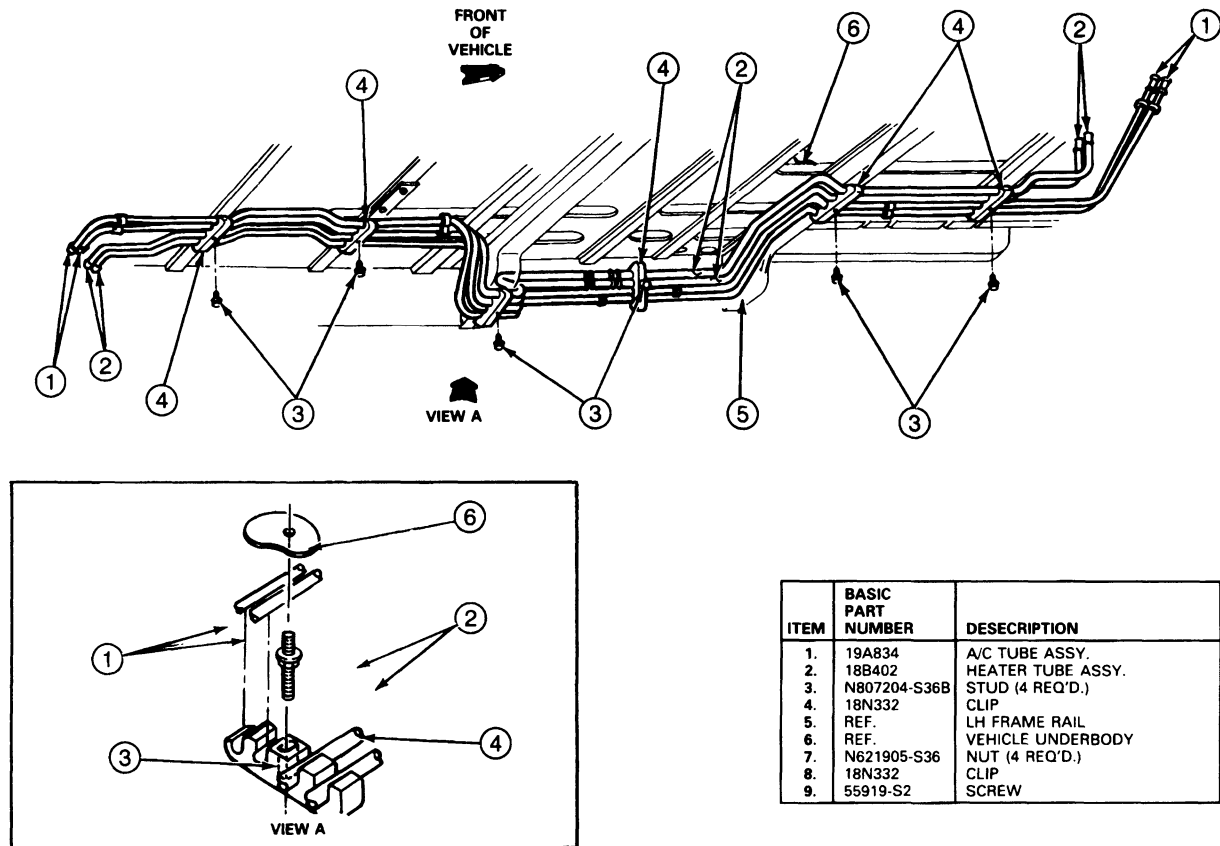
Item	Part Number	Description
1	18B402	Heater Tube Assembly
2	55917-S2	Screw
3	18N332	Clip
4	Ref.	L.H. Frame Rail

(Continued)

Item	Part Number	Description
5	N807204-S36B	Stud (4 Req'd.)
6	N621905-S36	Nut (4 Req'd.)
7	18N332	Clip
8	55919-S2	Screw
9	Ref.	Underbody

REMOVAL AND INSTALLATION (Continued)

Vehicle Underbody Air Conditioner Lines and Heater Tubes, Auxiliary Air Conditioning and Heat



ITEM	BASIC PART NUMBER	DESCRIPTION
1.	19A834	A/C TUBE ASSY.
2.	18B402	HEATER TUBE ASSY.
3.	N807204-S36B	STUD (4 REQ'D.)
4.	18N332	CLIP
5.	REF.	LH FRAME RAIL
6.	REF.	VEHICLE UNDERBODY
7.	N621905-S36	NUT (4 REQ'D.)
8.	18N332	CLIP
9.	55919-S2	SCREW

CCL 4290-B

Item	Part Number	Description
1	19A834	A/C Tube Assembly
2	18B402	Heater Tube Assembly
3	N807204	Stud (4 Req'd.)
4	18N332	Clip

(Continued)

Item	Part Number	Description
5	Ref.	L.H. Frame Rail
6	Ref.	Vehicle Underbody
7	N621905	Nut (4 Req'd.)
8	18N332	Clip
9	55919-S2	Screw

SPECIFICATIONS

ELECTRICAL

Description	Specification
Auxiliary System	15 Amp. Fuse F-9 in Fuse Panel
Auxiliary Blower Motor	60 Amp. in High Current Fuse Block (Engine Compartment)
Clutch Cycling Pressure Switch	Main System Expansion Valve — Auxiliary System
Illumination, Auxiliary Control Assembly	One 1CP-161 Bulb

REFRIGERANT (A/C ONLY)

Description	Specification
Clutch Cycling Control	Common with Main A/C System
System Protection High Pressure Relief Valve	Common with Main A/C System
Capacity, Main (Front) System Only	3-1/2 Lbs. Plus 1/4 Lb. Minus 0 56 Oz. Plus 4 Oz. Minus 0 1.588 Kg. Plus 0.113 Kg. Minus 0

(Continued)

SPECIFICATIONS (Continued)**REFRIGERANT (A/C ONLY) (Cont'd)**

Description	Specification
Capacity, Main (Front) System and Auxiliary System	4- 1/2 Lbs Plus 1/4 Lb. Minus 0 68 Oz. Plus 4 Oz. Minus 0 1.928 Kg. Plus 0.113 Kg. Minus 0
Type Refrigerant 12 (R-12) Ford Spec. Motorcraft Part Number, 30 Lb. Container	Dichlorodifluoro- methane CCl ₂ F ₂ ESA-M17B2A YN-7

Description	N-m	Lb-Ft
Expansion Valve to Evaporator Core	21-27	15-20
Liquid Line to Expansion Valve	14-20	10-15

SECTION 12-03F Compressor and Clutch, FS-6

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	12-03F-1	REMOVAL AND INSTALLATION (Cont'd.)	
MAINTENANCE		Clutch Hub and Pulley	12-03F-5
Adding Refrigerant Oil	12-03F-2	Compressor	12-03F-4
During Component Replacement	12-03F-2	Manifold and Hose Assembly	12-03F-4
During Compressor Replacement	12-03F-2	Pulley Bearing Clutch	12-03F-7
MAJOR REPAIR OPERATIONS		SPECIAL SERVICE TOOLS/EQUIPMENT	12-03F-16
Head Replacement	12-03F-15	SPECIFICATIONS	12-03F-15
Rear Head Gasket and O-Ring	12-03F-11	TESTING	
Shaft Seal and/or Front Head Gasket and O-Ring	12-03F-8	Compressor External Leak Test	12-03F-2
Valve Plates and Inlet Reeds	12-03F-13	Compressor Manifold Leak Test	12-03F-2
REMOVAL AND INSTALLATION		Compressor Rotating Torque Check	12-03F-3
Clutch Field Coil	12-03F-7	VEHICLE APPLICATION	12-03F-1

VEHICLE APPLICATION

Econoline with 4.9L, 5.0L and 5.8L MFI Engines

DESCRIPTION AND OPERATION

The FS-6 compressor is a six-cylinder axial design compressor with mounting brackets for tangential mounting.

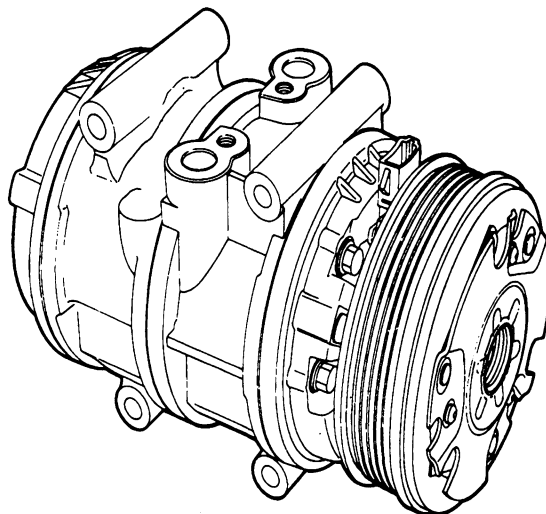
The compressor mainshaft is driven by a belt from the engine camshaft pulley. Three double-acting pistons, positioned axially around the compressor shaft, operate in a front and rear cylinder assembly. The pistons are actuated by a swashplate that is pressed on the compressor shaft. The swashplate changes the rotating action of the shaft to provide a reciprocating driving force to each of the three pistons. This driving force is applied, through shoes and balls, to the midpoint of each of the double ended pistons.

Reed-type suction and discharge valves are mounted in valve plates between the cylinder assembly and the head at each end of the compressor.

The heads are connected with each other by gas-tight passageways which direct refrigerant gas to a common output.

A magnetic clutch is used to drive the compressor shaft. When voltage is applied to the clutch field coil, the clutch plate and hub assembly (which is solidly coupled to the compressor shaft) is drawn by magnetic force toward the pulley which rotates freely on the compressor front head casting. The magnetic force locks the clutch plate and hub assembly and the pulley together as one unit. The compressor shaft then turns with the pulley. When voltage is removed from the clutch field coil, springs in the clutch plate and hub assembly move the clutch plate away from the pulley and the compressor shaft ceases to rotate.

FS-6 Compressor, Tangential Mount



CCL 2514-A

MAINTENANCE

Adding Refrigerant Oil

The FS-6 compressor uses a special paraffin base refrigerant oil (E73Z-19557-A or Motorcraft YN-9 or an equivalent refrigerant oil meeting Ford Spec. ESH-M2C31-A2). An oil charge of 300 ml (10 fluid ounces) is used in a new system. It is important that only the specified type and quantity of refrigerant oil be used in the compressor. If there is a surplus of oil in the system, too much oil will circulate with the refrigerant reducing the cooling capacity of the system. Too little oil will result in poor lubrication of the compressor.

When it is necessary to replace a component of the refrigerant system, the procedures given here must be followed to make certain that the total oil charge in the system is correct after the new part is installed.

When the compressor is operated, oil gradually leaves the compressor and is circulated through the system with the refrigerant. Eventually a balanced condition is reached in which a certain amount of oil is retained in the compressor and a certain amount is continually circulated. If a component of the system is removed after the system has been operated, some oil will go with it. To maintain the original total oil charge, it is necessary to compensate for this by adding the lost oil to the new replacement part.

The procedures for replacing oil follow.

During Compressor Replacement

A new service replacement FS-6 compressor contains 300 ml (10 fluid ounces) of the specified refrigerant oil.

1. Prior to installing the replacement compressor, drain the refrigerant oil from the removed compressor into a calibrated container.
2. Then, drain the refrigerant oil from the new compressor into a clean calibrated container.
 - If the amount of oil drained from the removed compressor is between 90 and 148 ml (3 and 5 ounces), pour the same amount of clean refrigerant oil into the new compressor.
 - If the amount of refrigerant oil that was removed from the old compressor is greater than 148 ml (5 ounces), pour 148 ml (5 ounces) of clean refrigerant oil into the new compressor.
 - If the amount of refrigerant oil that was removed from the old compressor is less than 90 ml (3 ounces), pour 90 ml (3 ounces) of clean refrigerant oil into the new compressor. This will maintain the total system oil charge within the specified limits.

NOTE: The suction accumulator / drier and orifice tube should also be replaced whenever the compressor is replaced.

During Component Replacement

When replacing other components of the air conditioning refrigerant system, measured quantities of the specified refrigerant oil should be added to the component to make sure that the total oil charge in the system is correct before the system is operated.

Clean refrigerant oil should be added to the replacement components as follows:

- Evaporator core: add 90 ml (3 fluid ounces).
- Condenser: add 30 ml (1 fluid ounces).
- Accumulator: drain oil from removed accumulator / drier. Add the same amount plus 60 ml (2 fluid ounces) of new refrigerant oil to the new accumulator.

Clean refrigerant oil should be poured directly into the replacement component.

If any other components, such as an orifice tube or a hose are replaced, no additional refrigerant oil is necessary unless a hose bursts with a fully charged system. Then, the addition of some refrigerant oil may be necessary with the amount to be determined by the technician. The suction accumulator / drier should also be replaced under these circumstances.

TESTING

Compressor Manifold Leak Test

1. Tighten the manifold retaining bolts to 18-23 N·m (13-17 ft·lb).
2. Leak test the manifold O-ring seals.
3. If no leaks are found during the leak test, the manifold O-ring seals are good.
4. If a leak is found at the manifold and the manifold bolts are tightened to 18-23 N·m (13-17 ft·lb), install new manifold O-ring seals and repeat the leak test procedure.

Compressor External Leak Test

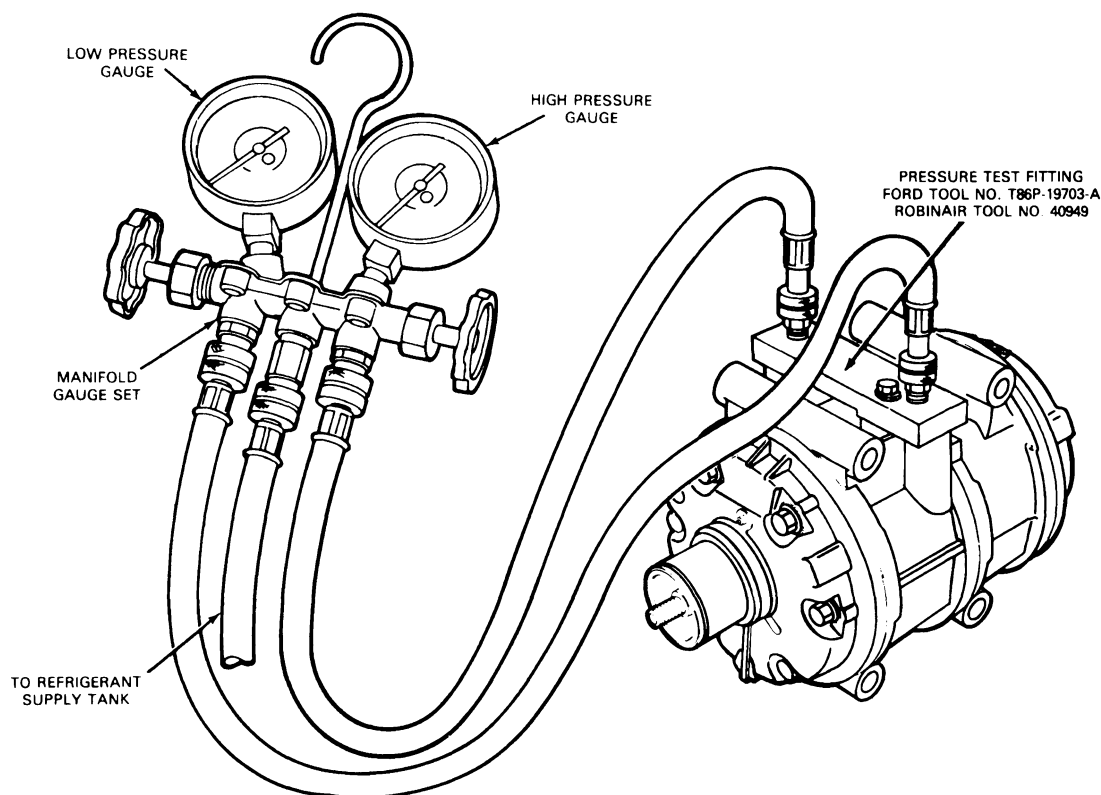
1. Remove the compressor from the vehicle. Observe all safety precautions. Refer to Section 12-03.
2. Install Pressure Test Adapter T86P-19703-A on the compressor.
3. Connect the high and low pressure lines of a manifold gauge set such as Rotunda Air Conditioning Service Tool Kit 063-00010 or equivalent, to the corresponding fittings on the manifold pressure test adapter(s).
4. Attach the center hose of the manifold gauge set to a refrigerant drum standing in an upright position.
5. Prior to leak testing the shaft seal, rotate the compressor shaft ten complete revolutions to distribute oil in the compressor. Then, remove the clutch hub from the compressor as described in this section.
6. Open the low pressure gauge valve, the high pressure gauge valve, and the valve on the refrigerant drum to allow the refrigerant vapor to flow into the compressor.

TESTING (Continued)

7. Using a leak detector such as Rotunda Electronic Leak Detector 055-00015 or equivalent, check for leaks at the compressor rear head seal, compressor front head seal, the compressor shaft seal, the center joint seal and around the compressor cylinder bolt heads. After checking, turn OFF the manifold gauge valves and the refrigerant drum valve.
8. If an external leak is found at either head or at the shaft seal, service as necessary. If an external leak is found at the center joint of the compressor body, install a new compressor assembly.
9. If a refrigerant leak is found at a cylinder head bolt, remove the bolt and inspect the underside of the bolt head and the sealing surface around the bolt hole in the head for any damage. Replace the bolt if damage is found on the underside of the bolt head. Replace the compressor front head if damaged around the bolt hole.

If no damage is found to either the bolt head or the bolt hole sealing surface, install a new bolt. Tighten the bolt no more than 5 N·m (44 in-lb) tighter than the torque specified for assembly (25-26 N·m [18-19 ft-lb]). However, do not exceed the torque specified to correct a leak (34 N·m [25 ft-lb]). Leak test the compressor as outlined.

If the head bolt still leaks, install a new front head and leak test as described.
10. Carefully disconnect the manifold gauge hoses from the pressure test adapter allowing the refrigerant in the compressor to slowly escape. Then, install the clutch hub.
11. Remove the pressure test adapter from the compressor.

Connecting Gauge Set to Check for Leaks**Compressor Rotating Torque Check**

The rotational torque of a used compressor should be checked if excessive compressor drag is suspected.

1. Discharge the refrigerant system following the recommended service procedures. Refer to Section 12-03. Observe all safety precautions.

TESTING (Continued)

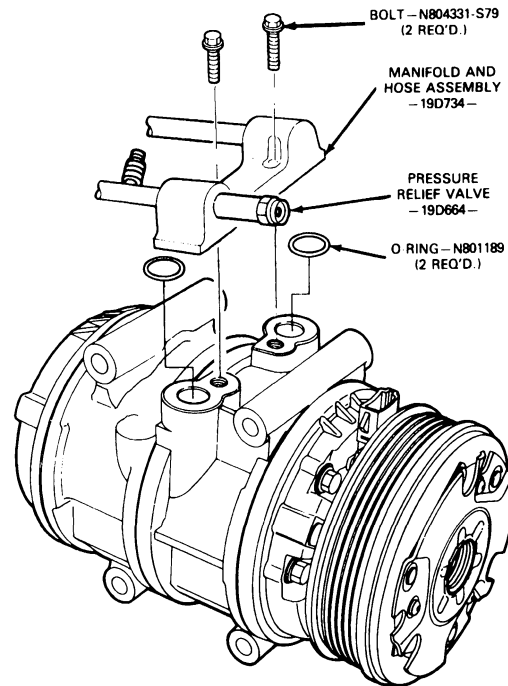
2. Remove the compressor from the vehicle. Use care not to allow dirt to enter the compressor.
3. With compressor clutch disengaged, rotate compressor shaft and note the torque required to rotate the shaft one complete revolution, not the starting torque.
4. If the rotational torque exceeds specification (10 N·m [7 ft-lb]) replace the compressor assembly.
5. If the rotational torque is less than the specified rotational torque, excessive drag does not exist in the compressor. Install the compressor. Then, leak test, evacuate and charge the system.
6. Check the system for proper operation.

REMOVAL AND INSTALLATION**Compressor****Removal and Installation**

Refer to Section 12-03.

Manifold and Hose Assembly**Removal**

1. Discharge the refrigerant from the system following the recommended procedures. Refer to Section 12-03.
2. Disconnect the manifold suction line fitting at the spring lock coupling near the bottom of the radiator with Spring Lock Disconnect Tool T85L-19623-A (3/4-inch, color coded white).
3. Disconnect the manifold discharge line at the condenser using Spring Lock Coupling Disconnect Tool T81P-19623-G2 (1/2-inch, color coded blue).
4. Remove the two bolts attaching the manifold and hose assembly to the compressor, and remove the manifold and O-rings. The compressor manifold O-rings are the red oval type. They must be replaced with the same type O-ring.



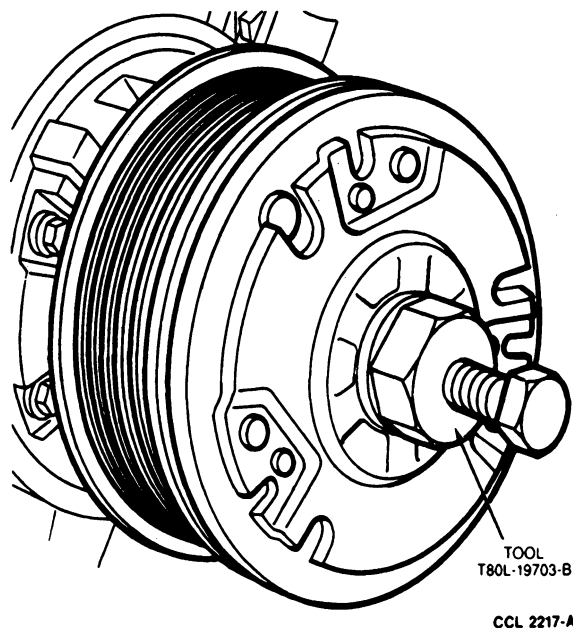
CCL 2622-B

Installation

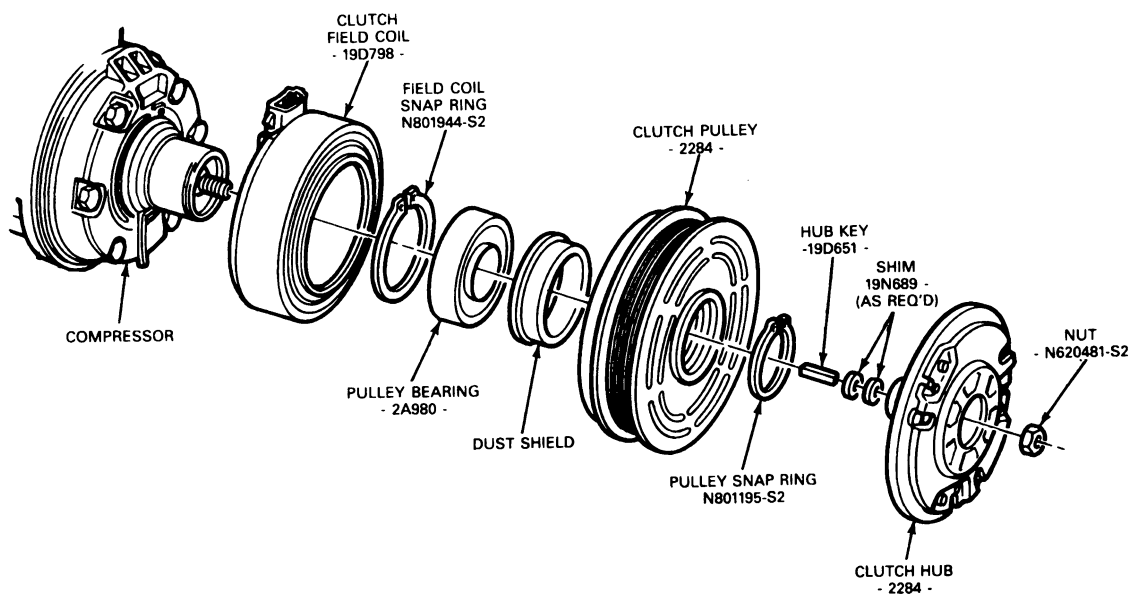
1. Lubricate the new O-rings with clean refrigerant oil and position them in the O-ring grooves of the manifold.
NOTE: Use only the red O-rings. Do not use black O-rings.
2. Apply sealing compound to the threads of the manifold attaching bolts.
NOTE: When installing a new compressor, use the manifold attaching bolts removed from the old (removed) compressor. Do not use the shipping cover bolts from the new compressor.
3. Position the manifold and hose assembly with O-rings to the vehicle and to the compressor.
4. Install two bolts to attach the manifold assembly to the compressor. Tighten bolts to 18-23 N·m (13-17 ft-lb).
5. Connect the suction and discharge lines to the condenser and suction line at the spring lock couplings. Use new O-rings and lubricate with clean refrigerant oil.
NOTE: Use only the specified spring lock coupling O-rings.
6. Leak test, evacuate and charge the system following the recommended procedures. Refer to Section 12-03. Observe all safety precautions.

REMOVAL AND INSTALLATION (Continued)**Clutch Hub and Pulley****Removal**

1. Remove the clutch hub retaining nut. Use Spanner Wrench T70P-4067-A if necessary.
2. Remove the clutch hub and shim(s) from the compressor shaft with Hub Remover T80L-19703-B. Hold the tool with a one-inch wrench and tighten the bolt with a 1/2-inch wrench to pull the hub from the compressor shaft.



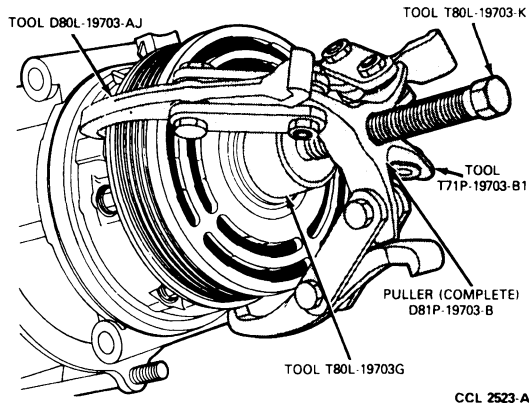
3. Remove the clutch pulley retaining snap ring.

Clutch Hub Pulley and Field Coil, Disassembled

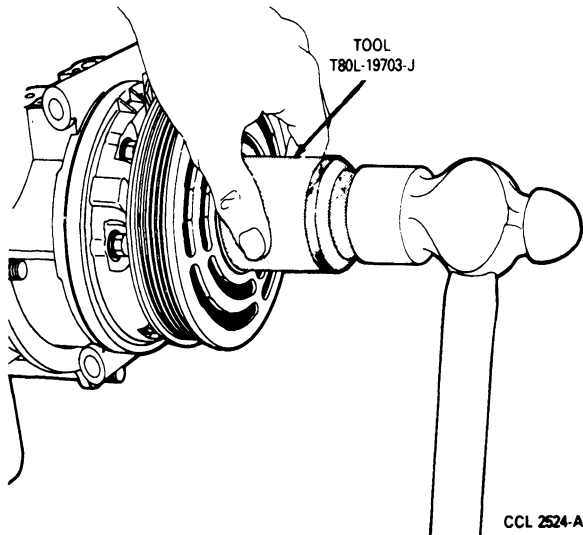
CCL 2216-B

REMOVAL AND INSTALLATION (Continued)

4. Pull the pulley and bearing assembly from the compressor. If the pulley and bearing assembly cannot be removed by hand, use Compressor Shaft Protector T80L-19703-G and Complete Puller D81P-19703-B or equivalent, to remove the pulley.

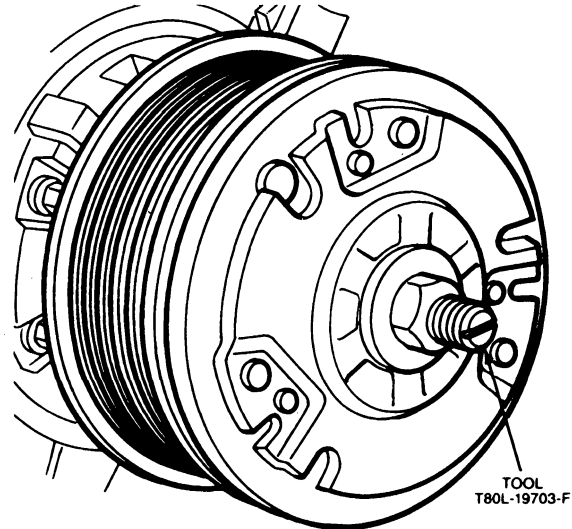
**Installation**

1. Clean the pulley bearing surface of the compressor head to remove any dirt or corrosion.
2. Install the pulley and bearing on the compressor. The bearing is a slip-fit and, if properly aligned, should slip on the compressor head. If difficulty is encountered installing the pulley, gently tap the pulley on the compressor using Pulley Replacer T80L-19703-J. Make sure the pulley bearing is aligned with the compressor head.

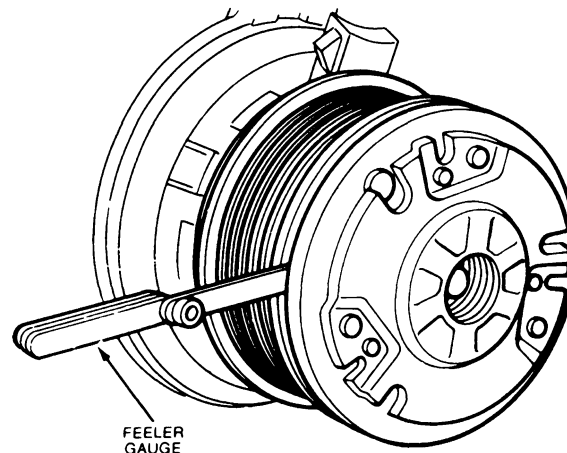


3. Install the pulley retaining snap ring with the bevel side of the snap ring out.

4. Using the two thickest shims of the shim pack between the clutch hub and the end of the compressor shaft, align the shaft key with the keyway in the hub and install the hub on the compressor shaft. Use Hub Replacer T80L-19703-F to press the hub on the compressor shaft if necessary. Do not attempt to drive the hub on the compressor shaft as damage to the compressor will result. Use only the specified tool if the hub will not easily slide on the compressor shaft.



5. Install the hub retaining nut on the compressor shaft. Tighten the hub retaining nut to 13-19 N·m (10-14 ft·lb). DO NOT USE AIR TOOLS.
6. Check and record the air gap between the hub and the mating pulley surface in three locations equally spaced around the pulley.



REMOVAL AND INSTALLATION (Continued)

7. Rotate the compressor pulley one-half turn (180 degrees) and again check the air gap in three equally spaced locations. The smallest air gap must be within the limits of the specified air gap. Add or remove shims between the hub and the compressor shaft as necessary until the smallest air gap is within specification.

Clutch Field Coil**Removal**

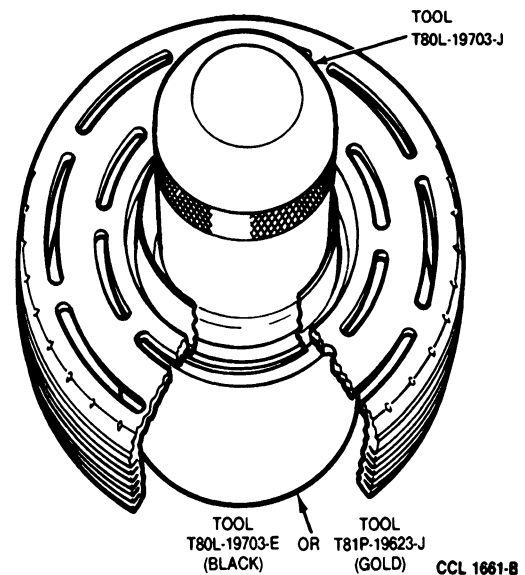
1. Remove the clutch hub and pulley as described in this section
2. Remove the snap ring retaining the clutch field coil on the front of the compressor.
3. Remove the clutch field coil from the compressor.

Installation

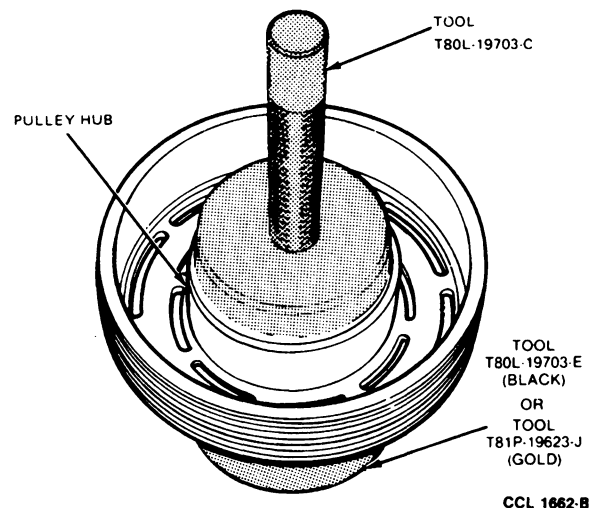
1. Position the clutch field coil to the compressor, engaging the locator pin on the compressor head with the hole in the clutch field coil mounting plate.
2. Install the snap ring to retain the clutch field coil on the compressor with the bevel side of the snap ring out.
3. Install the clutch pulley and hub assembly on the compressor as described in this section.

Pulley Bearing Clutch**Removal**

1. Remove the clutch hub and pulley from the compressor.
2. Position the largest opening of Pulley Support T80L-19703-E over the hub of the pulley and place on bench with support tool under pulley. Then, drive the bearing from the pulley with Pulley Replacer T80L-19703-J.

**Installation**

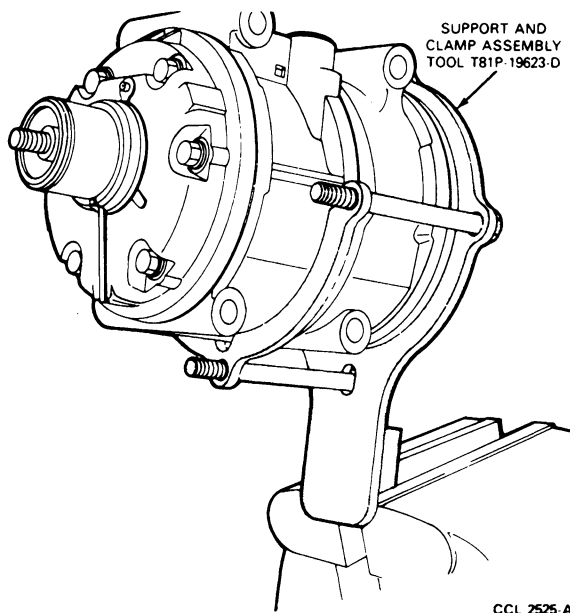
1. Place the smallest opening of Pulley Support T80L-19703-E over the dust shield on clutch pulley friction face side. Place on bench with support under pulley.



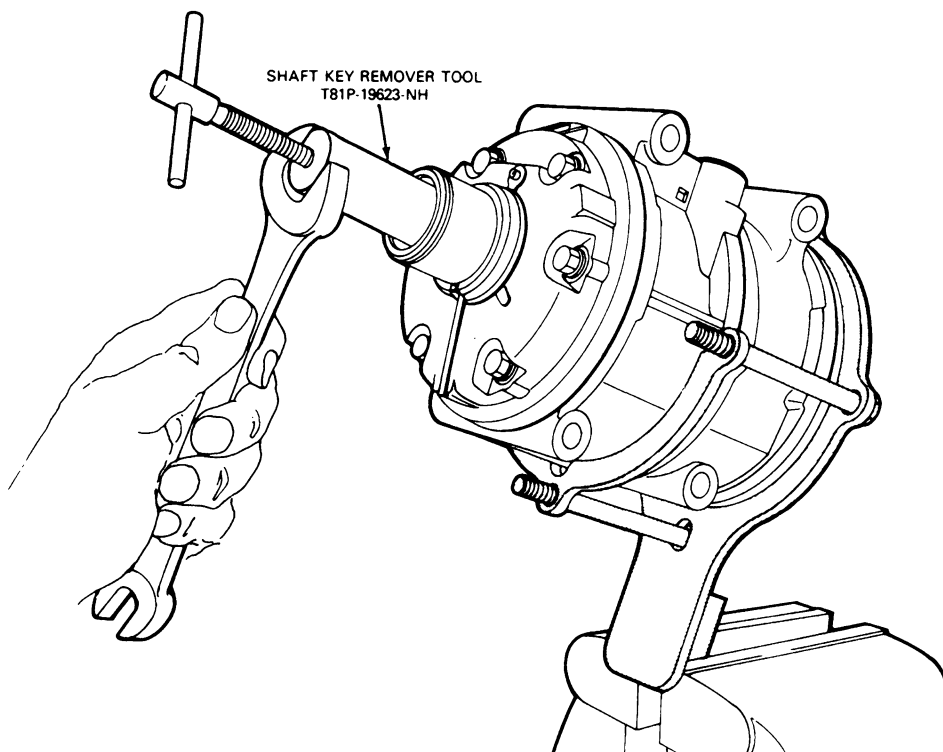
2. Position the new bearing to the pulley bearing bore. Install the bearing in the bore until seated with Pulley Bearing Replacer T80L-19703-C. Make sure the bearing is aligned with the bearing bore.
3. Stake the bearing in the bearing bore with a blunt drift in four equally spaced places around the bearing. Do not use the same locations used to retain the removed bearing.
4. Install the pulley and hub on the compressor following the procedure for clutch hub and pulley installation.

MAJOR REPAIR OPERATIONS**Shaft Seal and/or Front Head Gasket and O-Ring****Removal**

1. Remove the clutch assembly as described in this section.
2. Invert the compressor and pour the refrigerant oil from the suction and discharge openings.
3. Clean the front head and head-to-cylinder joint area to remove any dirt.
4. Install Support and Clamp Assembly T81P-19623-D, on the compressor to retain the cylinder assembly and the rear head in position. Then, clamp the tool in a vise.



5. Remove the key from the compressor shaft with Shaft Key Remover T81P-19623-NH.

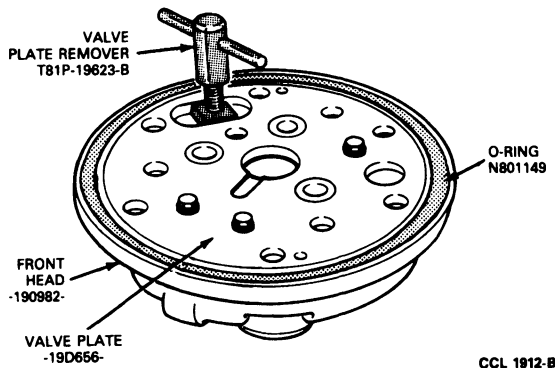


MAJOR REPAIR OPERATIONS (Continued)

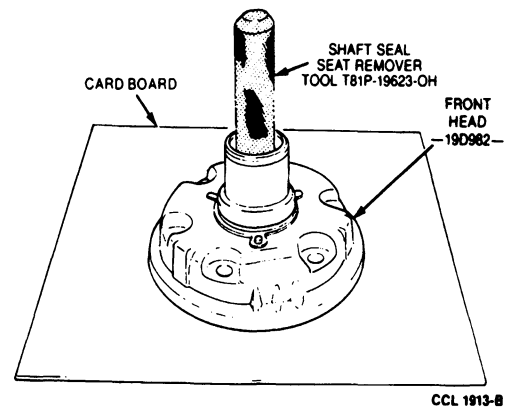
6. Remove the six cylinder bolts from the compressor using a 10mm socket. Then, pull the front head from the compressor. The valve plate assembly, inlet reed, shaft seal and cylinder gasket normally will come off with the head assembly.

NOTE: Use extreme care not to damage any sealing surfaces.

7. Remove the two dowel pins from the front head or the cylinder assembly.
8. Carefully lift the inlet reed valve from the head assembly.
9. Remove the front valve plate assembly and gasket from the front head with Valve Plate Remover T81P-19623-B.



10. Carefully remove the gasket from the valve plate assembly using care not to damage the surface of the valve plate assembly.
11. Remove the shaft seal assembly and felt seal from the head.
12. Place the head on a piece of clean corrugated cardboard and remove the seal seat assembly from the head with Shaft Seal Seat Remover T81P-19623-OH.
13. Clean the front head, valve plate assembly and inlet reed with clean cleaning solvent, and allow them to dry. **DO NOT BLOW DRY THE VALVE PLATE OR REED VALVE WITH COMPRESSED AIR.**

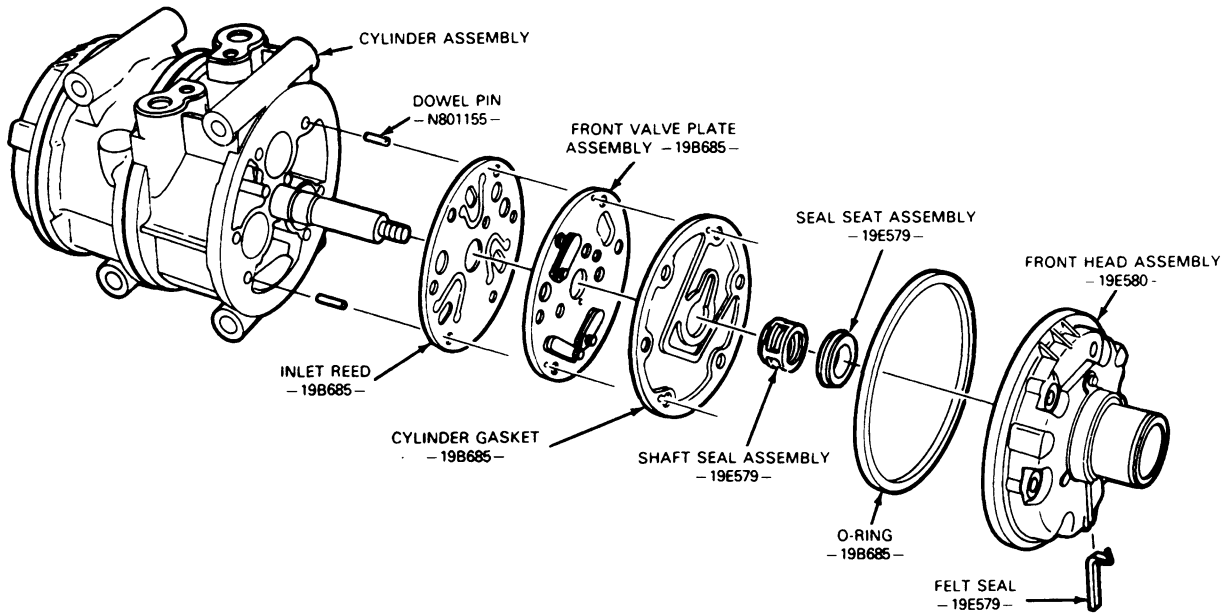
**Installation**

1. Inspect the inlet reed, valve plate assembly and the front head for damage. Replace any damaged parts.
2. Install the two dowel pins in the dowel pin holes of the cylinder assembly.
3. Lubricate the inlet reed with a light coating of clean refrigerant oil. Then, position the inlet reed to the cylinder assembly aligning the holes in the inlet reed with the dowel pins.
4. Assemble the valve plate assembly to the cylinder assembly aligning the dowel pin holes with the dowel pins.
5. Assemble a new cylinder gasket to the head side of the valve plate assembly aligning the dowel pin holes with the dowel pins.
6. Carefully remove the shaft seal and seal seat from the protective package. **DO NOT CUT** the transparent protective cover, but peel it from the backing to expose the seal and seat.

CAUTION: DO NOT TOUCH the sealing surfaces of the shaft seal or seal seat.

MAJOR REPAIR OPERATIONS (Continued)

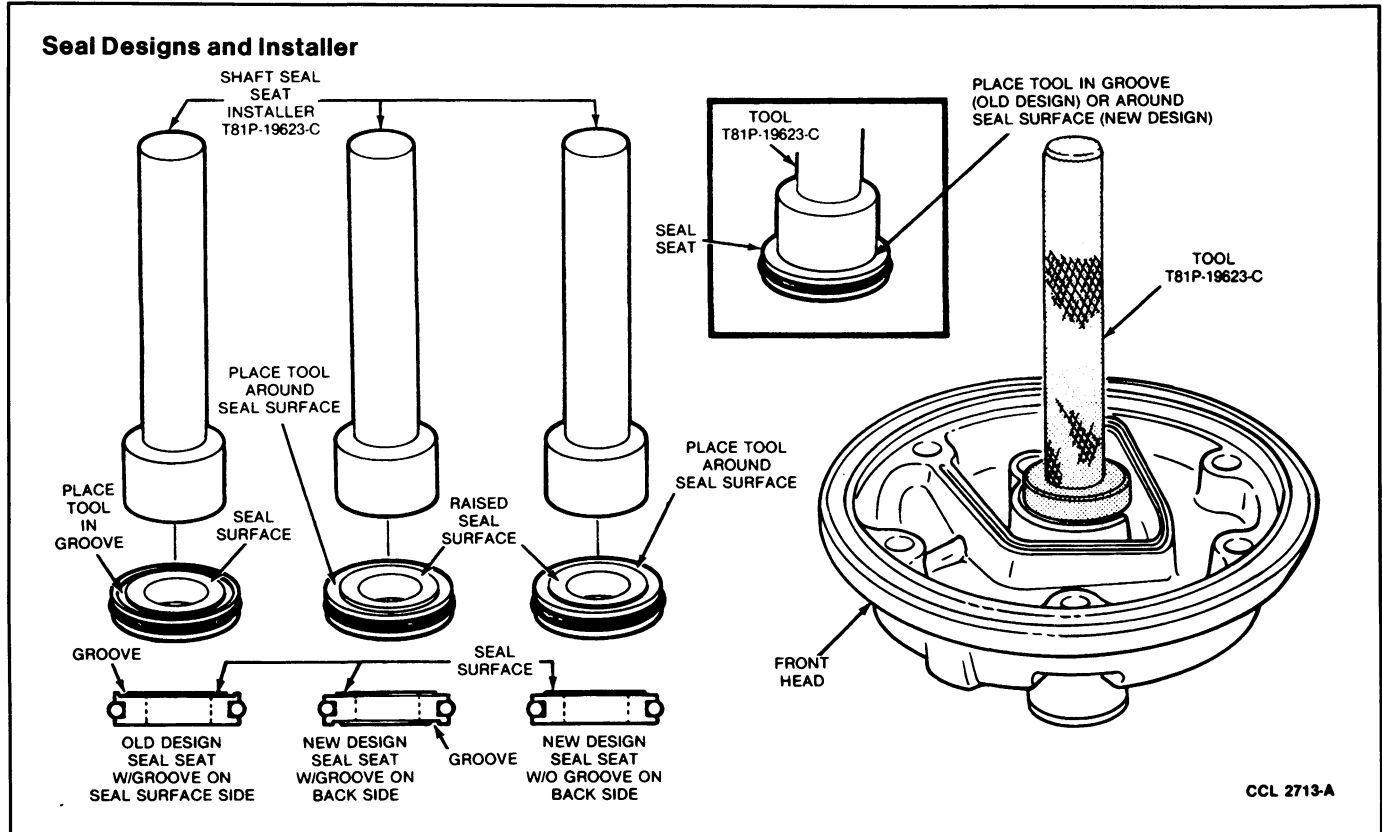
Shaft Seal and Front Head Assembly



7. Lubricate the new shaft seal seat with clean refrigerant oil and install the seat in the front head. Current FS-6 seal seats do not have a groove on the seal side of the seat, but have a raised seal surface. Position the installation tool to the seal seat so that the raised seal surface is covered and protected by the tool during installation.

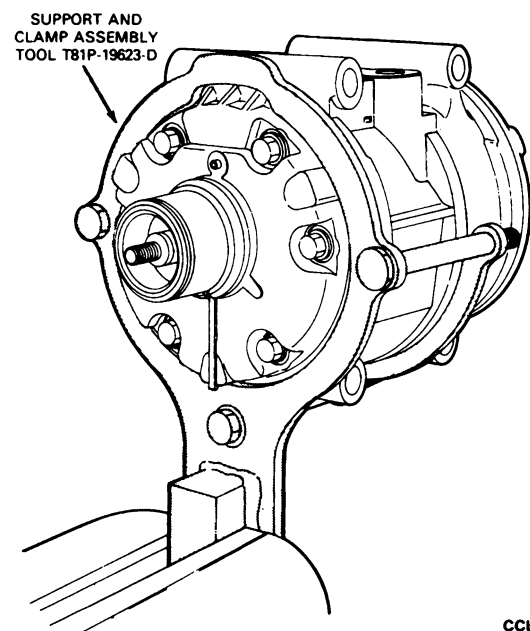
8. Lubricate the new shaft seal with clean refrigerant oil and assemble the seal to the compressor with the sealing surface toward the end of the shaft. Engage the internal flats of the seal with the two flats on the shaft.

CAUTION: Avoid touching the carbon sealing surface of the seal assembly to prevent damaging the surface. Use extreme care to keep seal and seal seat clean at all times.

MAJOR REPAIR OPERATIONS (Continued)

9. Install a new lubricated O-ring in the O-ring groove of the front head.
10. Position the front head to the cylinder assembly aligning the dowel pin holes in the head with the dowel pins. Install six cylinder bolts and tighten to 25-26 N-m (18-19 ft-lb) in a diagonally opposite sequence. **DO NOT USE AIR TOOLS.**
11. Pour new refrigerant oil into the compressor. Refer to Step 2 of Removing and Adding Refrigerant oil during compressor replacement.
12. Install the key in the slot of the compressor shaft.
13. Leak test the compressor as described in this section.
14. Install the clutch assembly on the compressor following the procedure given for Clutch Field Coil Installation. **DO NOT USE AIR TOOLS.**

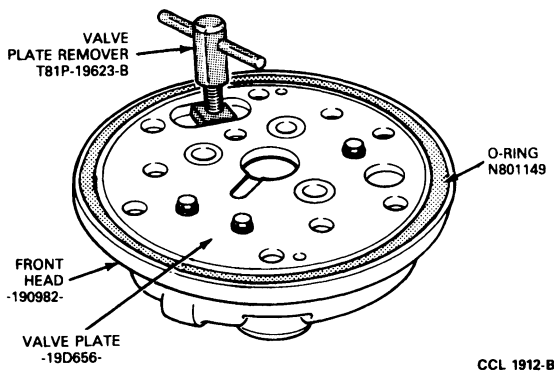
3. Install Support and Clamp Assembly T81P-19623-D on the front of the compressor to retain the cylinder assembly and the front head in position. Then, clamp the tool in a vise.
4. Hold the rear head and remove the six cylinder bolts.

**Rear Head Gasket and O-Ring****Removal**

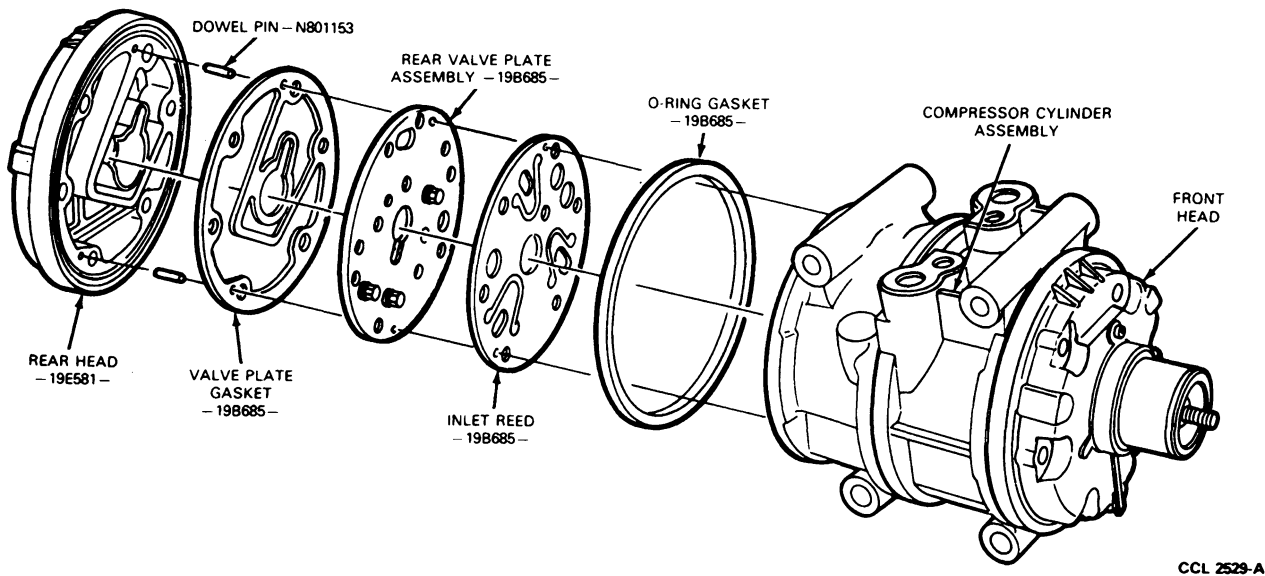
1. Remove the clutch assembly from the compressor as described in this section.
2. Invert the compressor and pour the refrigerant oil from the suction and discharge manifold openings.

MAJOR REPAIR OPERATIONS (Continued)

5. Separate the rear head from the cylinder assembly. Remove the O-ring from the head.
6. Remove the two dowel pins.
7. Remove the inlet reed from the rear head and valve plate assembly.
8. Remove the valve plate assembly from the rear head with Valve Plate Remover T81P-19623-B.
9. Carefully remove the cylinder gasket from the head and/or valve plate assembly.
10. Wash the rear head, valve plate assembly and inlet reed with clean cleaning solvent and allow to dry. **DO NOT BLOW DRY THE VALVE PLATE OR REED VALVE WITH COMPRESSED AIR.**

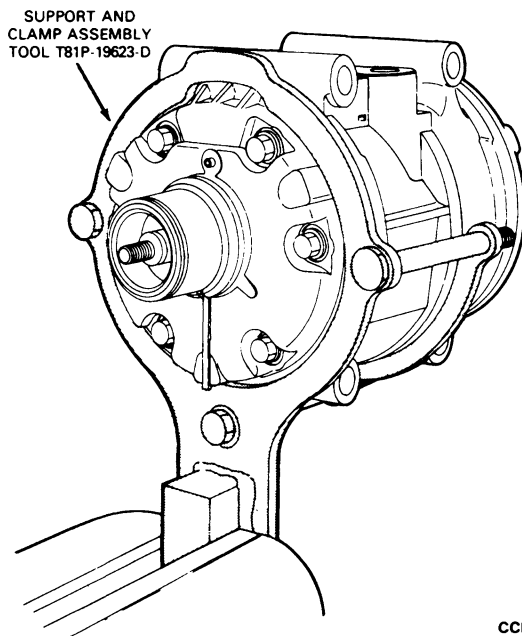
**Installation**

1. Install the two dowel pins in the dowel pin holes of the cylinder assembly.
2. Lubricate the inlet reed with clean refrigerant oil. Install the inlet reed aligning the dowel pin holes with the dowel pins.
3. Install the valve assembly on the cylinder assembly aligning the dowel pin holes with the dowel pins.
4. Install the cylinder gasket on the head taking care to align the dowel pin holes with the dowel pins.
5. Install a new O-ring gasket into the O-ring groove of the rear head.
6. Position the rear head to the cylinder assembly and align the dowel pins with the dowel pin holes.
7. Hold the rear head in place and install the six cylinder bolts. Tighten bolts to 25-26 N·m (18-19 ft·lb) in a diagonally opposite sequence. **DO NOT USE AIR TOOLS.**
8. Remove the compressor from the Support and Clamp Assembly T81P-19623-D.
9. Pour new refrigerant oil into the compressor. Refer to Step 2 of Removal and Adding Refrigerant Oil During Replacement.
10. Install the shaft key in the compressor.
11. Leak test the compressor as described in this section.
12. Install the clutch assembly on the compressor as described in this section.

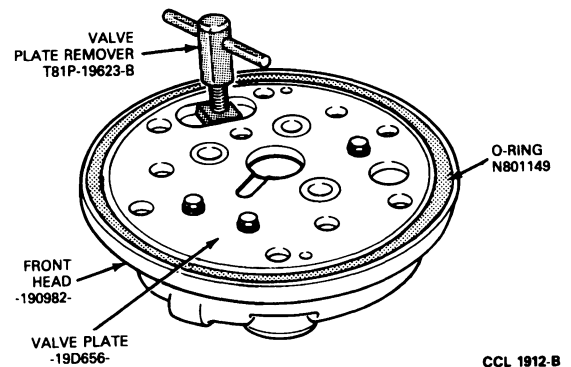
Rear Head, Disassembled

MAJOR REPAIR OPERATIONS (Continued)**Valve Plates and Inlet Reeds****Removal and Installation**

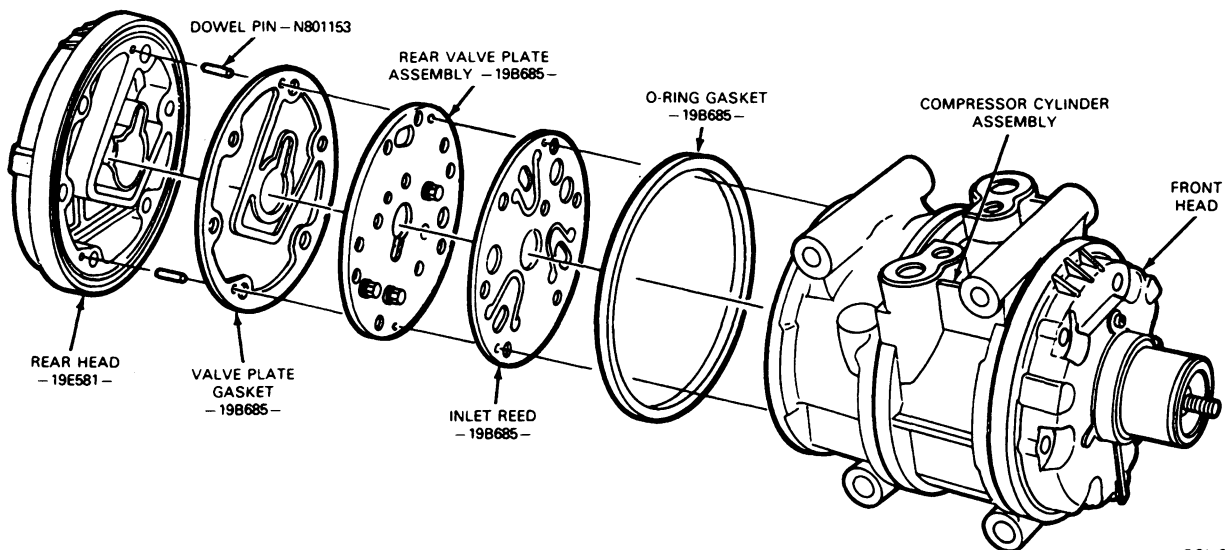
1. Remove the clutch assembly from the compressor as described in this section.
2. Invert the compressor and pour the refrigerant oil from the compressor through the suction and discharge openings.
3. Install Support and Clamp Assembly T81P-19623-D on the compressor to retain the front head and the cylinder assembly assembled together. Then, clamp the tool in a vise.
4. Remove the six cylinder bolts from the compressor using a 10mm wrench. Remove the rear head from the compressor. The valve plate assembly inlet reed and the cylinder gasket will normally be removed with the rear head.
5. Remove the two dowel pins.
6. Remove the O-ring and the inlet reed from the rear head.
7. Remove the valve plate assembly from the rear head with Valve Plate Remover T81P-19623-B.



CCL 2528-A



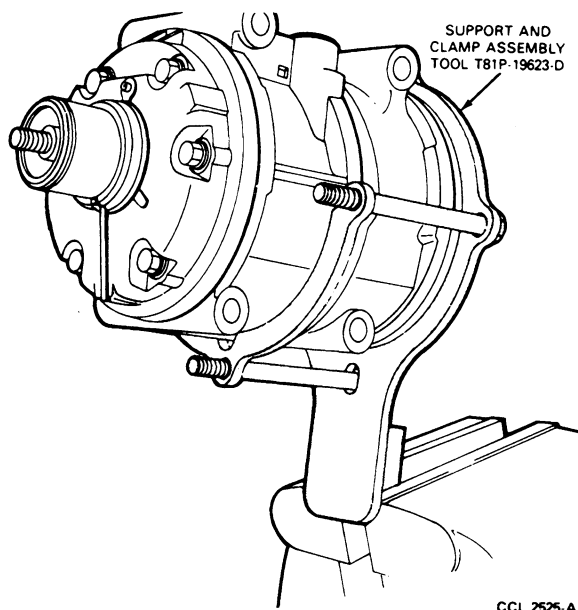
8. Clean the rear head with clean cleaning solvent. Dry the head with compressed air.
9. Install the two dowel pins in the dowel pin holes of the cylinder assembly.

Rear Head, Disassembled

CCL 2529-A

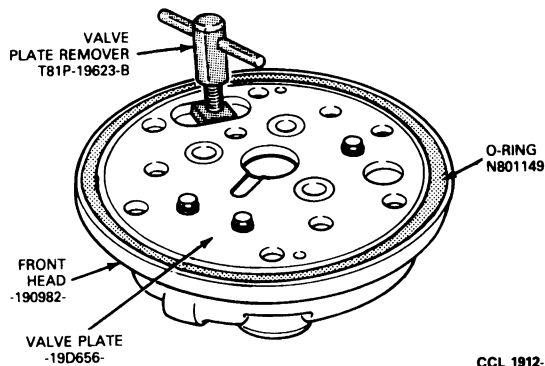
MAJOR REPAIR OPERATIONS (Continued)

10. Position the inlet reed (lightly lubricated with refrigerant oil) to the cylinder assembly aligning the dowel pin holes with the dowel pins.
11. Position the valve plate assembly to the inlet reed and align the dowel pin holes with the dowel pins.
12. Install the cylinder gasket over the valve plate assembly aligning the dowel pin holes with the dowel pins.
13. Install a new O-ring into the O-ring groove of the rear head. Position the rear head to the cylinder assembly aligning the dowel pin holes in the head with the dowel pins.
14. Hold the rear head against the cylinder assembly and install two cylinder bolts into opposite holes to hold the rear head in place. Tighten the two bolts just snug.
15. Remove the Support and Clamp Assembly T81P-19623-D, from the front half of the compressor and install the tool to clamp the rear head to the cylinder assembly.



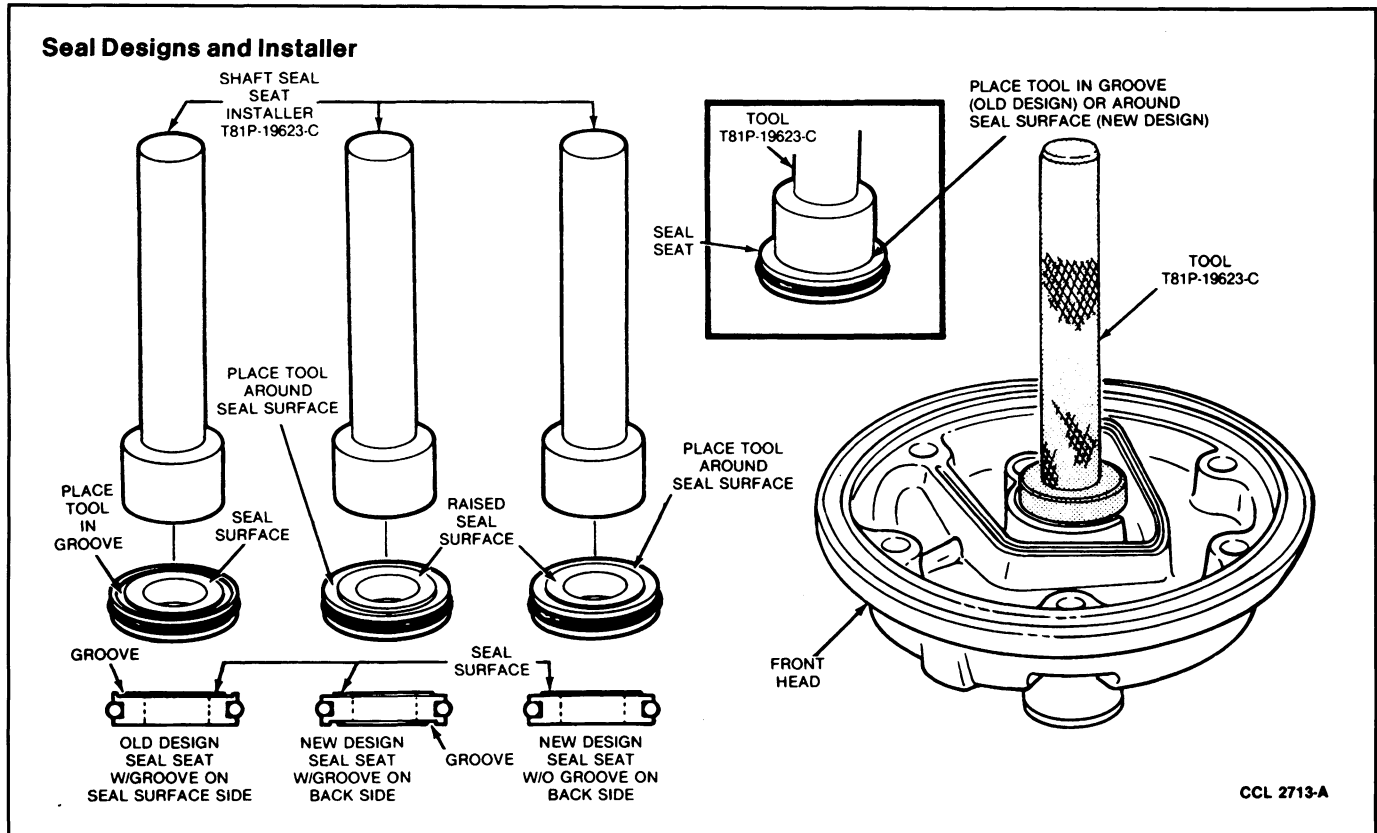
CCL 2525-A

16. Remove the key from the compressor shaft with Shaft Key Remover T81P-19623-NH.
17. Remove the two cylinder bolts from the compressor.
18. Pull the front head from the compressor assembly. The valve plate assembly, inlet reed and shaft seal assembly will come off with the front head.
19. Remove the two dowel pins.
20. Remove the O-ring and the inlet reed from the front head.
21. Remove the valve plate assembly from the front head with Valve Plate Remover T81P-19623-B.



22. Remove the shaft seal and felt seal from the front head.
23. Place the front head on a piece of clean corrugated cardboard and remove the seal seat assembly from the front head with Shaft Seal Seat Remover T81P-19623-OH.
24. Clean the front head with clean cleaning solvent and dry with compressed air.
25. Install the two dowel pins in the dowel pin holes of the cylinder assembly.
26. Lubricate the inlet reed with a light coating of clean refrigerant oil. Then position the inlet reed to the cylinder assembly aligning the dowel pin holes of the inlet reed with the dowel pins.
27. Assemble the valve plate assembly to the cylinder assembly aligning the dowel pin holes with the dowel pins.
28. Assemble the cylinder gasket to the valve plate assembly aligning the dowel pin holes with the dowel pins.
29. Carefully remove the shaft seal and seal seat from the protective package. **DO NOT CUT** the transparent protective cover, but peel it from the backing to expose the seal and seat.
- CAUTION: DO NOT TOUCH the sealing surfaces of the shaft seal or seal seat.**
30. Lubricate the new shaft seal seat with clean refrigerant oil and install the seat in the front head. Use Shaft Seal Seat Installer T81P-19623-C positioned to the seal seat as shown to install the seat in the head. Current FS-6 seal seats do not have the groove on the seal side, but have a raised seal surface. Position the tool to the seal seat so that the raised seal surface is covered and protected by the tool during installation. Be sure that shaft seal is seated against the recess in the front head with the groove up.

MAJOR REPAIR OPERATIONS (Continued)



31. Lubricate new shaft seal with clean refrigerant oil and assemble the seal on the compressor shaft with the sealing surface toward the end of the shaft. Engage the internal flats of the seal with the two flats on the shaft.

CAUTION: Avoid touching the carbon sealing surface of the seal assembly to prevent damaging the surface.

32. Install a new O-ring in the O-ring groove of the front head.
33. Position the front head to the cylinder assembly aligning the dowel pin holes in the head with the dowel pins. Install the six cylinder bolts and tighten them to 25-26 N·m (18-19 ft-lb) specification in a diagonally opposite sequence. **DO NOT USE AIR TOOLS.**
34. Pour new refrigerant oil into compressor. Refer to Step 2 of Removal and Adding Oil During Compressor Replacement.
35. Install the key in the slot of the compressor shaft.
36. Leak test the compressor as described in this section.
37. Install the clutch assembly on the compressor as described in this section.

Head Replacement

If it is necessary to replace the front or rear head, follow the service procedure for replacing the head gasket. **DO NOT BLOW DRY THE VALVE PLATES OR REED VALVE WITH COMPRESSED AIR.**

SPECIFICATIONS

COMPRESSOR SPECIFICATIONS

Description	Specifications
Type	Swashplate 3 Double Acting Pistons — Axial Type
Displacement	10.4 CID
Cylinder Bore (Dia.)	1.4 inch
Stroke	1.2 inch
Rotation	Clockwise
Rotational Torque Maximum, Manifold Removed	10 N·m (7 Ft-Lb)
Refrigerant Oil Type	ESA-M2C31-A2
Capacity (System Total)	300 ml (10 Fluid Ounces)
Part Number	E73Z-19577-A Motorcraft YN-9

(Continued)

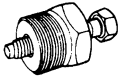
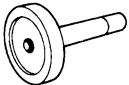

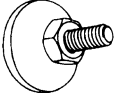

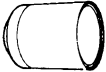
SPECIFICATIONS (Continued)

COMPRESSOR SPECIFICATIONS (Cont'd)

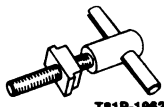
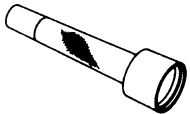

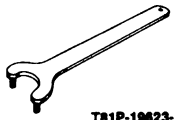

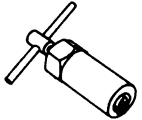

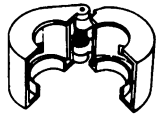
Description	Specifications
Magnetic Clutch	
Air Gap Between Pulley and Hub	0.021-0.036 inch
Current Draw	4.67 Amps @ 12.8 Volts
Run-out (Maximum)	0.02 inch—Radial or Axial
Torque Limits	
Hose Manifold to Compressor	18-23 N-m (13-17 Ft-Lb)
Clutch Hub Nut	13-19 N-m (10-14 Ft-Lb)
Compressor Cylinder Bolts	25-26 N-m (18-19 Ft-Lb)
Max. to Correct Freon Leak	34 N-m (25 Ft-Lb)

TL7783A

SPECIAL SERVICE TOOLS/EQUIPMENT

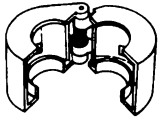
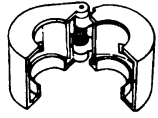
Tool Number/ Description	Illustration
T80L-19703-B Hub Remover	 T80L-19703-B
T80L-19703-C Pulley Bearing Replacer	 T80L-19703-C
T80L-19703-E Clutch Pulley Support (Ford and Warner Clutch)	 T80L-19703-E
T80L-19703-F Hub Driven Plate Replacer	 T80L-19703-F
T80L-19703-G Compressor Shaft Protector	 T80L-19703-G
T80L-19703-J Pulley Replacer	 T80L-19703-J

(Continued)


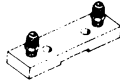
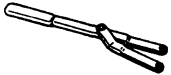
Tool Number/ Description	Illustration
T81P-19623-B Valve Plate Remover	 T81P-19623-B
T81P-19623-C Shaft Seal Seat Installer	 T81P-19623-C
T81P-19623-D Support and Clamp Assembly	 T81P-19623-D
T81P-19623-MH Spanner Wrench	 T81P-19623-MH
T81P-19623-J Pulley Support	 T81P-19623-J
T81P-19623-NH Shaft Key Remover	 T81P-19623-NH
T81P-19623-OH Shaft Seal Seat Remover	 T81P-19623-OH
T81P-19623-G1 3/8 Inch Spring Lock Disconnect Tool	 T81P-19623-G1

(Continued)

SPECIAL SERVICE TOOLS/EQUIPMENT (Continued)

Tool Number/ Description	Illustration
T81P-19623-G2 1/2 Inch Spring Lock Disconnect Tool	 T81P-19623-G2
T83P-19623-C 5/8 Inch Spring Lock Disconnect Tool	 T83P-19623-C

(Continued)

Tool Number/ Description	Illustration
T85L-19623-A 3/4 Inch Spring Lock Disconnect Tool	 T85L-19623-A
T86P-19703-A Pressure Test Adapter Tangential Mount Only	 T86P-19703-A
T70P-4067-A Spanner Wrench	 T70P-4067-A

Tool Number	Description
D81P-19703-B	Complete Pulley Puller

Motorcraft Number	Robinair Number	Draf Number	Description
YT-1011	10884	1011	Hub Remover
YT-1059	40930	1059	Pulley Bearing Replacer
TY-1064	18010	1064	Clutch Pulley Support (Ford and Warner Clutch)
YT-1052	18020	1052	Hub Installer
YT-1012	41358	1012	Compressor Shaft Protector
YT-1059	40938	1059	Pulley Replacer
—	10501	—	Complete Pulley Puller
YT-1069	10967	1069	Valve Plate Remover
YT-1061	40945	1061	Shaft Seal Seat Installer
YT-1067	18015	1067	Support and Clamp Assembly
YT-499	10546	499	Spanner Wrench
—	—	—	Pulley Support
T-1062	18005	1062	Shaft Key Remover
YT-1060	40495	—	Shaft Seal Seat Remover
—	41098	—	3/8 Inch Spring Lock Disconnect Tool
—	41099	—	1/2 Inch Spring Lock Disconnect Tool
—	41100	—	5/8 Inch Spring Lock Disconnect Tool
—	41101	—	3/4 Inch Spring Lock Disconnect Tool
—	40949	—	Pressure Test Adapter Tangential Mount Only
YT-499	10456	499	Spanner Wrench

ROTUNDA EQUIPMENT

Tool Number	Description
063-00010	Air Conditioning Service Kit
055-00015	Electronic Leak Detector

INSTRUMENTATION
AND WARNING
DEVICES

GROUP

13

SECTION TITLE	PAGE	SECTION TITLE	PAGE
CHARGING SYSTEM GAUGE / WARNING LIGHT	13-04A-1	SPEEDOMETER / ODOMETER	13-02A-1
CHARGING SYSTEM GAUGE / WARNING LIGHT, F-SUPER DUTY COMMERCIAL CHASSIS	13-04B-1	SPEEDOMETER / ODOMETER, F-SUPER DUTY COMMERCIAL CHASSIS	13-02B-1
GAUGE, FUEL	13-03A-1	GAUGES, ENGINE OPERATION	13-05A-1
GAUGE, FUEL, F-SUPER DUTY COMMERCIAL CHASSIS	13-03B-1	GAUGES, ENGINE OPERATION, F-SUPER DUTY COMMERCIAL CHASSIS	13-05B-1
HORNS	13-06-1	GAUGES / WARNING DEVICES, MISCELLANEOUS ELECTRONICS	13-09-1
INSTRUMENT CLUSTER	13-01A-1	HORNS	13-06-1
INSTRUMENT CLUSTER, F-SUPER DUTY COMMERCIAL CHASSIS	13-01B-1	THEFT WARNING	13-11-1

SECTION 13-01A Instrument Cluster

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	13-01A-1	REMOVAL AND INSTALLATION (Cont'd.)	
REMOVAL AND INSTALLATION		Instrument Cluster Replacement	13-01A-4
Automatic Transmission Selector Indicator	13-01A-7	SPECIAL SERVICE TOOLS / EQUIPMENT	13-01A-7
Instrument Cluster	13-01A-4	VEHICLE APPLICATION	13-01A-1

VEHICLE APPLICATION

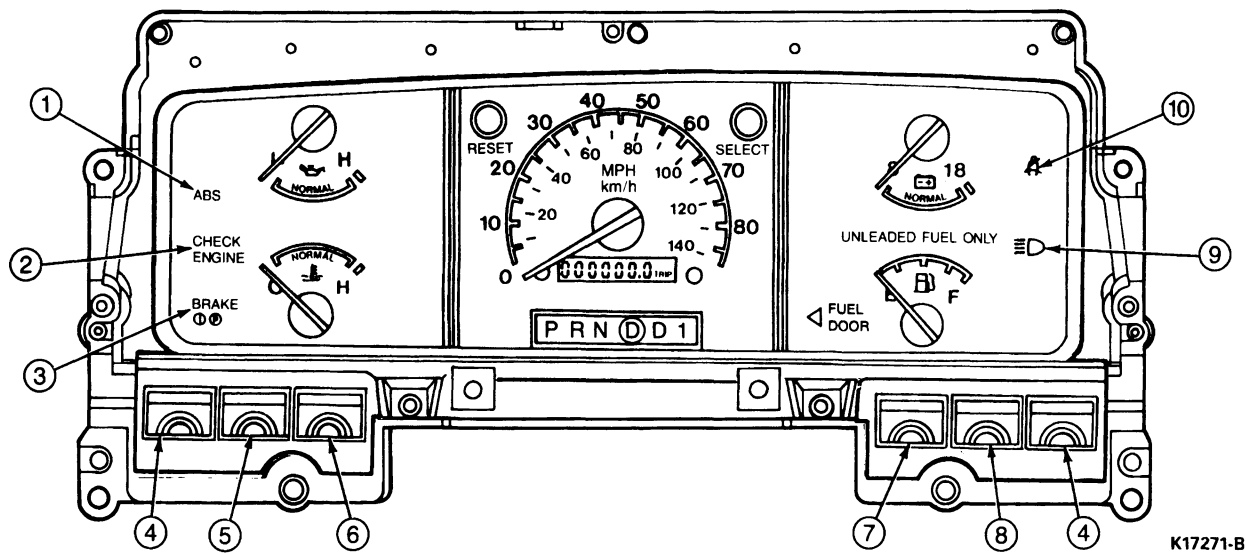
E-150-250-350, F-150-250-350, Bronco, F-Super Duty Motorhome Chassis, E-350 Commercial and Motorhome Chassis Vehicles (All Except F-Super Duty Commercial Chassis)

DESCRIPTION AND OPERATION

The cluster warning lamps are located in two vertical columns, one on each side of the cluster and also along the bottom of the cluster. F-Series and Bronco optional clusters have the warning lights along the right hand side and bottom of the cluster.

DESCRIPTION AND OPERATION (Continued)

F-Series, F-Super Duty, F-Super Duty Motorhome and Bronco Vehicles Equipped with a Base Cluster



K17271-B

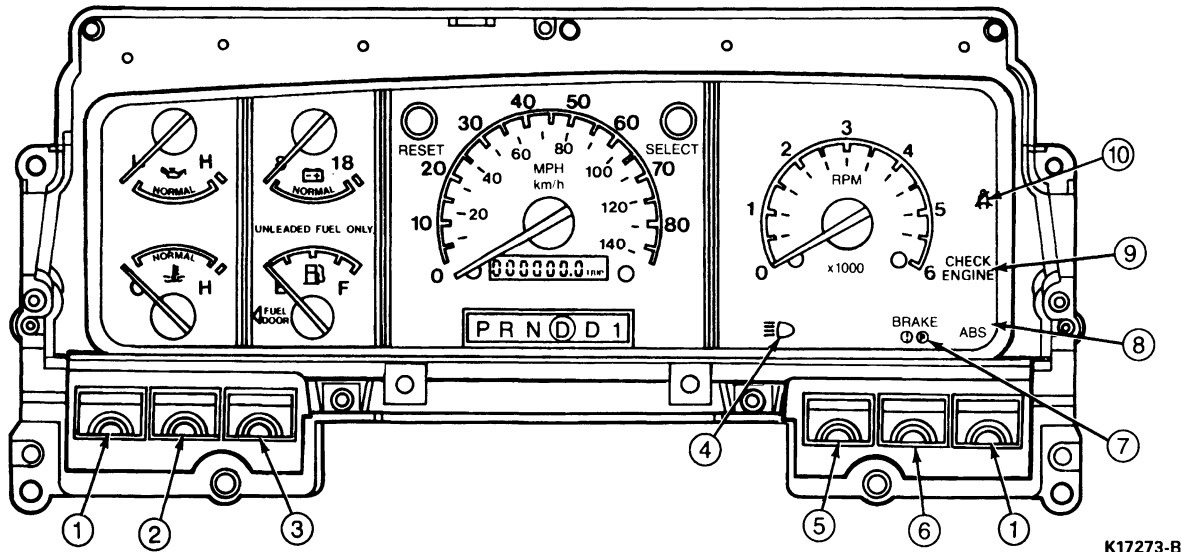
Item	Description
1	ABS
2	Check Engine
3	Brake
4	Turn Signal
5	Fuel Reset

Item	Description
6	Charging System
7	Low Range
8	4x4 High Range
9	High Beam
10	Fasten Seat Belts

(Continued)

TK17271A

F-Series, F-Super Duty, F-Super Duty Motorhome and Bronco Vehicles Equipped with an Optional Cluster



K17273-B

Item	Description
1	Turn Signal
2	Fuel Reset
3	Charging System

(Continued)

Item	Description
4	High Beam
5	Low Range
6	4x4 Indicator

(Continued)

DESCRIPTION AND OPERATION (Continued)

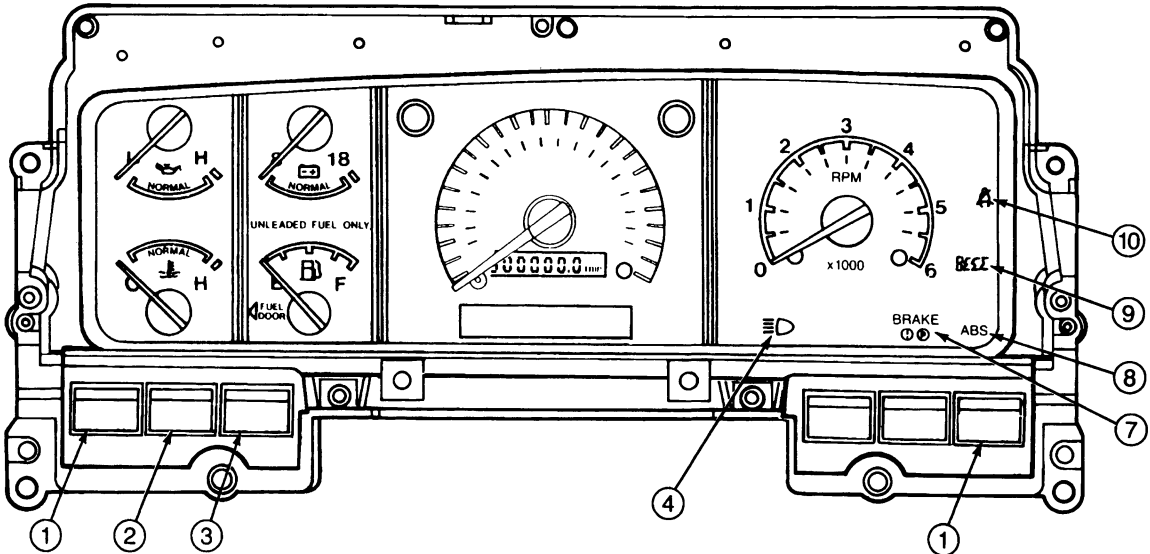
Item	Description
7	Brake
8	ABS (Bronco) and RABS (F-Series)

(Continued)

Item	Description
9	Check Engine
10	Fasten Seat Belts

TK17273A

F-Series Lightning Truck



K19257-A

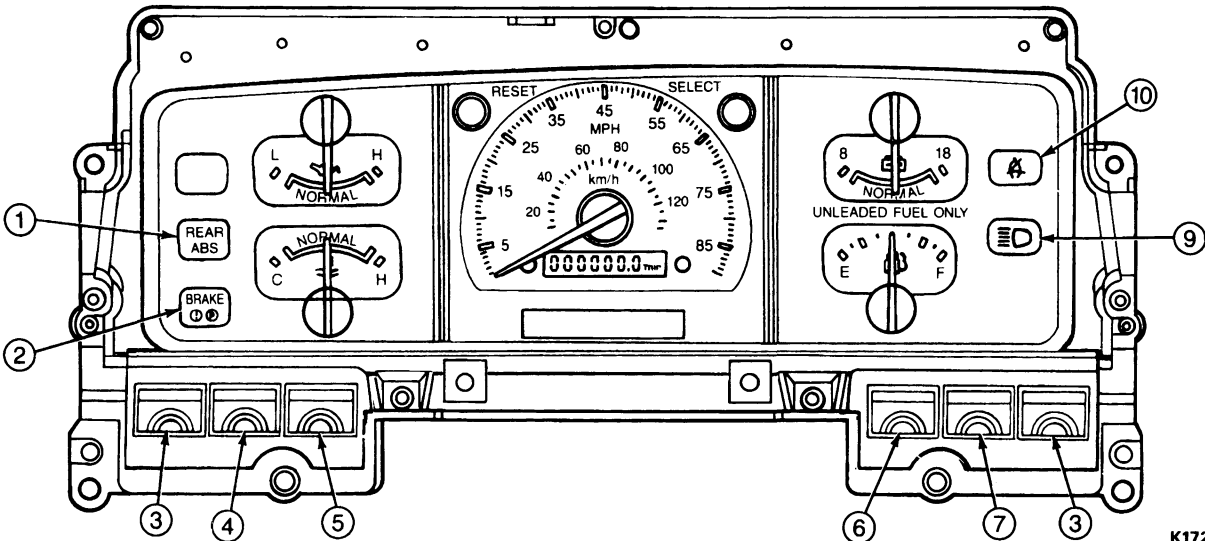
Item	Description
1	Turn Signal
2	Fuel Reset
3	Charging System (AMP)
4	High Beam

(Continued)

Item	Description
7	Brake
8	ABS
9	Check Engine
10	Fasten Seat Belts

TK19257A

Instrument Cluster, E-150-250-350



K17275-B

DESCRIPTION AND OPERATION (Continued)

Item	Description
1	Rear ABS
2	Brake
3	Turn Signal
4	Check Engine
5	Charging System

(Continued)

Item	Description
6	Check Transmission
7	Air Bag (Econoline, except Chassis) Door Ajar (Econoline Chassis)
9	High Beam
10	Fasten Seat Belt

TK17275A

REMOVAL AND INSTALLATION**Instrument Cluster Replacement**

Instrument cluster components that are serviceable at the dealership level are:

- Bulb and socket assemblies — base P/N 13B765
- Oil/temperature gauge assembly — base P/N 10E872
- Fuel/volt gauge (if applicable) — base P/N 10E871
- Tachometer (if applicable) — base P/N 17360
- Fuel anti-slosh/low fuel module (if applicable) — base P/N 10E849
- Cluster lens — base P/N 10B885
- Cluster mask — base P/N 10894
- Lens attaching screws — base P/N 804988

NOTE: The instrument cluster must be serviced as a complete assembly if it is determined that any of the following components are faulty:

- Speedometer/odometer assembly
- Flex (printed) circuit assembly
- Flex circuit/gauge clips
- Instrument cluster backplate

Instructions for ordering and handling a replacement instrument cluster are provided in this section.

In addition to the above components, the following components are serviceable on Econoline Chassis and Motorhome vehicles only:

- Fuel label or label (blank) — base P/N 9A095
- Bezel — base P/N 10876
- Right- and left-hand jewels — base P/N 807025
- Screws — base P/N 807025

If diagnostic procedures result in a determination that any other instrument cluster component is faulty, call the applicable "800" number listed below to order a replacement cluster. Please have the information below ready before you call:

1. Vehicle type and cluster type (base / RPO - mechanical / electronic).
2. PSOM conversion constant (refer to "Determining the Correct Conversion Constant" in Pinpoint Test C in Section 13-02A or -02B).
3. Current "actual" vehicle mileage.

4. Form # 1878 (filled out)

5. Form # 1863 (filled out)

For dealers serviced by the Detroit, New York, and Atlanta Parts Distribution Centers, call 1-800-262-9606.

For all other dealers the number to call is 1-800-321-6969.

The service cluster received will be pre-programmed with the vehicle mileage (eliminating the need for "circled S" odometers) and the PSOM speed signal conversion constant.

NOTE: The instrument cluster requires special handling to avoid damaging internal components. The cluster **MUST** be kept **FACE UP** or in the in-vehicle position. Leaving the cluster face down may result in a loss of dampening fluid used in the gauges. The lost fluid could stain the cluster face or result in excessive pointer waver.

CAUTION: The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (o-dichlorobenzene, ethyl alcohol and/or cellosolve) has produced fogging, spotting, staining, or splotches on the lenses, either through overspray, or direct use on the lenses. Therefore, extreme caution should be taken during interior clean-up to prevent overspray of cleaning agents which contain the chemical agents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ultra-Clear Spray Glass Cleaner E4AZ-19C507-AA (ESR-M145P5-A) or equivalent commercial cleaning product, using a clean soft, lint-free cloth. The Ford Glass Cleaner has been especially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow directions shown on the container for best results.

Instrument Cluster

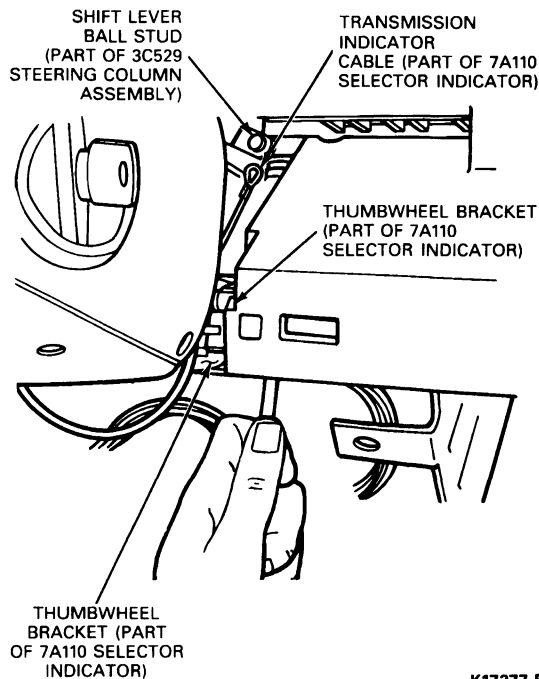
There are three finish panels which attach to the instrument panel. They are:

REMOVAL AND INSTALLATION (Continued)

- An instrument cluster opening upper finish panel assembly.
- An instrument cluster snap-in molding which attaches on the right side of the steering column opening.
- An instrument cluster snap-in molding which attaches on the left side of the steering column opening.

Removal

1. Disconnect the battery ground cable.
2. Remove the cluster opening finish panels as described in Section 01-12A or -12B.
3. Remove the transmission indicator cable loop from the ball stud on the shift lever (automatic transmission equipped vehicles only).
4. Remove the thumb wheel bracket screw and detach bracket from steering column (automatic transmission equipped vehicles only).

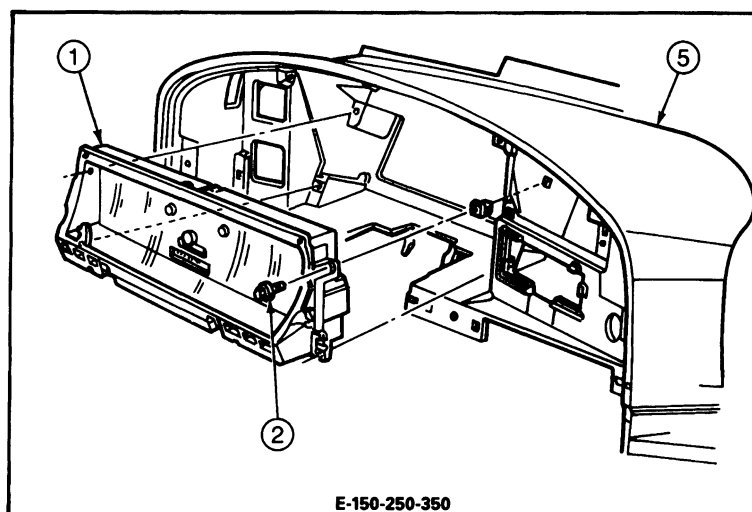
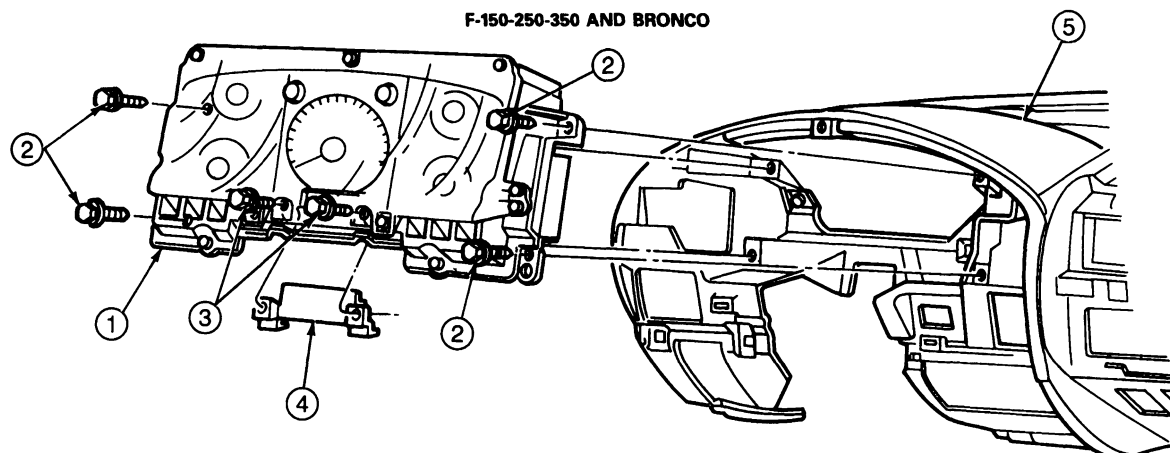


K17277-B

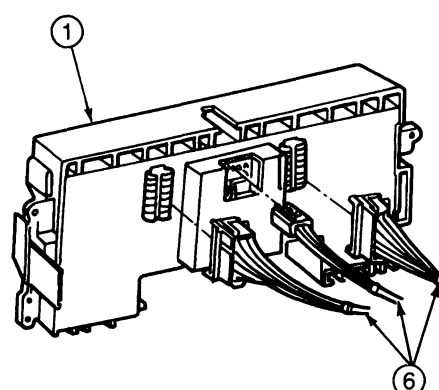
5. Remove four screws attaching the cluster to the instrument panel. Pull cluster out of instrument panel, bottom first, to rest on the steering column.
6. Disconnect the three electrical connectors and remove the instrument cluster.

REMOVAL AND INSTALLATION (Continued)

Instrument Cluster Installation



E-150-250-350



REAR VIEW OF INSTRUMENT CLUSTER & WIRING

K17279-B

Item	Part Number	Description
1	10849	Instrument Cluster
2	N803876-S36B	Screw (4 Req'd) 1.9-2.5 N-m (17-22 In-Lb)
3	N800705-S36B	Screw (2 Req'd) 1.4 N-m (12 In-Lb)

(Continued)

Item	Part Number	Description
4	7A110 or 7B100	Automatic Transmission Selector or Cover Plate
5	04320	Instrument Panel
6	14401	Wiring Connectors

TK17279A

Installation

1. Position the cluster facing up on the steering column and connect the three electrical connectors. Position the instrument cluster in the instrument panel to engage locator pins.
2. Install the four screws attaching the cluster to the instrument panel.
3. Place the transmission selector cable loop on the shift lever ball stud (automatic transmission equipped vehicles only).

4. Position thumbwheel bracket on the right side of the steering column and secure screw (automatic transmission equipped vehicles only).
5. Adjust the automatic transmission selector lever indicator (if equipped).
6. Install the cluster opening finish panels as described in Section 01-12A or -12B.

REMOVAL AND INSTALLATION (Continued)

7. Connect the battery negative cable.

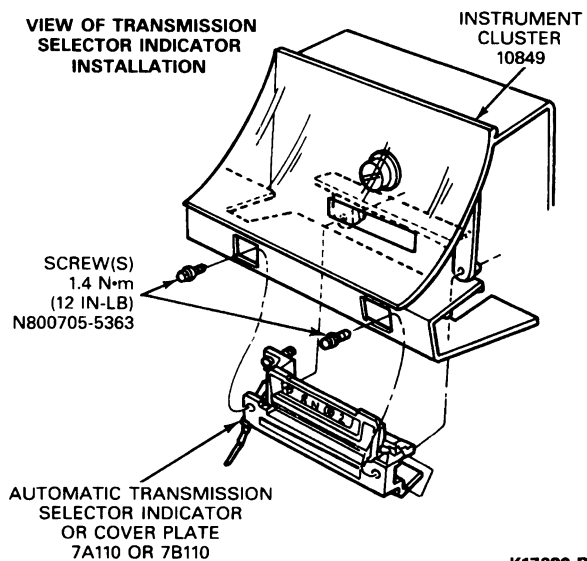
NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Automatic Transmission Selector Indicator Removal and Installation

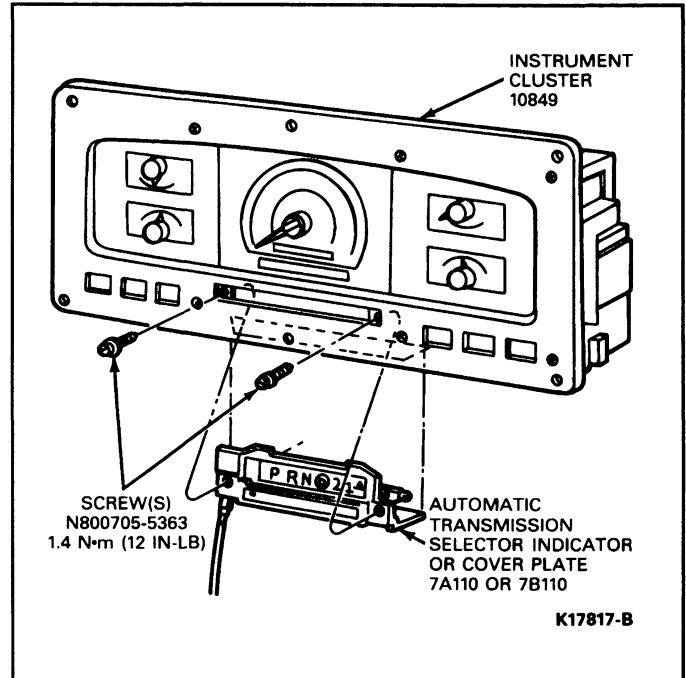
1. Remove the instrument cluster from the instrument panel as described in Section 01-12A or 01-12B.
2. Remove the two screws attaching the automatic transmission selector to the cluster. Remove the indicator by sliding it out downward from the bottom of the cluster.

For installation, follow removal procedures in reverse order.

Automatic Transmission Selector Indicator Installation



K17289-B



K17817-B

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
007-00001	Digital Volt-Ohmmeter

SECTION 13-01B Instrument Cluster, F-Super Duty Commercial Chassis

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	13-01B-1	REMOVAL AND INSTALLATION (Cont'd.)	
REMOVAL AND INSTALLATION		Printed Circuit/Cluster	13-01B-2
Anti-Slosh Module	13-01B-3	SPECIAL SERVICE TOOLS/EQUIPMENT	13-01B-3
Instrument Cluster	13-01B-2	VEHICLE APPLICATION	13-01B-1

VEHICLE APPLICATION

F-Super Duty Commercial Chassis

DESCRIPTION AND OPERATION

The cluster warning lamps are located in two vertical columns, one on each side of the cluster. The left and right columns are as follows:

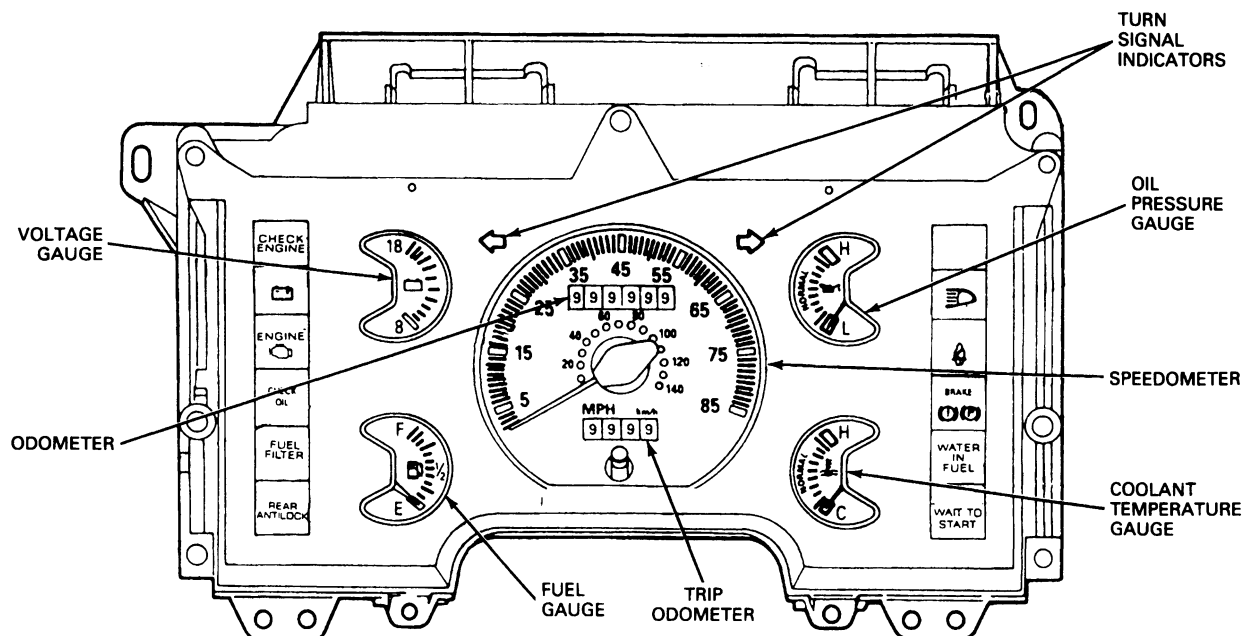
Left side, top-to-bottom

- Check Engine
- Alternator (ISO)
- Engine (w/ ISO)
- Check oil
- Fuel Filter
- Rear Antilock

Instrument Cluster

Right side, top-to-bottom

- Blank
- High beam (ISO)
- Fasten belts (ISO)
- Brake (w/ ISOS)
- Water in fuel
- Wait to start



K17807-A

REMOVAL AND INSTALLATION

CAUTION: The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/ or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (o-dichlorobenzene, ethyl alcohol and/ or cellosolve) has produced fogging, spotting, staining or splotches on the lenses, either through overspray, or direct use on the lenses. Therefore, extreme caution should be taken during interior clean-up to prevent overspray of cleaning agents which contain the chemical agents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ultra-Clear Spray Glass Cleaner E4AZ-19C507-AA (ESR-M145P5-A) or equivalent commercial cleaning product, using a clean soft, lint-free cloth. The Ford Glass Cleaner has been especially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow directions shown on the container for best results.

Instrument Cluster

Removal

1. Disconnect the battery ground cable(s)
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
2. Remove six cluster bezel-to-panel retaining screws and remove the cluster.
3. Disconnect two wiring harness connectors from backplate.
4. Disengage speedometer cable from speedometer.

Installation

1. Apply approximately 4.80mm (3/16 inch) diameter ball of D7AZ-19A331-A (ESE-M1C171-A) Silicone Dielectric compound or equivalent in the drive hole of the speedometer head.
2. Position the cluster near its opening in the instrument panel.
3. Connect the speedometer cable (quick disconnect) to the speedometer head. Connect the speedometer cable and housing assembly to the transmission, if removed.
4. Connect two wiring harness connectors to the backplate.

5. Position cluster to instrument panel and install the six cluster-to-panel retaining screws.
6. Connect the battery ground cable(s).
7. Check operation of all gauges and lamps.

Printed Circuit/Cluster

Removal

1. Disconnect battery ground cable(s).
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
2. Remove the instrument cluster assembly from the instrument panel as outlined.
3. Remove two screws attaching the redundant warning module to the rear of the instrument cluster.
4. Remove one screw attaching the anti-slosh module to the rear of the instrument cluster.
5. Remove the six screws that retain the bezel, mask the lens to the cluster backplate and remove the mask and lens.
6. Remove the six screws retaining the four gauges and two nuts retaining the voltage gauge to the instrument cluster backplate, and remove gauges.
7. Using a pair of needle nose pliers remove the nine gauge terminal clips by squeezing both ends of the gauge terminal clip and push through the clip opening in the backplate. (Discard clips; use new clips.) Remove lamp bulbs and print circuit.

Installation

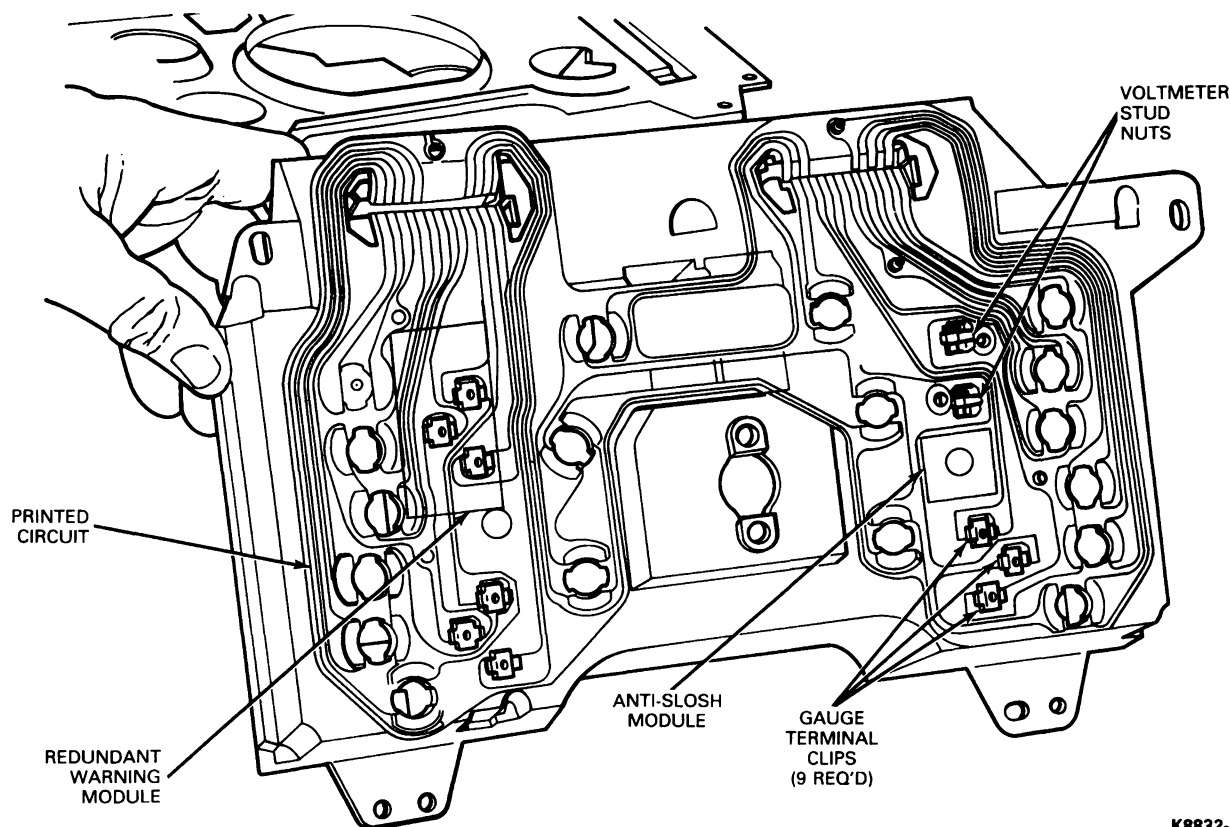
1. Carefully position the printed circuit to the back of the cluster and engage it to the plastic location pins.
2. Install new gauge terminal clips and lamp bulbs.
3. Install cluster gauges and secure with screws (and nuts for voltage gauge).
4. Install the mask, lens and bezel to backplate and secure with screws.
5. Reinstall the redundant warning module and the anti-slosh module to the rear of the instrument cluster and retain with screws.
6. Install instrument cluster assembly to instrument panel.
7. Connect the battery ground cable(s).
8. Check operation of all gauges and lamps.

REMOVAL AND INSTALLATION (Continued)

Printed Circuit



= BULB AND SOCKET LOCATIONS



K8832-E

Anti-Slosh Module

Removal and Installation

1. Disconnect the battery negative cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

2. Remove the instrument cluster opening finish panels. Refer to Section 01-12, for procedure.
3. Remove four screws attaching the cluster to the instrument panel. Pull the instrument cluster forward, reach behind the cluster on the right and remove the anti-slosh module.

For installation, follow removal procedures in reverse order. When installing cluster make sure that the cluster locator pins are properly engaged.

SPECIAL SERVICE TOOLS/EQUIPMENT

ROTUNDA EQUIPMENT

Tool Number	Description
007-00001	Digital Volt-Ohmmeter

SECTION 13-02A Speedometer/Odometer

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
Programmable Speedometer/Odometer Module (PSOM).....	13-02A-1	Speedometer Assembly, Electric	13-02A-13
PSOM Wiring	13-02A-1	SPECIAL SERVICE TOOLS/EQUIPMENT	13-02A-14
DIAGNOSIS AND TESTING	13-02A-2	VEHICLE APPLICATION	13-02A-1

VEHICLE APPLICATION

F-150-250-350, E-150-250-350 Bronco, F-Super Duty Chassis Cab, F-Super Duty Motorhome Chassis, E-350 Motorhome and Commercial Chassis (All Vehicles Except F-Super Duty Commercial Chassis)

DESCRIPTION AND OPERATION

Programmable Speedometer/Odometer Module (PSOM)

The programmable electric analog speedometer receives its input from the anti-lock brake sensor. The liquid crystal display (LCD) odometer is a combination trip odometer and total odometer. The total odometer is normally displayed. To see the trip odometer, press and release the SELECT button on the upper right side of the speedometer. To zero out the trip odometer, press and release the RESET button on the upper left side of the speedometer while the trip odometer is displayed. If the trip odometer is displayed, press and release the SELECT button to return the display to the total odometer value. The speedometer, containing the trip odometer and total mileage odometer, is serviceable only as an instrument cluster assembly. Refer to Section 13-01A for ordering instructions.

NOTE: Before ordering a service cluster, contact the instrument cluster technical hotline for diagnostic and system troubleshooting assistance. The hotline phone number is 1-800-523-7763.

The speedometer is also used to provide a speed signal for correct operation of the vehicle's Powertrain Control Module (PCM), electronic transmission, and speed control (if so equipped). Because of this, it is **VERY IMPORTANT** to change the speedometer's internal conversion constant if the size of tires on the vehicle is changed. Changing the conversion constant to the proper value when the tires are changed will also make sure that the speedometer retains the original factory-set accuracy. The conversion constant can only be changed six times once the vehicle leaves the factory.

PSOM Wiring

The PSOM is attached to the vehicle wiring through a 12-pin connector. Below is a list of pinouts. See the appropriate vehicle Electrical and Vacuum Troubleshooting Manual for additional information.

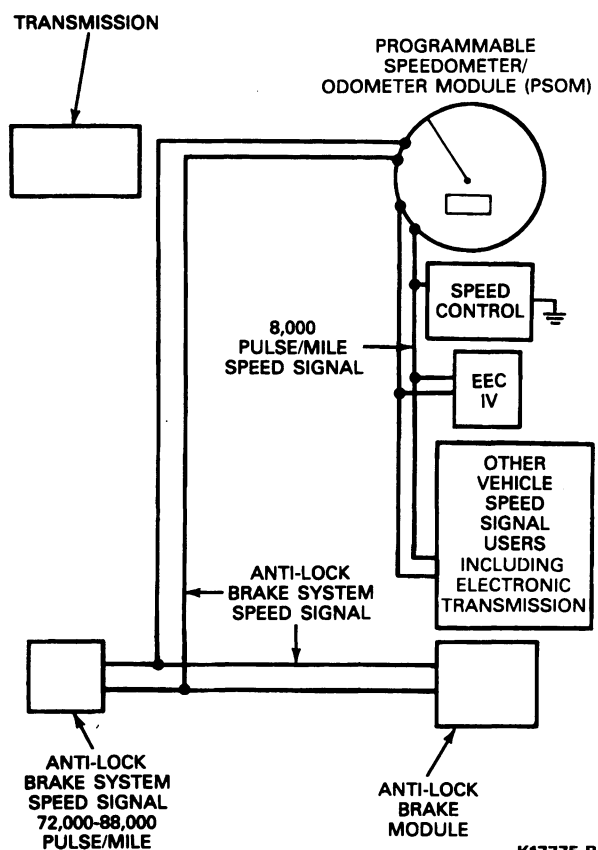
Pin Number	Function	F-Series, Bronco Circuit Number/Color Code	Econoline Circuit Number/Color Code
1	Battery Input (main current source for module)	54 (Lt Gr/Y) fuse 8, 15A	195 (T/W) Fuse 8, 15A
2	Module Ground (must be CLEAN with no high-current switching devices attached)	67 (Pk/O)	397 (Bl/W)
3	Ignition Input — hot in RUN only	296 (Wh/Pur) Fuse 18, 10A	489 (Pk/Bl) Fuse 17, 20A

(Continued)

DESCRIPTION AND OPERATION (Continued)

Pin Number	Function	F-Series, Bronco Circuit Number/Color Code	Econoline Circuit Number/Color Code
4	Speed Input from RABS (positive)	523 (Red / Pk)	523 (Red / Pk)
5	Speed Input Return (normally grounded by RABS II module)	519 (Lt. Gr / Bl)	519 (Lt. Gr / Bl)
7	Speed Output (8000 pulses / mile)	679 (Gray / Bl)	679 (Gray / Bl)
9	PSOM Conversion Constant Service Ground Wire	567 (Lt. Blue / Y0)	567 (Lt. Blue / Y)

System Block Diagram



DIAGNOSIS AND TESTING

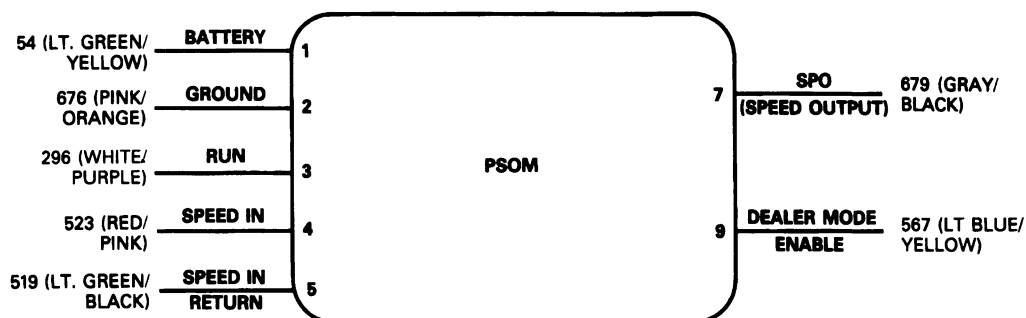
Possible malfunctions of the PSOM are:

- Inoperative speedometer or odometer
- Improper operation such as an erratic, jumpy or hesitating speedometer or scrambled digits on the odometer.
- Inaccuracy concerns such as the odometer not indicating the proper mileage after traveling a known distance or the speedometer higher or lower than expected to travel a known distance in the proper amount of time.
- Loss of speed output signal to engine control computer, transmission or speed control.

These four areas each have their own diagnostic flow chart and procedure on the following pages.

DIAGNOSIS AND TESTING (Continued)

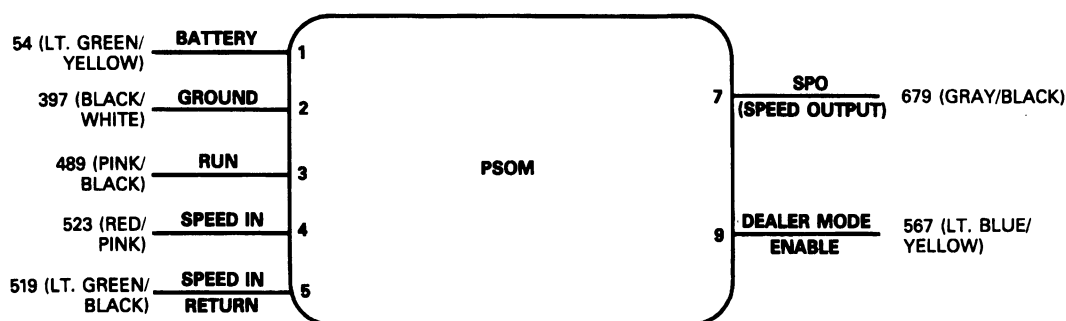
Block Wiring Diagram, F-Series and Bronco



F-SERIES AND BRONCO

K17836-B

Block Wiring Diagram, Econoline



ECONOLINE

K17837-B

SPEEDOMETER INOPERATIVE — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK REAR ANTI-LOCK LAMP ILLUMINATION		
	<ul style="list-style-type: none"> Ignition key to RUN. Anti-lock lamp on dash goes out after self-test. 	Yes No	GO to A2 (display). REFER to Section 06-09A or 06-09B for diagnosis of anti-lock sensor and speed sensor ring.
A2	CHECK ODOMETER DISPLAY		
	<ul style="list-style-type: none"> Odometer display on, and digits appear normal? 	Yes No	GO to A3. GO to A6.
A3	CHECK FOR PRESENCE OF ERROR MESSAGE		
	<ul style="list-style-type: none"> Does the word "Error" appear on the odometer display? NOTE: "Error 3" means conversion constant must be programmed. See Diagnostic Test C.	Yes No	REPLACE instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. VERIFY proper operation. GO to A4.

DIAGNOSIS AND TESTING (Continued)

SPEEDOMETER INOPERATIVE — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A4	CHECK ODOMETER OPERATION		
	<ul style="list-style-type: none"> • Odometer display increments mileage with vehicle motion or rear wheels turning? 	Yes No	GO to A9. GO to A5.
A5	CHECK SPEEDOMETER OPERATION		
	<ul style="list-style-type: none"> • Speedometer indication increases with increasing vehicle speed? 	Yes No	REPLACE instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. VERIFY proper operation. GO to A8.
A6	CHECK SPEEDOMETER POWER FUSES		
	<ul style="list-style-type: none"> • Remove and inspect battery power fuse (#8) and ignition power fuse (# 18 — F-Series, or # 17 — E-Series). Replace as required. • If fuses are OK, do speedometer and odometer now operate properly? 	Yes No	GO to A7. REPLACE instrument cluster. REFER to Section 13-01A for ordering information. Verify proper operation.
A7	CHECK SPEEDOMETER CONNECTOR		
	<ul style="list-style-type: none"> • Verify battery, ground and ignition voltages on Pins 1, 2 and 3 respectively with ignition key in RUN. • Is resistance to ground less than 1 ohm and are terminals in wiring harness connector completely seated in connector and locking tabs in place? 	Yes No	REPLACE the instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. SERVICE wiring harness and fuses as required. VERIFY proper operation.
A8	CHECK SPEED INPUT SIGNAL		
	NOTE: Only wiring harness end of connector is to be probed. <ul style="list-style-type: none"> • Connect an AC voltmeter to Pin 4 (speed in +) and Pin 5 (speed in -). • Does the voltage increase smoothly and continuously from 0 to approximately 3.5 volts as vehicle speed increases from 0 to 30 mph? OR, <ul style="list-style-type: none"> • If available, a frequency counter may be connected to Pin 4 (speed in +) and Pin 5 (speed in -). • Does the displayed frequency of the signal increase smoothly and continuously from 0 to approximately 667 Hz at approximately 30 mph? OR, <ul style="list-style-type: none"> • If neither a voltmeter nor frequency counter is available, vehicle speed control may be used as a good indicator. If it works normally, then the speedometer module is at least receiving a speed input signal and the wiring and sensor can be assumed to be good. • Does the speed control work normally? 	Yes No	REPLACE the instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. SERVICE wiring. CHECK for open or shorted wiring. If no problems are found, REFER to Section 06-09A or 06-09B.
A9	CHECK SPEEDOMETER OPERATION		
	<ul style="list-style-type: none"> • Does speedometer indication increase with increasing vehicle speed? 	Yes No	Normal operation. ADVISE customer. REPLACE the instrument cluster. REFER to Section 13-01A for instrument cluster ordering information.

TK17789B

DIAGNOSIS AND TESTING (Continued)

SPEEDOMETER, IMPROPER OPERATION — TEST B

TEST STEP		RESULT	ACTION TO TAKE																																												
B1	CHECK SPEEDOMETER OPERATION																																														
	<ul style="list-style-type: none"> Is speedometer free from hesitation or sticking when accelerating or decelerating smoothly? This may also be confirmed by performing the following test: <ul style="list-style-type: none"> Press and hold the RESET button on the front of the speedometer while turning the ignition switch to RUN. Release the RESET button. Does the pointer smoothly prove out, or sweep from 0 to maximum speed then back to 0? 	Yes No	GO to B2. After verifying good power and ground connections, GO to A6. REPLACE instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. VERIFY proper operation.																																												
B2	CHECK ODOMETER DISPLAY																																														
	<ul style="list-style-type: none"> Are all odometer digits formed correctly (no extra or missing segments)? Do the select and reset buttons work normally? <p>NOTE: The trip odometer must be currently displayed for the RESET button to work. If unsure about missing or extra segments, perform the odometer display self-test as follows:</p> <ul style="list-style-type: none"> Press and hold the reset button on the front of the speedometer while turning the ignition switch to RUN. Release the RESET button. Press and release the select button. The odometer will begin with all zeroes and step through the display test each time the select button is pushed. Refer to PSOM Display Test Sequence. <p>NOTE: The first digit on the left does not always match the other digits.</p> <ul style="list-style-type: none"> Turn off the ignition switch to exit this test. 	Yes No	GO to B3. CHECK pointer. REPLACE instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. VERIFY proper operation.																																												
<p>PSOM DISPLAY TEST SEQUENCE</p> <p>NUMBER OF TIMES TRIP ODO SELECT BUTTON IS DEPRESSED ROM LEVEL DEALER MODE REPROGRAMMING LOCKOUT COUNT</p> <p>MODE 006 ENGLISH/MILES OR OVERSEAS/METRIC</p> <table> <tr> <td>0</td><td>.....</td><td>000000.0</td><td>TRIP</td></tr> <tr> <td>1</td><td>.....</td><td>111111.1</td><td>TRIP</td></tr> <tr> <td>2</td><td>.....</td><td>222222.2</td><td>TRIP</td></tr> <tr> <td>3</td><td>.....</td><td>333333.3</td><td>TRIP</td></tr> <tr> <td>4</td><td>.....</td><td>444444.4</td><td>TRIP</td></tr> <tr> <td>5</td><td>.....</td><td>555555.5</td><td>TRIP</td></tr> <tr> <td>6</td><td>.....</td><td>666666.6</td><td>TRIP</td></tr> <tr> <td>7</td><td>.....</td><td>777777.7</td><td>TRIP</td></tr> <tr> <td>8</td><td>.....</td><td>888888.8</td><td>TRIP</td></tr> <tr> <td>9</td><td>.....</td><td>999999.9</td><td>TRIP</td></tr> <tr> <td>10</td><td>.....</td><td>000000.0</td><td>TRIP</td></tr> </table> <p>(REPEATS TO +1) K19255-A</p>				0	000000.0	TRIP	1	111111.1	TRIP	2	222222.2	TRIP	3	333333.3	TRIP	4	444444.4	TRIP	5	555555.5	TRIP	6	666666.6	TRIP	7	777777.7	TRIP	8	888888.8	TRIP	9	999999.9	TRIP	10	000000.0	TRIP
0	000000.0	TRIP																																												
1	111111.1	TRIP																																												
2	222222.2	TRIP																																												
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8	888888.8	TRIP																																												
9	999999.9	TRIP																																												
10	000000.0	TRIP																																												
B3	CHECK SPEEDOMETER POINTER																																														
	<ul style="list-style-type: none"> Does pointer jump or waver at a constant speed? 	Yes No	GO to B4. GO to B5.																																												

DIAGNOSIS AND TESTING (Continued)

SPEEDOMETER, IMPROPER OPERATION — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B4	CHECK RABS SPEED SENSOR RING AND SENSOR		
	<ul style="list-style-type: none"> Are any of the following conditions present? <ul style="list-style-type: none"> Damaged, missing or bent teeth Metal chips on speed sensor Open or shorted sensor Improper gap between sensor and speed sensor ring Refer to Section 6-09A for additional information, especially tests F4-F6. 	<p>Yes</p> <p>No</p>	<p>REPAIR or REPLACE as necessary. VERIFY proper operation.</p> <p>REPLACE the instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. VERIFY proper operation.</p>
B5	CHECK FOR STUCK POINTER		
	<ul style="list-style-type: none"> Is pointer stuck at upper pointer stop? 	<p>Yes</p> <p>No</p>	<p>GO to B6.</p> <p>Speedometer normal.</p>
B6	SPEEDOMETER POINTER PROVE OUT		
	<ul style="list-style-type: none"> Can the pointer be brought back to the normal position by performing the following procedure? <ul style="list-style-type: none"> Press and hold the RESET button on the front of the speedometer while turning the ignition switch to RUN. Release the RESET button. The pointer would normally prove out, or sweep from the lower to upper pointer stop and back again. In this case, the pointer will "jump back" to where it should be in the sweep and continue to sweep normally when the pointer gets to within 180 degrees of the upper pointer stop (about 35 mph). Turn off the ignition switch to exit prove out. 	<p>Yes</p> <p>No</p>	<p>Speedometer normal.</p> <p>REPLACE the instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. VERIFY proper operation.</p>

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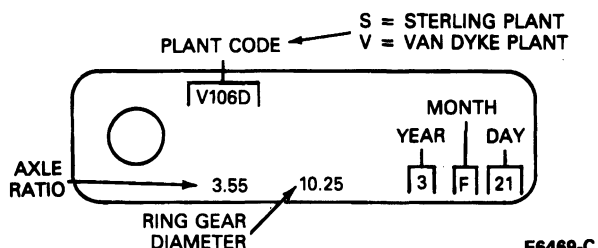
SPEEDOMETER INACCURATE — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Refer to speedometer calibration tolerance specifications table in Step C6. Be sure to check the odometer calibration. If both the odometer and speedometer are incorrect in the same direction, it is usually a sign that the conversion constant, tire size, or speed sensor ring are different than programmed. A speedometer inaccurate with an accurate odometer is usually a problem with the speedometer module itself. Are speedometer and odometer calibration within specified limits? 	<p>Yes</p> <p>No</p>	<p>Speedometer normal.</p> <p>GO to C2.</p>
C2	CHECK FOR "NOT PROGRAMMED" MESSAGE		
	<ul style="list-style-type: none"> Does "ERROR 3" message alternate with normal odometer display? 	<p>Yes</p> <p>No</p>	<p>GO to C6. RESET conversion constant.</p> <p>GO to C3.</p>
C3	CHECK TIRES / AXLE CAPACITY		
	<ul style="list-style-type: none"> Are tires the same size on opposite ends of a common axle and properly inflated? 	<p>Yes</p> <p>No</p>	<p>DETERMINE conversion constant. GO to C5.</p> <p>CORRECT condition or ADVISE customer. GO to C1.</p>

DIAGNOSIS AND TESTING (Continued)

SPEEDOMETER INACCURATE — TEST C (Continued)

TEST STEP		RESULT	ACTION TO TAKE
C4	VERIFY CONVERSION CONSTANT AND DISPLAY TYPE		
<ul style="list-style-type: none"> Check whether the conversion constant in the speedometer is correct with the following procedure: <ul style="list-style-type: none"> Press and hold the RESET button on the front of the speedometer while turning the ignition switch to RUN. Release the RESET button. The pointer will prove out and some codes will appear on the odometer display. If an "E" is on the left side of the display, the module is programmed for English display mode and should have English graphics (mph). A lower case "o" signifies an overseas (metric) graphics (kph). Verify the graphics and display modes agree. (The number appearing after the type is the microprocessor revision level and is not used in this test.) Press and release the RESET button again. The conversion constant and the word CAL will be shown on the odometer display. Verify the programmed conversion constant is the same as that displayed on the chart. Turn off the ignition switch to exit this test. Is the programmed conversion constant the same as that displayed on the chart and does the programmed display mode match the speedometer graphics? 		Yes No, conversion constant wrong, programmed display mode OK. No, conversion constant OK, programmed display mode wrong.	REPLACE instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. VERIFY proper operation. RESET conversion constant. REFER to Reset Conversion Constant in C7. REPLACE instrument cluster. REFER to Section 13-01A for ordering information. VERIFY proper operation.
C5	DETERMINING CONVERSION CONSTANT		
<ul style="list-style-type: none"> Check tire size and type on vehicle rear axle or SAE average rev / mile. <ul style="list-style-type: none"> Refer to tire / axle capacity chart and note conversion constant. Can the conversion constant be determined? 		Yes No	VERIFY conversion. GO to C4. GO to C6.
C6	MEASURE TIRE DIAMETER		
<ul style="list-style-type: none"> To determine the conversion constant perform the following procedure: <ul style="list-style-type: none"> Hoist vehicle. Measure tire outside diameter (TOD). Note number of rear axle speed sensor teeth, ring gear diameter, or axle capacity / tape group. Verify speed sensor ring diameter with identification tag attached to rear axle cover retaining bolts. If tag is missing manually count teeth. <p>NOTE: Typically, 7.5-inch rear axles have 102-tooth speed sensor rings, 8.8-inch rear axles have 108-tooth speed sensor rings, and other axles, such as 9.75-inch, 10.25-inch, 10.5-inch and 11-inch axles are equipped with 120-tooth speed sensor rings.</p> <ul style="list-style-type: none"> Is outside diameter greater than 25.2 inches? 		Yes No	Use formula $\text{revs / mile} = (1528 - (28 \times \text{TOD}))$ to calculate SAE average revs / mile. Revs / mile = 20,850 / TOD.



E6469-C

DIAGNOSIS AND TESTING (Continued)

SPEEDOMETER INACCURATE — TEST C (Continued)

TEST STEP		RESULT	ACTION TO TAKE
C7	RESET CONVERSION CONSTANT		
<ul style="list-style-type: none"> Re-program speed conversion constant using the following procedure: <ul style="list-style-type: none"> Locate the dealer mode programming enable single-terminal connector. On E-Series, the connector is located near the 76-way connector below the fuse block. On F-Series, the connector is located at the bottom of the instrument panel below the center of the glove box. On all vehicles, the dealer mode enable wire is Circuit #567 (LB/Y). Insert metal clip in service wire panel connector. Clip other end to vehicle ground while the ignition is in the OFF position. Turn ignition to RUN (not crank) position while holding down the trip odometer RESET button on speedometer. Release RESET button. Speedometer will prove out (sweep across dial and back). The English / Metric and revision levels will be displayed. The last number of the display is the dealer mode programming lockout count. This count shows the number of allowable conversion constant changes remaining. When the count is zero (0), no additional changes can be made to this instrument cluster. If a conversion constant change is required, a service cluster must be ordered. Refer to Section 13-01A for ordering information. Press and release RESET button again and PSOM conversion constant (without the decimal point) followed by the word CAL. Press and release the odometer SELECT button as many times as necessary to change conversion constant to the correct value. When the correct new value is displayed in odometer window, press and release the RESET button to lock in the new conversion constant. <p>NOTE: Doing this reduces the number of times the PSOM can be reprogrammed by one count. The module can only be reprogrammed six times. If you change your mind and want to go back to the old conversion constant, turn the ignition switch off before you lock in the new constant.</p> <ul style="list-style-type: none"> Turn the ignition switch off and remove the ground wire. Verify proper speedometer operation. Is conversion constant now set to the desired value? <p>NOTE: The module can only be re-programmed six (6) times.</p>		Yes No	Procedure complete. GO to C5.

Actual Speed	Actual Speed	Odometer Measure
48 km / h (30 mph)	97 km / h (60 mph)	Over Actual 16.1 km (10 mile) Distance
45-55 km / h (23-34 mph)	93-108 km / h (58-65 mph)	15.4-16.6 km / h (9.6-10.3 miles)

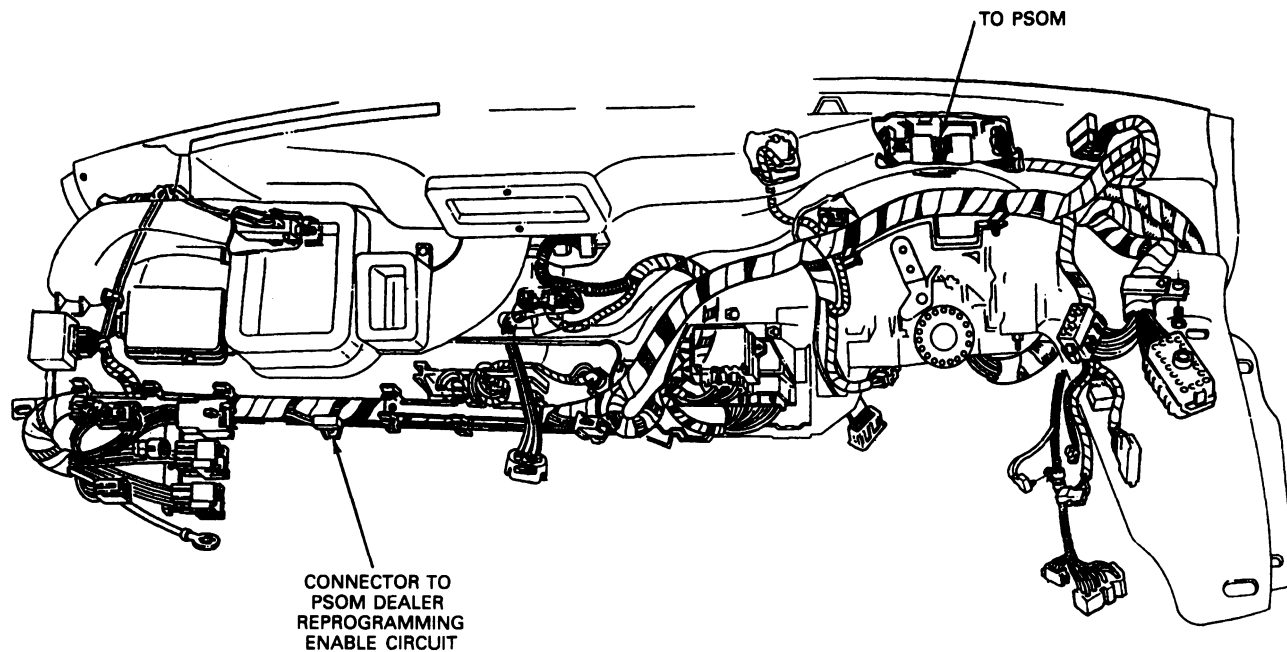
TK17791B

DIAGNOSIS AND TESTING (Continued)

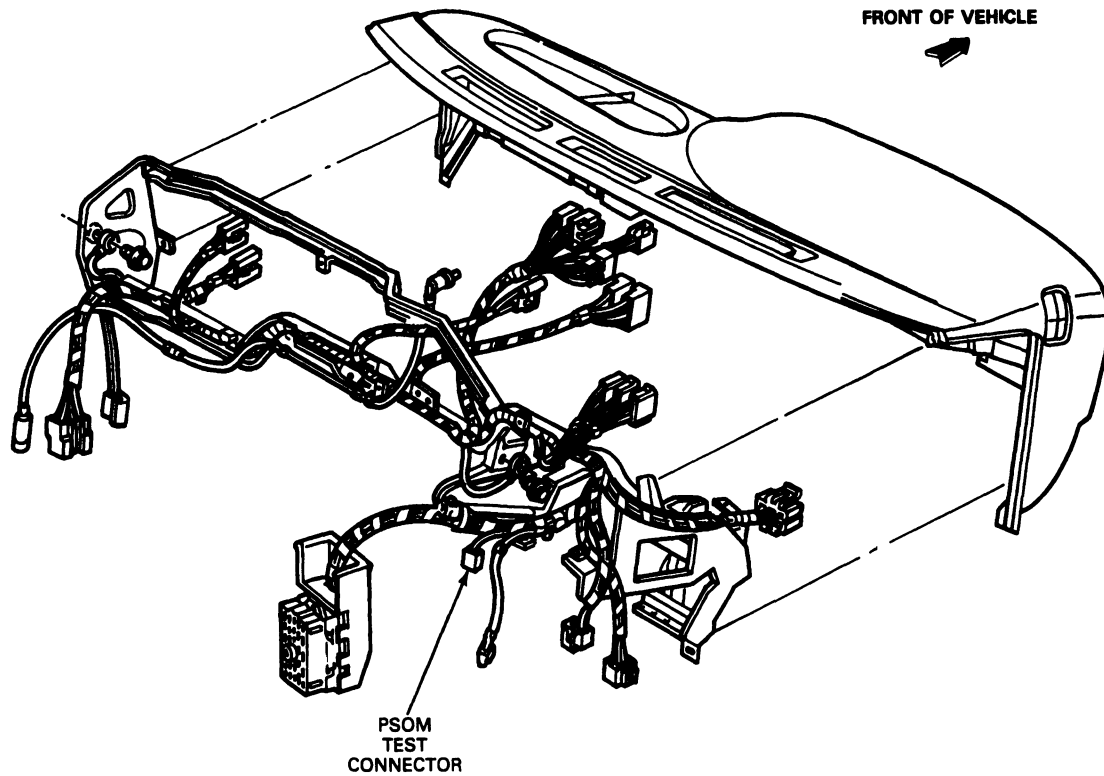
SPEED CONTROL, EEC, OR ELECTRONIC TRANSMISSION INOPERATIVE OR ERRATIC — TEST D
NOTE: Follow this procedure only after being referred here by the Speed Control, EEC, or electronic transmission shop manual diagnostics.

TEST STEP		RESULT	ACTION TO TAKE
D1	CHECK ANTI-LOCK LAMP ILLUMINATION		
	<ul style="list-style-type: none"> Ignition key to ON. Does anti-lock lamp on dash go out after self-test? 	Yes No	GO to D2. REFER to Section 06-09A or 06-09B.
D2	CHECK SPEEDOMETER SPEED OUTPUT SIGNAL		
	<p>NOTE: Only wiring harness end of connector is to be probed.</p> <ul style="list-style-type: none"> Use an ohmmeter to check for shorts in the wiring between Pin 7 (speed out) and battery/ignition or ground. Is circuit shorted? Use ohmmeter to check for opens in wiring between Pin 7 (speed out) and the affected module. Verify that the terminals in PSOM wiring connector are completely seated in the connector. Is the circuit open? Connect an AC voltmeter to Pin 7 (speed out) and Pin 2 (module ground). Does the voltage increase smoothly and continuously from 0 to approximately 4.5 volts as vehicle speed increases from 0 to approximately 30 mph? <p>OR,</p> <ul style="list-style-type: none"> If available, a frequency counter may be connected to Pin 7 (speed out) and Pin 2 (module ground). Does the displayed frequency of the signal increase smoothly and continuously from 0 to approximately 67 hz at approximately 30 mph? <p>OR,</p> <ul style="list-style-type: none"> If neither a voltmeter or frequency counter is available, vehicle speed control may be used as a good indicator. If it works normally above 35 mph, this means that the speedometer module is at least receiving a speed input signal and the wiring and sensor can be assumed to be good. Does speed control work? 	Yes No	SERVICE wiring between speedometer and affected module as required. VERIFY proper operation. GO to D3.
D3	CHECK SPEED INPUT SIGNAL		
	<p>NOTE: Only wiring harness end of connector is to be probed.</p> <ul style="list-style-type: none"> Connect an AC voltmeter to Pin 4 (speed +) and Pin 5 (speed -). Does the voltage increase smoothly and continuously from 0 to approximately 3.5 volts as vehicle speed increases from 0 to approximately 30 mph? <p>OR,</p> <ul style="list-style-type: none"> If available, a frequency counter may be connected to Pin 4 (speed in +) and Pin 5 (speed in -). Does the displayed frequency of the signal increase smoothly and continuously from 0 to approximately 667 hz at approximately 30 mph? 	Yes No	REPLACE instrument cluster. REFER to Section 13-01A for instrument cluster ordering information. SERVICE wiring. CHECK for open or shorted wiring. If no problems are found, REFER to Section 06-09.

TK17792B

DIAGNOSIS AND TESTING (Continued)**Instrument Panel Wiring, F-Series and Bronco with Gas Engines and F-Series with Diesel Engines**

K17841-B

DIAGNOSIS AND TESTING (Continued)**Instrument Panel Wiring, Econoline**

K17843-A

DIAGNOSIS AND TESTING (Continued)

Conversion Constants Charts

TIRE DESCRIPTION SIZE/TYPE/SAE REVS/MILE	AXLE INFORMATION		3800/700/108	5400/400/120	6340/600/120	7800/800/120	8000/DSO/120	
	AXLE CAPACITY	TAPE GROUP						
P215/75R15SL/A/S/753	10.17	N/A	N/A	N/A	N/A	N/A		
P225/75R15SL/A/S/737	9.95	N/A	N/A	N/A	N/A	N/A		
P235/75R15XL/A/S/720	9.72	N/A	N/A	N/A	N/A	N/A		
LT225/75R16D/A/S/710	N/A	10.65	N/A	10.65	10.65			
LT225/75R16E/A/S/710	N/A	10.65	10.65	10.65	10.65			
LT245/75R16E/A/S/680	N/A	10.20	10.20	N/A	N/A			

TIRE DESCRIPTION SIZE/TYPE/SAE REVS/MILE	AXLE INFORMATION		3800/800/108	5300/100- 119/120	6250/120-199/120	7400/160- 179/120	8250/180-199/120	11000/940- 949/120	
	AXLE CAPACITY	TAPE GROUP							
P215/75R15SL/A/S/753	10.17	N/A	N/A	N/A	N/A	N/A	N/A		
P235/75R15XL/A/S/720	9.72	N/A	N/A	N/A	N/A	N/A	N/A		
P235/75R15XL/A/T/716	9.67	N/A	N/A	N/A	N/A	N/A	N/A		
31-10.50R15C/A/T/680	9.18	N/A	N/A	N/A	N/A	N/A	N/A		
LT215/85R16D/A/T/684	N/A	10.26	N/A	10.26	10.26	N/A			
LT215/85R16D/A/S/687	N/A	10.31	N/A	N/A	N/A	N/A			
LT235/85R16E/A/T/653	N/A	9.80	9.80	N/A	9.80	9.80			
LT235/85R16E/A/S/656	N/A	9.84	9.84	N/A	9.84	9.84			
7.50R-16D/HWY/653	N/A	9.80	N/A	N/A	N/A	N/A	N/A		
7.50R-16D/A/T/649	N/A	9.74	N/A	N/A	N/A	N/A	N/A		
P265/75R15/A/T/680	9.18	N/A	N/A	N/A	N/A	N/A	N/A		
P275/60HR17/A/S/6-90.5	9.32	N/A	N/A	N/A	N/A	N/A	N/A		

NOTE: CONVERSION CONSTANT = $\frac{\text{(TIRE SAE AVG REV/MI)}}{\text{(NUMBER OF RABS SPEED SENSOR RING TEETH)}}$
8000

NOTE: SOME MANUFACTURERS MAY REFER TO A/S TIRES AS "HWY"
AND A/T TIRES AS "MUD & SNOW".

K19256-A

REMOVAL AND INSTALLATION

Speedometer Assembly, Electric

Federal law requires that the odometer in any replacement speedometer must register the same mileage as that registered in the removed speedometer.

Instrument cluster components that are serviceable at the dealership level are:

- Bulb and socket assemblies — base P/N -13B765-
- Oil /temperature gauge assembly — base P/N -10E872-
- Fuel /voltage gauge assembly — base P/N -10E871-
- Tachometer (if applicable) — base P/N -17360-
- Fuel anti-slosh low fuel module (if applicable) — base P/N -10E849-
- Cluster lens — base P/N -10B885-
- Cluster mask — base P/N -10894-
- Lens attaching screws — base P/N -804988-

NOTE: The instrument cluster must be serviced as a complete assembly if it is determined that any of the following components are faulty:

- Speedometer /odometer assembly
- Flex (printed) circuit assembly
- Flex circuit / gauge clips
- Instrument cluster backplate

Instructions for ordering and handling a replacement instrument cluster are provided in Section 13-01A.

In addition to the above components, the following components are serviceable on Econoline Chassis and Motorhome vehicles only:

- Fuel label or label (blank) — base P/N -9A095-
- Bezel — base P/N -10876-
- Right- and left-hand jewels — base P/N -807025-
- Screws — base P/N -807025-

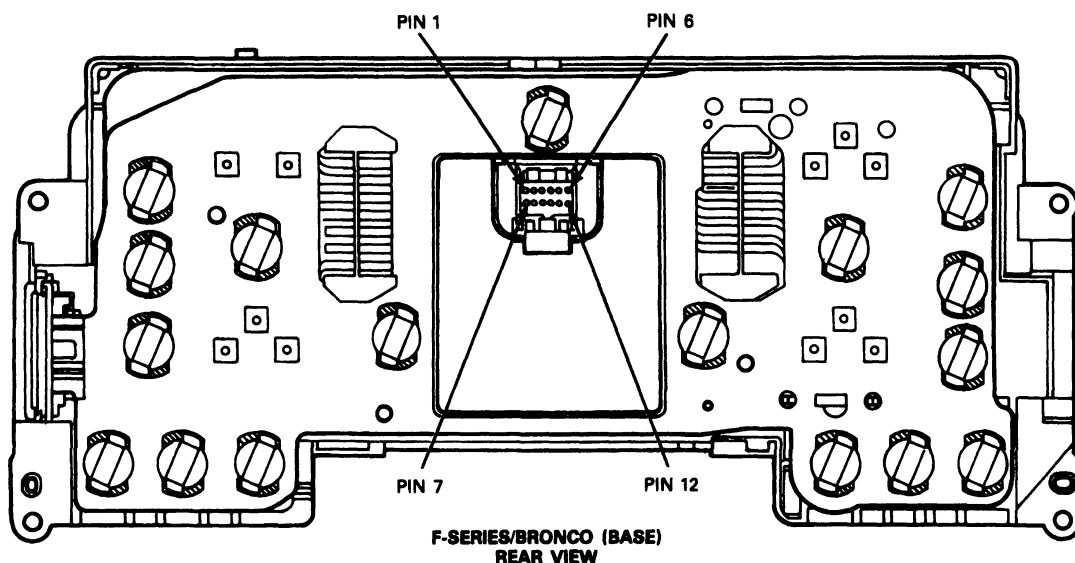
If the diagnostic procedures described in this section result in a determination that any other instrument cluster component is faulty, the complete instrument cluster must be replaced. Refer to Instrument Cluster Replacement in Section 13-01A for instrument cluster ordering information.

The service cluster received will be pre-programmed with the vehicle mileage (eliminating the need for "circled S" odometers) and the PSOM speed signal conversion constant.

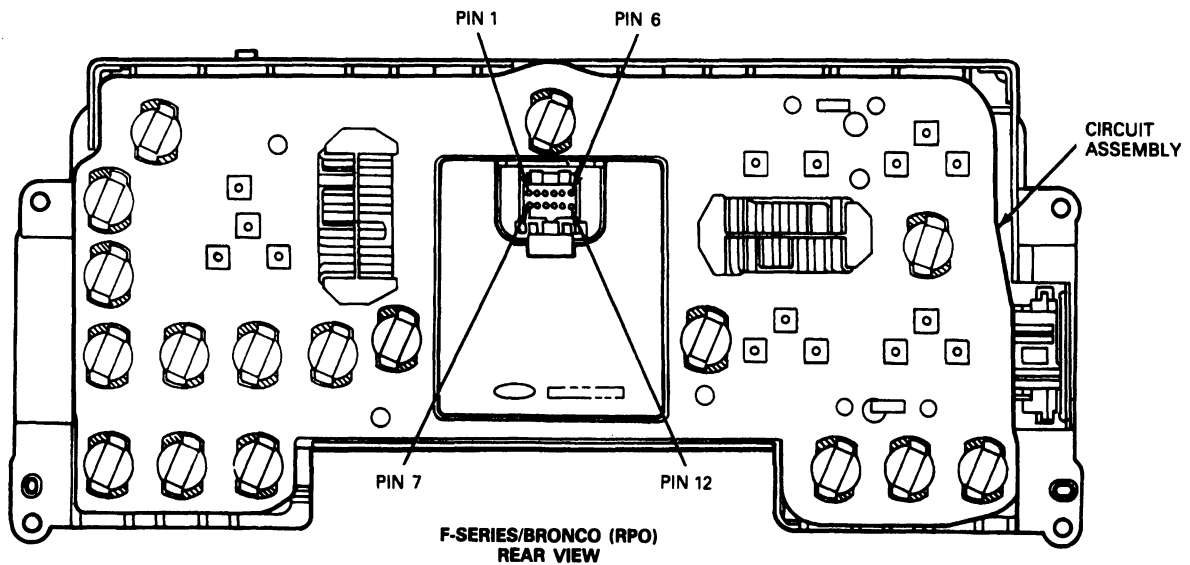
NOTE: The instrument cluster requires special handling to avoid damaging internal components. The cluster MUST be kept FACE UP or in the in-vehicle position. Leaving the cluster face down may result in a loss of dampening fluid used in the gauges. The lost fluid could stain the cluster face or result in excessive pointer waver.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

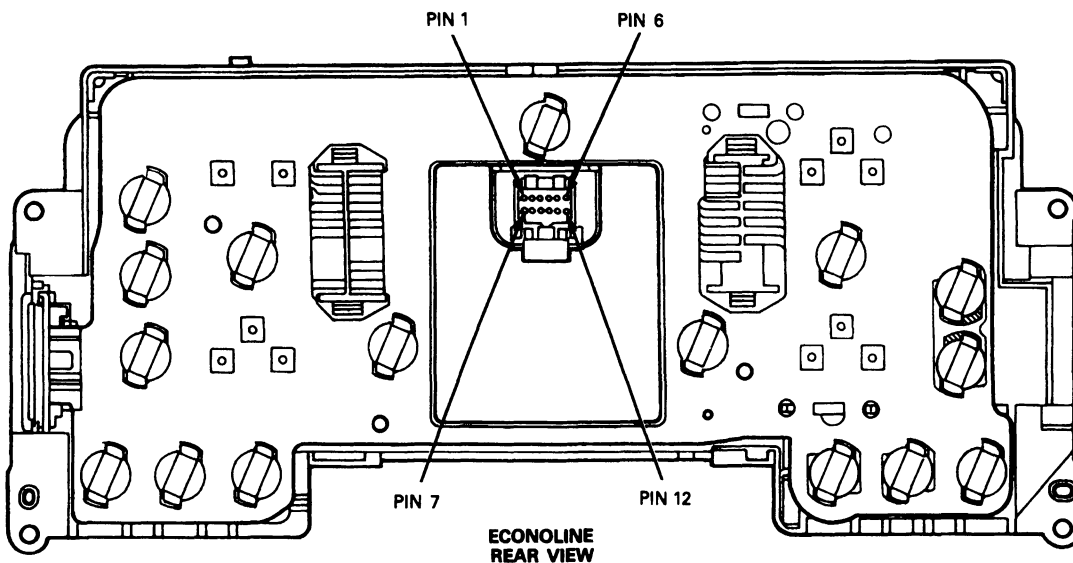
Rear View of Cluster, F-Series and Bronco (Base)



K17847-A

REMOVAL AND INSTALLATION (Continued)**Rear View of Cluster, F-Series and Bronco (RPO)**

K17848-A

Rear View of Cluster, Econoline

K17849-A

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
055-00101	Digital Tach/Dwell Multimeter
007-00001	Digital Volt-Ohmmeter

SECTION 13-02B Speedometer / Odometer, F-Super Duty Commercial Chassis

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Speedometer System	13-02B-1	Speedometer Core 17262	13-02B-5
DIAGNOSIS AND TESTING		Speedometer Head	13-02B-4
Diagnosis Guides	13-02B-1	SPECIAL SERVICE TOOLS/EQUIPMENT	13-02B-6
REMOVAL AND INSTALLATION		SPECIFICATIONS	13-02B-5
Speedometer Cable	13-02B-4	VEHICLE APPLICATION	13-02B-1

VEHICLE APPLICATION

F-Super Duty Commercial Chassis Vehicles

DESCRIPTION AND OPERATION

Speedometer System

The speedometer is connected to the output shaft of the transmission by means of a flexible shaft (core), and a drive gear located inside the park brake assembly. The core drives the speedometer which registers speed in miles per hour (also in kilometers per hour). It also drives an odometer which records distance traveled in miles and tenths of a mile (also in kilometers and tenths of a kilometer).

All vehicles equipped with gasoline (MFI) engines and / or automatic transmission have a speed sensor attached to the park brake assembly. This is used to sense vehicle speed required for the engine / transmission management system and to regulate the speed control system for vehicles so equipped.

DIAGNOSIS AND TESTING

Diagnosis Guides

SPEEDOMETER IS NOISY — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK CONNECTIONS		
	<ul style="list-style-type: none"> Verify quick connect is properly attached at speedometer head. Is quick connect properly attached? 	Yes No	GO to A2. REPAIR or REPLACE bad connection. CHECK for noise.
A2	VERIFY CONDITION WITH ENGINE RUNNING IN NEUTRAL		
	<ul style="list-style-type: none"> With engine running and vehicle in neutral, check for noise. Is noise still present? 	Yes No	CHECK for other cause of vehicle noise. GO to A3.
A3	CHECK SENSOR		
	<ul style="list-style-type: none"> Check sensor for erratic or noisy operation. Is sensor erratic or noisy? 	No Yes	GO to A4. REPLACE sensor. CHECK system for noise.

DIAGNOSIS AND TESTING (Continued)**SPEEDOMETER IS NOISY — TEST A (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
A4	CHECK CABLE		
	<ul style="list-style-type: none"> Check cable for any kinks or bends. Does cable have kinks or bends? 	No Yes	GO to A5 . If cable is kinked, REPLACE cable. For minor bends, ADJUST cable routing to obtain generous curves and CHECK for proper connection.
A5	CHECK CORE		
	<ul style="list-style-type: none"> Disconnect cable, remove core and check for kinks, burrs or bent tips. Are there kinks, burrs or bent tips? 	Yes No	REPLACE core. RECHECK system for noise. GO to A6 .
A6	CHECK GEAR(S)		
	<ul style="list-style-type: none"> Check for damaged or worn driven gear(s). Are driven gears damaged or worn? 	No Yes	REPLACE speedometer head. RECHECK system. REPLACE gear(s) as required. CHECK system.

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SPEEDOMETER IS ERRATIC OR POINTER WAVERS — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK CONNECTIONS		
	<ul style="list-style-type: none"> Verify quick connect is properly attached at speedometer head. 	All connections are good One or more connections are bad	GO to B2 . REPAIR or REPLACE bad connections. CHECK for erratic or wavering pointer.
B2	CHECK CABLE		
	<ul style="list-style-type: none"> Check speedometer cable for kinks or bends in the routing. While cable is disconnected at park brake assembly, check drive tip square for wear. 	Cable and drive are OK Cable and drive are worn, kinked or bent	GO to B3 . If cable is kinked, REPLACE cable. For minor bends, ADJUST cable routing to obtain generous curves, and CHECK for proper connection. If drive tip is worn, REPLACE with a new core.
B3	CHECK DRIVEN GEAR		
	<ul style="list-style-type: none"> Check driven gear for damage, wear or use of incorrect parts. 	Driven gear is not OK Driven gear is OK	REPLACE driven gear. CHECK speedometer. GO to B4 .
B4	CHECK CORE		
	<ul style="list-style-type: none"> Disconnect cable, remove core and check for kinks, burrs or bent tips. Add lubricant to inside of cable housing before installing core. 	Core is not OK Core is OK	REPLACE core. CHECK speedometer. GO to B5 .
B5	CHECK CORE MOTION		
	<ul style="list-style-type: none"> Install core and turn by hand to feel for rough or irregular motion. 	Core motion is rough or irregular Core motion is OK	REPLACE core. CHECK speedometer. REPLACE speedometer head. CHECK speedometer.

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DIAGNOSIS AND TESTING (Continued)**SPEEDOMETER IS INOPERATIVE — TEST C**

TEST STEP		RESULT	ACTION TO TAKE
C1	CHECK CONNECTIONS		
	<ul style="list-style-type: none"> Verify quick connect is properly attached at speedometer head. Check square drive tip of the core at transmission end of cable to make sure it is properly seated in the speed sensor. Are connections good and is drive tip seated properly? 	Yes No	GO to C2 . RESEAT drive tip if not seated properly. CHECK to see if speedometer is now operative.
C2	CHECK ROTATION		
	<ul style="list-style-type: none"> Rotate gear to assure core is free and not bound up. Does cable core rotate freely? 	Yes No	GO to C3 . REPLACE core.
C3	CHECK ODOMETER/ POINTER		
	<ul style="list-style-type: none"> Check operation of odometer/ pointer. 	Odometer is operating and speedometer pointer does not operate Speedometer pointer operates and odometer does not operate If both odometer and speedometer pointer fail to operate	REPLACE speedometer head. RECHECK speedometer for operation. REPLACE speedometer head. CHECK speedometer for operation. GO to C4 .
C4	CHECK SPEEDOMETER HEAD		
	<ul style="list-style-type: none"> Disconnect cable and check that magnet shaft in speedometer head turns freely. By rotating with a short section of cable core. Does magnet shaft turn freely? 	No Yes	REPLACE speedometer head. RECHECK speedometer for operation. GO to C5 .
C5	CHECK SPEED SENSOR		
	<ul style="list-style-type: none"> Disconnect cable from speed sensor and check that shaft in sensor turns freely. Does shaft turn freely? 	No Yes	REPLACE speed sensor. CHECK speedometer for operation. GO to C6 .
C6	CHECK GEARS		
	<ul style="list-style-type: none"> Check drive gear and driven gear for damage or wear. Check drive tip on both ends of the cable for wear. Is drive gear, drive tip or driven gear damaged? 	Yes No	REPLACE damaged or worn gear or core. CHECK speedometer for operation. GO to C7 .
C7	CHECK CABLE		
	<ul style="list-style-type: none"> Check speedometer cable for kinks or improper routing. Are there kinks in cable? 	Yes No	REPLACE cable. CHECK speedometer for operation. GO to C8 .
C8	CHECK CORE		
	<ul style="list-style-type: none"> With cable disconnected, check core. Is core damaged or will not turn? 	Yes No	REPLACE core. CHECK speedometer for operation. System OK.

TCK5860H

DIAGNOSIS AND TESTING (Continued)**SPEEDOMETER IS INACCURATE — TEST D**

TEST STEP		RESULT	ACTION TO TAKE
D1	CHECK CONNECTIONS		
	<ul style="list-style-type: none"> Verify quick connect is properly attached at speedometer head. Are all connections good? 	Yes No	<p>GO to D2.</p> <p>REPAIR or REPLACE as necessary. CHECK for accuracy.</p>
D2	CHECK ODOMETER		
	<ul style="list-style-type: none"> Check accuracy of odometer. If odometer is accurate, calibration of speedometer may be off. Changing the head may correct, but going on to change either gear will make speedometer reading more accurate, but now odometer will not be accurate. Is odometer accurate? 	Yes No	<p>REPLACE speedometer head. CHECK for speedometer accuracy.</p> <p>GO to D3.</p>
D3	CHECK DRIVEN GEAR		
	<ul style="list-style-type: none"> Check for proper driven gear. Refer to the Ford Truck Master Parts Catalog, for speedometer gear applications. If odometer is accurate, calibration of speedometer may be off. Changing the head may correct but going on to change either gear will make speedometer reading more accurate, but now odometer will not be accurate. Is the correct driven gear installed? 	No Yes	<p>REPLACE gear with correct gear. CHECK for accuracy.</p> <p>GO to D4.</p>
D4	CHECK DRIVE GEAR AXLE, TIRES AND RATIO ADAPTOR		
	<ul style="list-style-type: none"> Check for proper drive gear, axle, tires and ratio adaptor. Is drive gear axle, tire and ratio adapter correct? 	Yes No	<p>REPLACE speedometer head. CHECK for accuracy.</p> <p>REPLACE incorrect component or driven gear. CHECK for accuracy.</p>

TCK7225D

REMOVAL AND INSTALLATION**Speedometer Head****Removal**

1. Disconnect the speedometer cable as described in this section. Remove the instrument cluster. Refer to Section 13-01B.
2. Remove the bezel, lens and mask from the cluster after removing seven screws. Remove two additional screws from the rear of the instrument cluster in order to remove the speedometer.

Installation

1. Position the speedometer to the back plate.
2. Install two screws.
3. Install the mask, lens, and bezel to the instrument cluster.
4. If a new speedometer is being installed, examine the square drive hole for sufficient lubrication.
5. If lubricant is needed, apply a 4.8mm (3 / 16-inch) diameter daub of Speedometer Cable Lubricant E6TZ-19581-A (ESF-M1C160-A) or equivalent in the drive hole.

6. Reconnect speedometer cable.

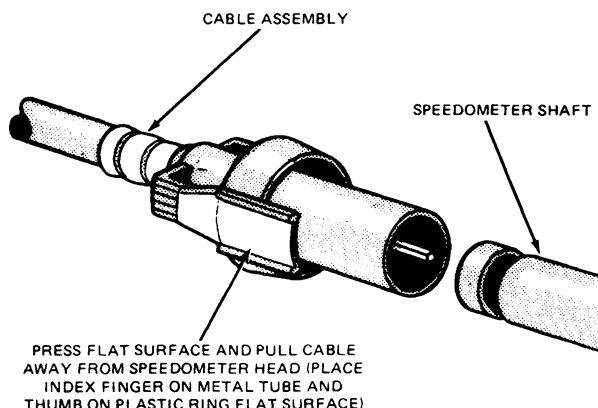
Speedometer Cable**Removal**

1. Raise the vehicle on a hoist.
2. Disengage the cable assembly from the park brake assembly and remove from the transmission.

NOTE: Remove the speedometer cable by pulling it out of the speed sensor. Do not attempt to remove the spring retainer clip with the speedometer cable in the sensor. To install the speedometer cable, align the core with the sensor and snap cable assembly into the speed sensor.

REMOVAL AND INSTALLATION (Continued)

3. Disconnect the speedometer cable from the speedometer.



K2327-1D

Installation

1. Connect the speedometer cable to the speedometer head.
2. Route the cable according to body builder specifications.
3. Raise the vehicle on a hoist.
4. Lubricate the cable core exposed at the transmission ferrule with Speedometer Cable Lubricant E6TZ-19581-A (ESF-M1C160-A) or equivalent.
5. Apply a coating of Ford Multi-Purpose Grease D0AZ-19584-AA (ESR-M1C159-A and ESB-M1C93-A) or equivalent to the O-ring on the ferrule.
6. Lubricate the inside diameter and teeth of the driven gear with Speedometer Cable Lubricant E6TZ-19581-A (ESF-M1C160-A) or equivalent and install the driven gear on the ferrule.
7. Assemble the driven gear retainer to the driven gear with the retainer tabs toward the gear teeth.
8. Insert the driven gear and cable into the transmission and retain with clamp. Tighten the retaining screw to 2.25-2.82 N·m (20-25 in-lb).
9. Secure the cable with clips/clamps at locations indicated by tape on the cable.

NOTE: The speedometer cable routing should avoid sharp bends; the cable should be straight for approximately 203mm (8 inches) from the speedometer.

10. Lower the vehicle.

Speedometer Core 17262**Removal**

1. Disconnect the speedometer cable (core and casing assembly) from the speedometer head.

2. Pull the speedometer core out of the upper end of the casing.
3. If the core is broken, raise the vehicle on a hoist and remove the bolt retaining the speedometer cable clamp to the transmission.
4. Remove the conduit and ferrule assembly and driven gear from the transmission. Remove the driven gear retainer, and remove the driven gear and shaft from the cable.
5. Remove the lower part of the core (if it is broken) from the lower end of the casing.

Installation

1. Position the driven gear to the casing and install the gear retainer. Install the driven gear and casing in the transmission, and install the retaining bolt. Lower the vehicle.
2. Using the Motorcraft Core Repair Kit, or equivalent, determine the exact length of the old core and cut the new core so that it is 20.64mm (13/16 inch) shorter than the old core. (Do not cut from the squared end of the core.) Remove any burrs or frayed edges.
3. Install the tip on the core, making certain to seat the core in the bottom of the tip.
4. Place the core and tip in a crimping die, place the die on a solid surface and strike it squarely with a hammer to crimp it.
5. Remove the crimping die.
6. Lubricate the core with silicone grease meeting Ford specifications ESR-M13P4-A or equivalent (do not over-lubricate). Install the core (square end first) into the upper end of the casing and push it all the way through to the transmission. When the cable is nearly seated, twist it slightly to make sure that the square end is engaged in the speedometer driven gear at the transmission.
7. Connect the cable assembly to the speedometer, being sure to eliminate any kinks in the housing and shaft. Check the operation of the speedometer.

SPECIFICATIONS**SPEEDOMETER CALIBRATION TOLERANCE SPECIFICATIONS**

48 km/h (30 mph) Actual Speed	97 km/h (60 mph) Actual Speed	Odometer Measure Over Actual 16 km (10 Miles) Distance
45-56 km/h (28-35 mph)	93-104 km/h (58-65 mph)	15.4-16.6 km 9.6-10.3 Miles)

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
055-00101	Digital Tach / Dwell Multimeter

SECTION 13-03A Gauge, Fuel

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Fuel Gauge Anti-Slosh Module	13-03A-3	Fuel Indicator Second Sender Test, F-Series	
Fuel Indicating Gauge.....	13-03A-3	Dual Tanks	13-03A-11
Fuel Level Indicating System	13-03A-2	Fuel Tank Damage	13-03A-12
Fuel Tank Selector Switch	13-03A-4	REMOVAL AND INSTALLATION	
DIAGNOSIS AND TESTING		Fuel Anti-Slosh Module	13-03A-12
Calibration Test (Without Tester),		Fuel Sender	13-03A-12
F-150-250-350	13-03A-11	Fuel/Volt Gauge	13-03A-12
Diagnosis Guides	13-03A-6	Instrument Cluster Replacement.....	13-03A-12
Fuel Gauge, Resistance	13-03A-11	SPECIAL SERVICE TOOLS/EQUIPMENT	
		VEHICLE APPLICATION	
		13-03A-1	

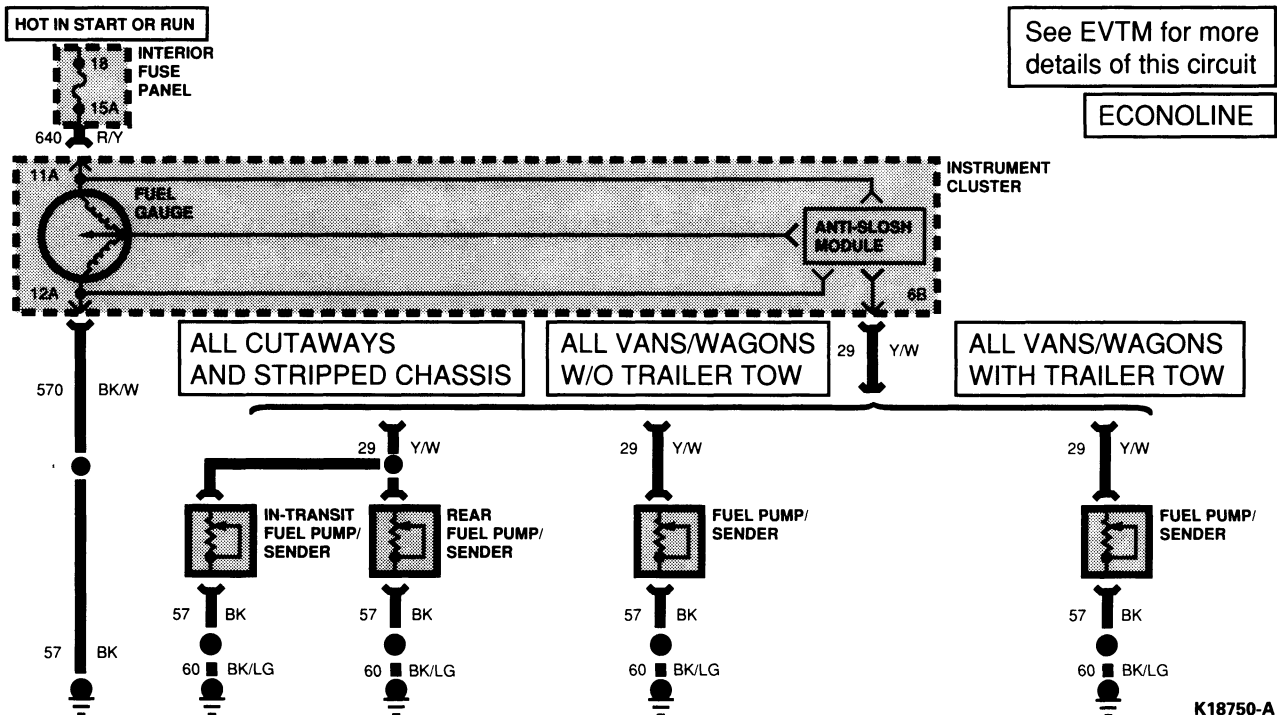
VEHICLE APPLICATION

E-150-250-350, F-150-250-350, Bronco, F-Super
Duty Motorhome Chassis, E-350 Motorhome and
Commercial Chassis (All Vehicles Except F-Super
Duty Commercial Chassis) F-Super Duty Chassis Cab
Vehicles

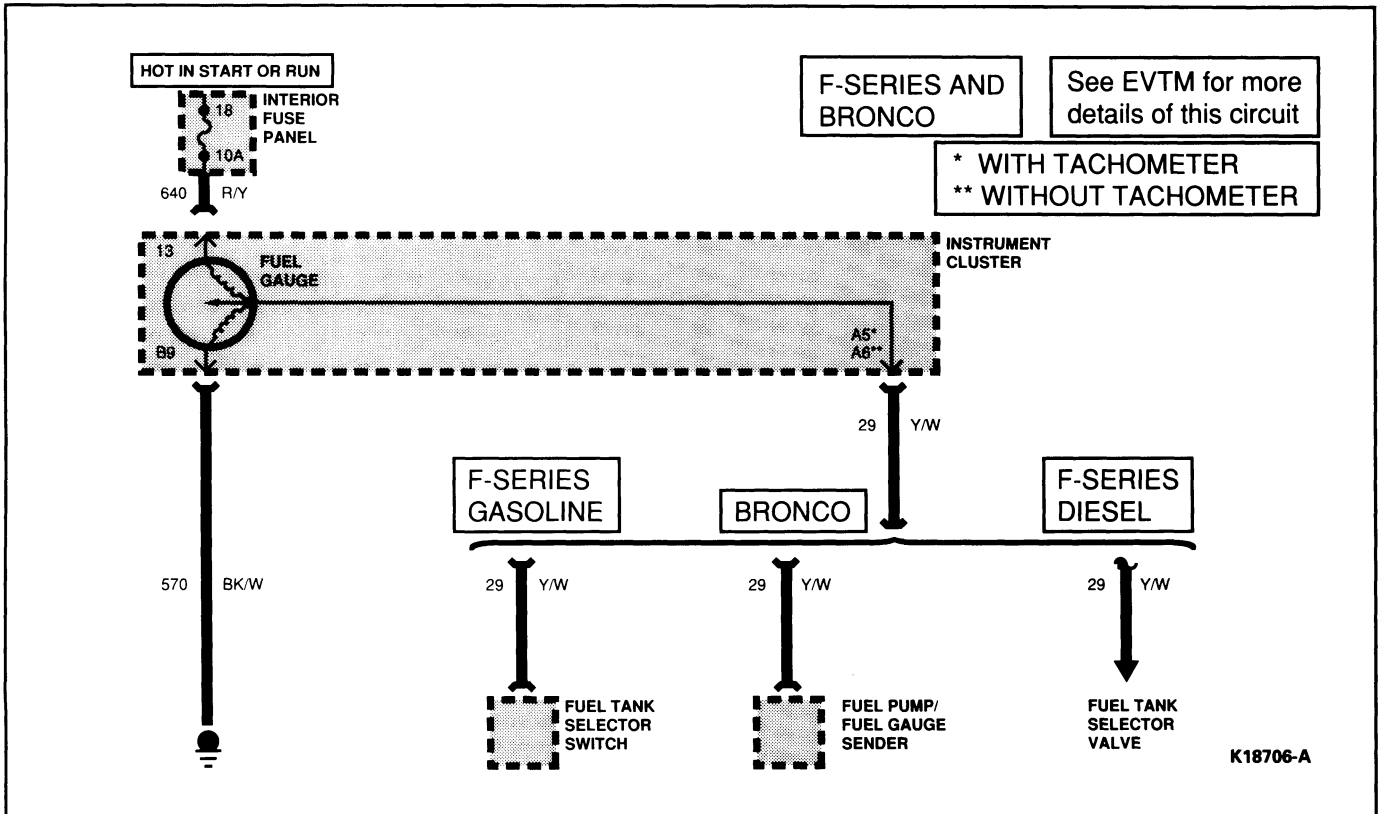
DESCRIPTION AND OPERATION

Fuel Level Indicating System

The fuel level indicating system is a magnetic gauge system. It consists of a magnetic fuel gauge mounted in the instrument cluster and a sender unit located in the fuel tank. For Econoline only, an electronic fuel level dampening module is in series between the two. No instrument voltage regulator is used with this system.



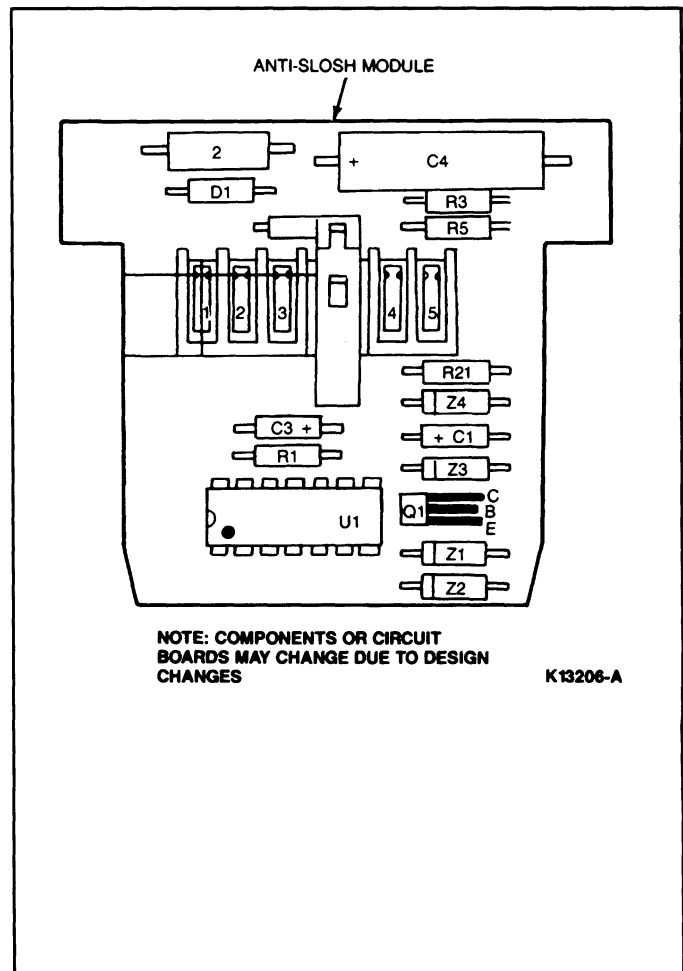
DESCRIPTION AND OPERATION (Continued)

**Fuel Indicating Gauge**

The magnetic gauge movement consists of three primary coils, one of which is wound at a 90-degree angle to the other two. The coils form a magnetic field which varies in direction according to the variable resistance of the sender unit which is connected between two of them. A primary magnet, to which a shaft and pointer are attached, rotates to align to this primary field, resulting in pointer position. The bobbin / coil assembly is pressed into a metal housing which has two holes for dial mounting. There is no adjustment, calibration or maintenance required for these gauges.

Fuel Gauge Anti-Slosh Module

The fuel anti-slosh module provides a delay to the fuel gauge to prevent the fuel gauge pointer from fluctuating as a result of excessive movement in the fuel tank. The module is a small printed circuit board which latches into a pocket on the back of the instrument cluster. The electrical connections for ignition, ground, input from fuel sender and output to fuel gauge are made through a spring-type connector on the module to the flex circuit on the cluster. There are no provisions for calibration or adjustment of the module.

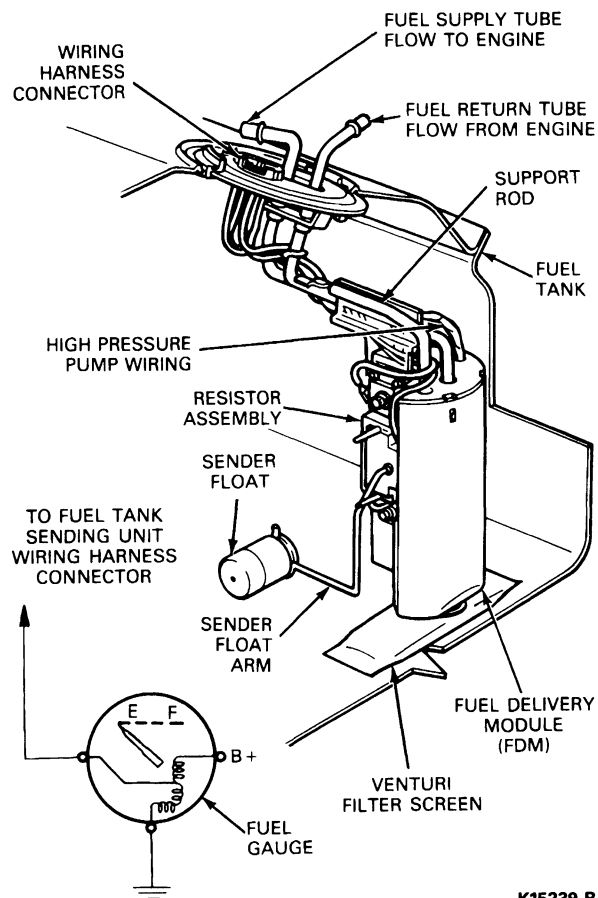


DESCRIPTION AND OPERATION (Continued)

Fuel Sender

The fuel sender consists of a variable screened resistor made up of a ceramic substrate. It is controlled by the action of an attached float in the fuel tank. When the fuel level is low, resistance in the sender is low. When the fuel level is high, the resistance in the sender is high. As the float moves from empty to full, the resistance will gradually and continuously increase.

Fuel Indicating System



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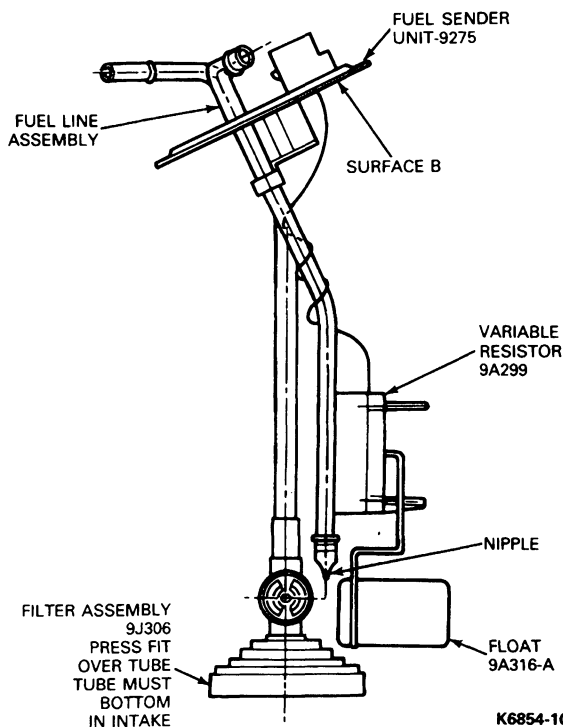
The electric fuel delivery system is used on the 4.9L, 5.0L, 5.8L, and 7.5L Multiport Fuel Injection (MFI) engines and utilize a fuel delivery module (FDM) assembly. The FDM unit includes a high pressure fuel pump, venturi jet pump, supply check valve, and a shuttle selector valve all located internally in the module, which acts as a reservoir mounted from the fuel tank sender flange. The fuel sending unit attached to the reservoir body is a separately serviceable component.

In addition, the FDM system achieves a significant reduction in fuel system complexity and simplifies fuel line routing. The in-line fuel filter is located on the left-hand frame rail to provide service access.

The fuel sender for the 7.3L diesel also operates the same as previously described, except for the following differences. The sender electrical connector has two pins instead of four for F-Series and Bronco. Econoline uses a pigtail wire harness as there is no electric fuel pump. The venturi filter screen is replaced by an inverted flexible cone-like member. The flexible cone makes sure fuel is always being taken from the bottom of the tank. The cone has as part of its assembly a relief-bypass valve. If the intake becomes obstructed at low temperatures the relief valve opens, allowing fuel to bypass the filter.

The fuel senders used with all engines equipped with MFI, as well as the 7.3L diesel engine, have a fuel return port which allows excess fuel delivered to the engine to be returned to the fuel tank.

Fuel Sender, 7.3L Diesel Engine, F-Series and Bronco



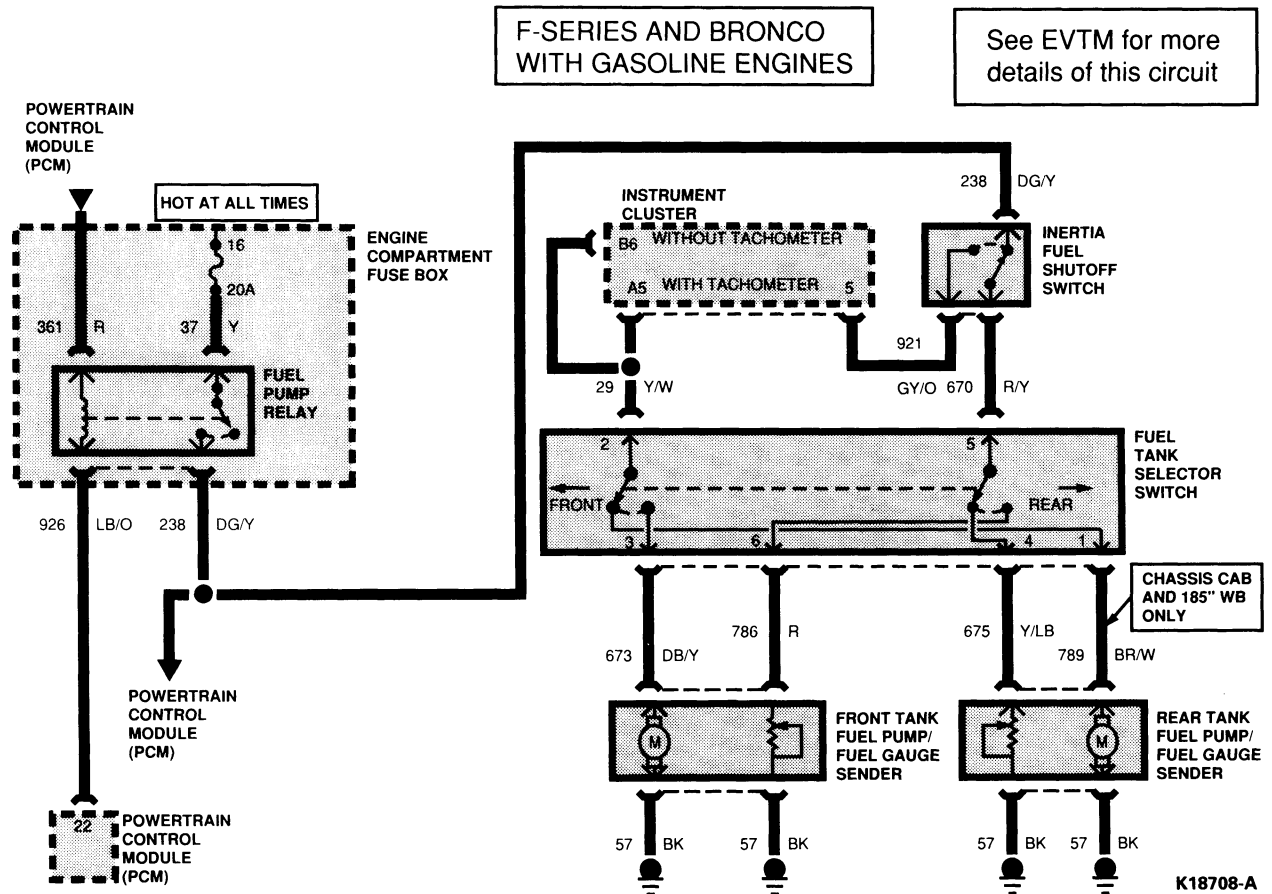
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Fuel Tank Selector Switch

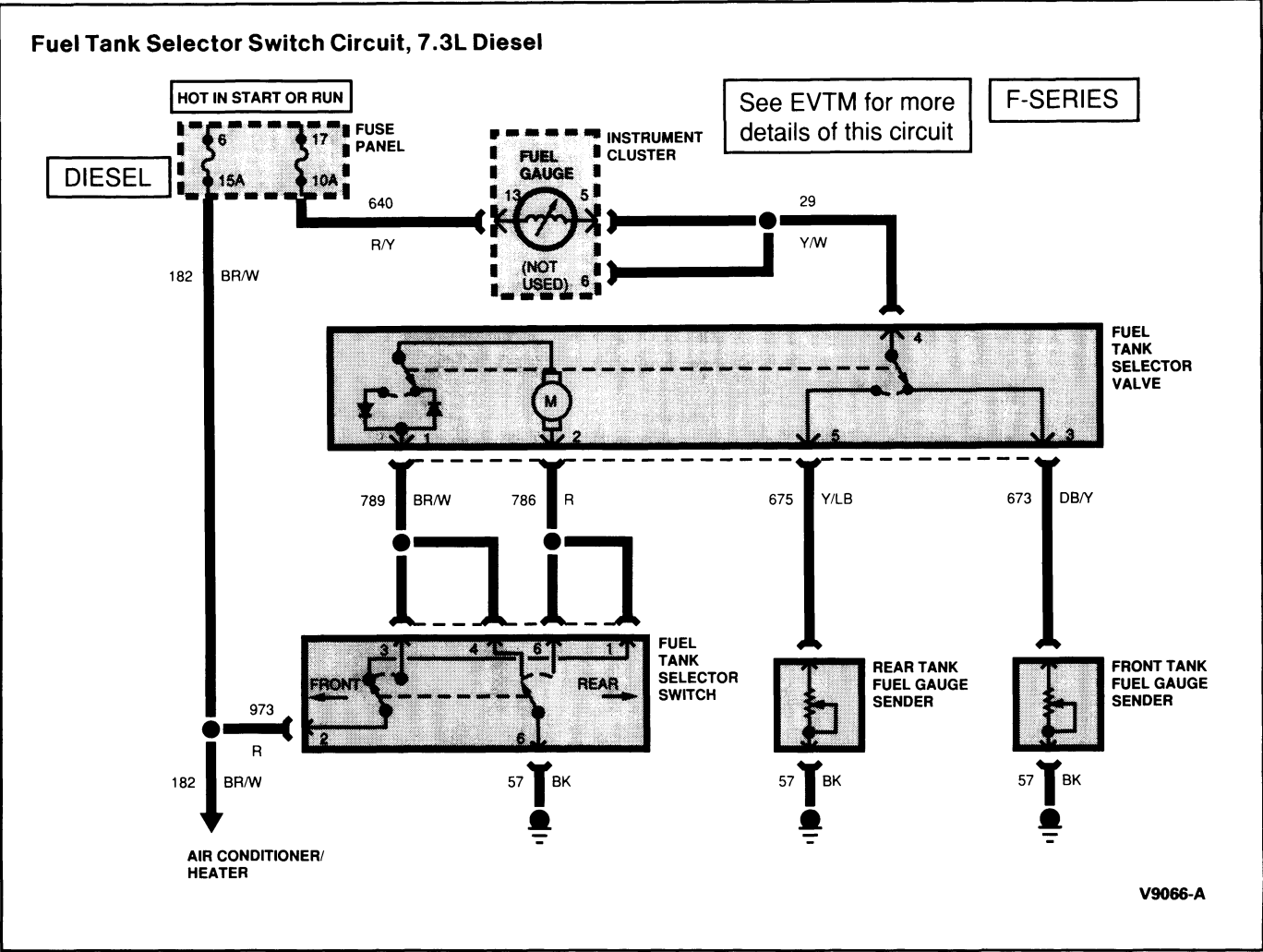
All fuel gauge sensing on vehicles with dual tanks (except with 7.3L diesel engine) passes through the fuel tank selector switch. The circuit diagrams are shown in the following illustrations.

DESCRIPTION AND OPERATION (Continued)

Fuel Tank Selector Switch Circuit, Except 7.3L Diesel



DESCRIPTION AND OPERATION (Continued)



DIAGNOSIS AND TESTING

Diagnosis Guides

NOTE: F-Series MFI vehicles are equipped with the Fuel Delivery Module (FDM) Fuel System. The fuel sender mounted on the FDM is a separately serviceable component.

CAUTION: The FDM will contain fuel. Take care to avoid spillage or fire.

CONDITION	POSSIBLE SOURCE	ACTION
Gauge shows full or partial tank when tank is empty.	<ul style="list-style-type: none">Wrong sender installed.Sender arm is bent or obstructed.Improper sender calibration.Improper gauge calibration.	<ul style="list-style-type: none">Check part number. Install correct sender.Check sender mounting angle. Bend sender arm gently to correct position.Test for correct resistance values and replace as needed.Perform calibration test as outlined in this section and replace as needed.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Gauge reading fluctuates (erratic). NOTE: Some needle movement toward empty during braking, accelerating or cornering is normal (F-Series and Bronco).	<ul style="list-style-type: none"> Loose connection or damaged wiring. Wear spot on sender variable resistor. Leaking sender float (brass float). 	<ul style="list-style-type: none"> Tighten all connections and terminations. Check and repair wiring for shorts or opens. Check sender for smooth electrical resistance change as arm is moved through full range. If resistance readings hesitate or jump, replace sender /float assembly. Replace float.
Fuel gauge shows empty at all levels of fill.	<ul style="list-style-type: none"> Loose or dirty wiring connections or short-to-ground in wiring. Leaking sender float (brass float). Missing sender float. Short circuit in sender. Sender arm movement obstructed. 	<ul style="list-style-type: none"> Check wiring connectors and sender terminals. Repair, clean, or tighten as needed. Replace sender / float. Install float. Make sure float is securely retained on sender arm. Test for correct resistance values and replace if needed. Inspect tank and sender for cause. Replace faulty component.
Fuel gauge shows full at all levels of fill.	<ul style="list-style-type: none"> Loose or dirty wiring connections or open circuit in wiring. Open circuit in sender. Sender arm movement obstructed. 	<ul style="list-style-type: none"> Check wiring, connectors and sender terminals. Repair or clean as required. Test for correct resistance values and replace if required. Inspect tank and sender for cause. Replace faulty component or bend sender arm gently away from obstruction.
Fuel gauge will not read full when tank is full.	<ul style="list-style-type: none"> Wrong sender installed. Sender arm movement obstructed (float rod bent). Leaking float (brass float). Sender or gauge calibration. Fuel tank not filling to rated capacity. 	<ul style="list-style-type: none"> Check part number. Install correct part. Inspect tank and sender for cause. Replace faulty component. Install new sender /float. Test for correct resistance value and replace if needed. Check fuel tank fill vent for kinks or obstructions. Correct as required and fill tank to verify proper capacity.

TK17811B

CHECK FUEL GAUGE OPERATION — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	VERIFY COMPLAINT		
	<ul style="list-style-type: none"> Key ON. Observe the fuel gauge performance. Does the gauge pointer move? 	Yes No	GO to D1 . GO to A2 .
A2	VERIFY CLUSTER PERFORMANCE		
	<ul style="list-style-type: none"> With the ignition ON, observe the other gauges and warning lights for proper operation. Do the other gauges and warning lights operate properly? 	Yes No	GO to C1 . GO to B1 .

TCK17730A

CHECK VOLTAGE TO FUSE PANEL — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	VERIFY POWER AT FUSE PANEL		
	<ul style="list-style-type: none"> Key ON. Use a voltmeter to verify system voltage at the load side of fuse. Is the voltage greater than 10 volts? 	Yes No	GO to C1 . GO to B2 .

DIAGNOSIS AND TESTING (Continued)

CHECK VOLTAGE TO FUSE PANEL — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B2	VERIFY POWER AT FUSE PANEL		
<ul style="list-style-type: none"> ● Key ON. ● Use a voltmeter to verify system voltage at the feed side of the fuse. ● Is the voltage greater than 10 volts? 		Yes	▶ REPLACE the fuse; RETURN to A1.
		No	▶ REPAIR the wiring to the fuse panel; RETURN to A1.

TCK17731A

CHECK POWER CIRCUIT TO CLUSTER — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	VERIFY POWER AT CLUSTER		
<ul style="list-style-type: none"> ● Have cluster connector(s) remain intact. ● Partially remove the cluster from the instrument panel. ● Key ON. ● Measure the voltage on the ignition wire at the instrument cluster connector to ground. ● Is the voltage greater than 10 volts? 		Yes	▶ GO to C2.
		No	▶ REPAIR the ignition wire. RETURN to A1.
C2	VERIFY GROUND CIRCUITRY AT CLUSTER		
<ul style="list-style-type: none"> ● Use an ohmmeter to check the continuity of the ground wire at the instrument cluster connector to ground. ● Is the resistance less than 1 ohm? 		Yes	▶ GO to D1.
		No	▶ REPAIR the wire to ground. RETURN to A1.

CHECK FUEL GAUGE WITH GAUGE SYSTEM TESTER — TEST D

TEST STEP		RESULT	ACTION TO TAKE
D1	CHECK FUEL GAUGE (EMPTY)		
<ul style="list-style-type: none"> ● Key OFF. ● Disconnect the fuel gauge sending unit. ● Connect one lead of the Rotunda Gauge System Tester (021-00055) or equivalent to the fuel sending unit input wire at the fuel gauge sending unit connector and the other lead to ground. ● Set the tester to 22 ohms. ● Key ON. ● Wait one minute. ● Read the fuel gauge. ● Does the fuel gauge read E (empty)? 		Yes	▶ GO to D5.
		No	▶ GO to D2.
D2	RE-CHECK FUEL GAUGE (EMPTY)		
<ul style="list-style-type: none"> ● Place the ignition in the OFF position. Then to the ON position. Tap on the instrument panel. ● Wait one minute. ● Read the Gauge. ● Does the fuel gauge read E (empty)? 		Yes	▶ GO to D5.
		No	▶ F-Series, Bronco, F-Super Duty: REPLACE Cluster. Econoline: GO to D3.
D3	CHECK PRINTED CIRCUIT BOARD (ECONOLINE ONLY)		
<ul style="list-style-type: none"> ● Key OFF. ● Disconnect the instrument cluster and anti-slosh module. ● Measure the resistance of the circuit between the "SIG" terminal of the fuel gauge and the anti-slosh module. ● Is the resistance less than 5 ohms? 		Yes	▶ GO to D4.
		No	▶ REPLACE Instrument Cluster printed circuit board.

DIAGNOSIS AND TESTING (Continued)

CHECK FUEL GAUGE WITH GAUGE SYSTEM TESTER — TEST D (Continued)

TEST STEP		RESULT	ACTION TO TAKE
D7	CHECK FUEL GAUGE (FULL)		
	<ul style="list-style-type: none"> ● Key OFF. ● Disconnect the fuel gauge sending unit. ● Connect one lead of the Rotunda Gauge System Tester (021-00055) or equivalent to the "Y" wire at the fuel gauge sending unit connector and the other lead to ground. ● Set the tester to 145 ohms. ● Key ON. ● Wait one minute. ● Read the fuel gauge. ● Does the fuel gauge read F (full)? 	Yes No	GO to E1 . Econoline: GO to D8 . F-Series, Bronco, F-Super Duty: REPLACE Instrument Cluster. REFER to the appropriate section in Group 13.
D8	CHECK ANTI-SLOSH MODULE (FULL) (ECONOLINE ONLY)		
	<ul style="list-style-type: none"> ● Turn the ignition to OFF position. Remove the instrument cluster. Inspect the flex circuit. Remove the slosh module. Connect the jumper wire from the Gauge Tester directly to the fuel gauge "SIG" terminal. ● Install the instrument cluster. ● Turn the ignition switch to the ON position. ● Read the fuel gauge. ● Does the fuel gauge read F (full)? 	Yes No	REPLACE the anti-slosh module. GO to D1 . REPLACE the fuel gauge. Return to D1 .

FUEL SENDER — TEST E

TEST STEP		RESULT	ACTION TO TAKE
E1	TANK INSPECTION		
	<ul style="list-style-type: none"> ● Inspect fuel tank for distortion or damage. ● Is the fuel tank damaged? 	Yes No	REPLACE fuel tank. GO to E2 .
E2	TEST BOX CHECK — EMPTY STOP		
	<ul style="list-style-type: none"> ● Connect one lead of a Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, to the fuel sender signal lead and the other lead to sender ground. ● When the float rod is against the empty stop (closest to fuel filter). ● Does the Digital Volt-Ohmmeter read 14-18 ohms? 	Yes No	GO to E3 . REPLACE fuel sender.
E3	TEST BOX CHECK — FULL STOP		
	<ul style="list-style-type: none"> ● Connect one lead of a Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, to the fuel sender signal lead and the other lead to sender ground. ● When the float rod is against the full stop. ● Does the Digital Volt-Ohmmeter read 154-162 ohms? 	Yes No	GO to E4 . REPLACE fuel sender.
E4	TEST BOX CHECK — FLOAT ROD TRAVEL		
	<ul style="list-style-type: none"> ● Connect one lead of a Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, to the fuel sender signal lead and the other lead to sender ground. ● Move float rod slowly from FULL to EMPTY stop position. 	Ohmmeter reading jumps to infinity or zero while decreasing Ohmmeter reading decreases slowly	REPLACE fuel sender. GO to E5 .
E5	HARNESS CONNECTOR CHECK — EMPTY STOP		
	<ul style="list-style-type: none"> ● Reattach all fuel indication connectors. ● Move float rod to empty stop position. ● Place ignition in the ON position. ● Wait 60 seconds. ● Read fuel gauge. ● Does gauge read empty? 	Yes No	GO to E6 . GO to B3 .

DIAGNOSIS AND TESTING (Continued)**FUEL SENDER — TEST E (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
E6	HARNESS CONNECTOR CHECK — FULL STOP		
	<ul style="list-style-type: none"> ● Reattach all fuel indication connectors. ● Move float rod to full stop position. ● Place ignition in the ON position. ● Wait 60 seconds. ● Read fuel gauge. ● Does gauge read full? 	Yes No	GO to E7 . GO to B3 .
E7	INSPECT FUEL SENDER		
	<ul style="list-style-type: none"> ● Inspect float and float rod. 	Float rod is distorted Float is: Badly distorted / damaged Hitting the filter Filled with fuel Loose on float rod.	REPLACE sender.

TK17809B

NO FUEL LEVEL INDICATION, VEHICLES WITH DUAL TANKS (6 PORT FUEL SELECTOR VALVE) — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	BYPASS TANK SELECTOR VALVE		
	<ul style="list-style-type: none"> ● Disconnect electrical connector from tank selector valve. ● Turn ignition to RUN position. ● Jumper connector terminals No. 4 and No. 5 for rear tank. ● Fuel gauge should indicate fuel level in rear tank. ● Move selector switch to FRONT TANK. ● Jumper connector terminals No. 3 and No. 4 for front tank. ● Fuel gauge should indicate fuel level in front tank. ● Does fuel gauge indicate fuel level in front and rear tanks? 	Yes No	REPLACE fuel tank selector valve. CHECK for faulty fuel gauge, fuel sender and / or wiring. REPAIR or REPLACE as necessary.

TCK17812A

Calibration Test (Without Tester), F-150-250-350

If only the fuel gauge is inoperative or appears to be out of calibration, a calibration test can be conducted on the vehicle fuel gauge system.

Fuel Gauge, Resistance

With the sending unit float arm in the empty stop position, resistance should be 15 ohms (below E). With the sending unit float arm in the full stop position, resistance should be 160 ohms (above F). The fuel gauge should read empty at 22.5 ohms and full at 145 ohms.

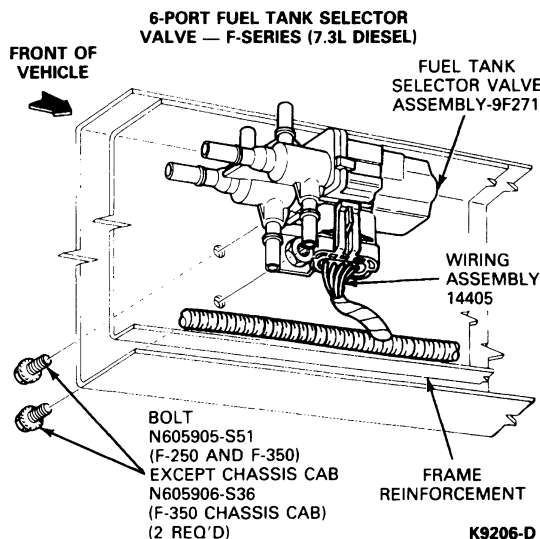
Fuel Indicator Second Sender Test, F-Series Dual Tanks

On F-Series aft / axle (standard) fuel tank, the fuel sender electrical connector can be disconnected and attached to a second test sender outside the tank. The float can then be manually operated (up and down) while the fuel gauge operation is observed. Proper gauge function indicates a problem with the fuel sender located in the tank. Improper operation indicates a problem with the gauge or wiring. Refer to diagnosis guide for fuel tank sending unit in this section.

DIAGNOSIS AND TESTING (Continued)

Fuel Tank Damage

If fuel indicating system components are functioning properly and inaccurate indications continue, check the fuel tank for damage which may have changed the fuel sender mounting angle and /or damaged the fuel sender. Make sure the fuel delivery module (FDM) is the correct model for the vehicle and that the FDM is not contacting the bottom of the tank. Also inspect the vent hoses for kinks or obstructions.



- Speedometer / odometer assembly
- Flex (printed) circuit assembly
- Flex circuit / gauge clips
- Instrument cluster backplate

In addition to the above components, the following components are serviceable on Econoline Stripped Chassis and Motorhome vehicles only:

- Fuel label or label (blank) — base P / N 9A095
- Bezel — base P / N 10876
- Right- and left-hand jewels — base P / N 807025
- Screws — base P / N 807025

NOTE: The instrument cluster requires special handling to avoid damaging internal components. The cluster must be kept face up or in the in-vehicle position. Leaving the cluster face down may result in a loss of dampening fluid used in the gauges. The lost fluid could stain the cluster face or result in excessive pointer waiver.

Fuel/Volt Gauge

Removal and Installation

1. Disconnect battery negative cable and remove instrument cluster from instrument panel. Refer to Section 13-01A.
2. Remove nine screws attaching the lens and mask to backplate, then remove lens and mask.
3. Remove gauge from backplate by grasping outside edges of dial and lifting.

NOTE: Gauges are attached to backplate by retaining clips.

For installation, follow removal steps in reverse order. When installing gauge, make certain gauge pins are properly seated into backplate retaining clips. Check system operation.

REMOVAL AND INSTALLATION

Instrument Cluster Replacement

Instrument cluster components that are serviceable at the dealership level are:

- Bulb and socket assemblies — base P / N 13B765
- Oil / temperature gauge assembly — base P / N 10E872
- Fuel / volt gauge assembly — base P / N 10E871
- Tachometer (if applicable) — base P / N 17360
- Fuel anti-slosh module (if applicable) — base P / N 10E849
- Cluster lens — base P / N 10B885
- Cluster mask — base P / N 10894
- Lens attaching screws — base P / N 804988

Instructions for ordering and handling a replacement instrument cluster are provided in Section 13-01A.

NOTE: The instrument cluster must be serviced as a complete assembly if it is determined that any of the following components are faulty:

Fuel Anti-Slosh Module

Removal and Installation

1. Disconnect battery negative cable and remove instrument cluster from instrument panel. Refer to Section 13-01A.
2. Remove fuel anti-slosh module by depressing latch and pulling straight out.

For installation, follow removal procedures in reverse order. When installing the module, be sure the latch seats properly by pressing top of module board with thumb. Check system operation.

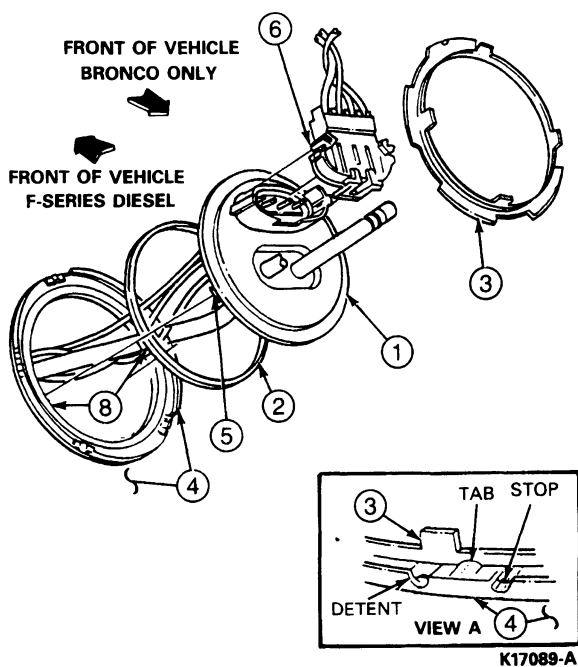
Fuel Sender

Removal

1. Remove the fuel tank. Refer to Section 10-01A.

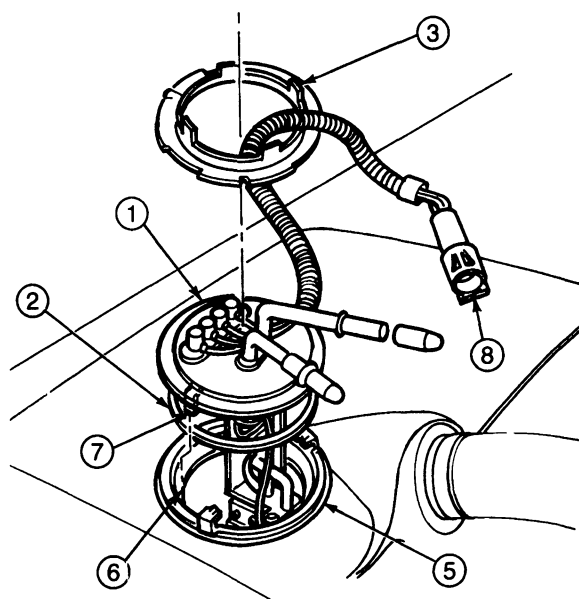
REMOVAL AND INSTALLATION (Continued)

2. Disconnect the wiring connector from the fuel system sender. For Econoline, disconnect the fuel sender pigtail from the body wiring harness.
3. Remove any dirt that has accumulated around the sender so it will not enter the tank or lines.
4. Loosen the quick connect fittings and disconnect the fuel tank line at the sender.
5. Turn the fuel sender metal locking ring counterclockwise with Fuel Tank Sender Wrench T74P-9275-A. For plastic locking rings, use a band-type oil filter wrench or equivalent to remove. Remove the locking ring, sender and sealing gasket.

Sending Units Secured with Metal Locking Ring, F-150-250-350 and Bronco

Item	Part Number	Description
1	9H307 (Gasoline Engines) 9275 (Diesel Engine)	Fuel Pump and Sending Unit
2	9417	Gasket
3	90383	Locking Ring
4	—	Retaining Ring (Part of 9002 Fuel Tank Assembly)
5	—	Locating Tabs (Part of 9H307 or 9275 Fuel Pump and Sending Unit)
6	14405 or 14406 (aft of Axle Fuel Tank)	Wiring Assembly

TK17089A

Sending Units Secured with Metal Locking Ring, E-150-250-350

K17091-A

Item	Part Number	Description
1	9H307	Fuel Delivery Module and Sender Assembly
2	9417	Gasket
3	90383	Locking Ring
5	—	Locating Tabs (Part of 9H307 or 9275 Fuel Pump and Sending Unit)
6	14405	Wiring Assembly
7	—	Locking Slots (Part of 9002 Fuel Tank)
8	14405 or 14406 (Aft of Axle Fuel Tank)	Wiring Assembly

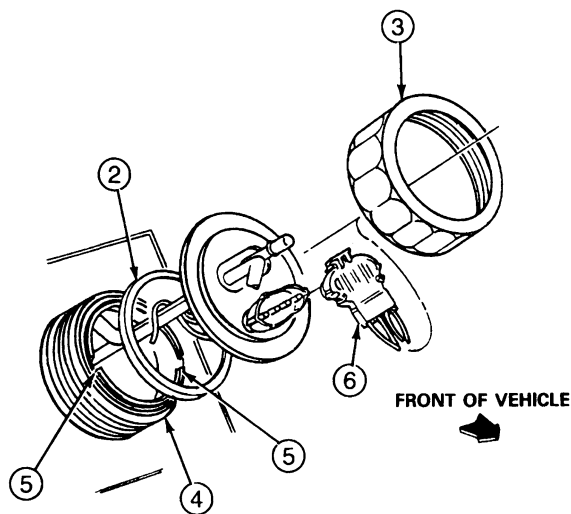
Installation

1. Clean the fuel sender mounting surface on the fuel tank.
2. Place a new sealing gasket in the groove of the fuel tank. Install the fuel sender into the fuel tank so that the tabs of the sender are positioned into slots of the fuel tank. The sealing gasket must remain in place during and after fuel sender installation.
3. Holding the fuel sender and sealing gasket in place, install and rotate the metal locking ring clockwise until the stop is against the retainer ring tab. Tighten plastic locking ring until hand-tight, then tighten to 54-75 N·m (40-55 ft·lb).
4. Connect the fuel sender wire and the fuel tank line.

REMOVAL AND INSTALLATION (Continued)

- 5. Install the fuel tank as outlined in Section 10-01A.
- 6. Refill the tank with the fuel removed during the removal procedure. (Make sure that the fuel added is free of any contamination.) Check for proper fuel gauge operation and for leaks while refilling.

Sending Units Secured With Plastic Locking Rings, F-350 Chassis Cab



K17093-A

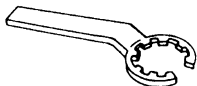
Item	Part Number	Description
1	9H307 (Gasoline Engines) 9275 (Diesel Engine)	Fuel Pump and Sending Unit
2	9417	Gasket

(Continued)

Item	Part Number	Description
3	9A307	Locking Ring
4	9002	Fuel Tank
5	—	Locating Tabs (Part of 9H307 or 9275 Fuel Pump and Sending Unit)
6	14405 or 14406	Wiring Assembly

TK17094A

SPECIAL SERVICE TOOLS / EQUIPMENT

Tool Number / Description	Illustration
T74P-9275-A Fuel Tank Sender Wrench	 T74P-9275-A

ROTUNDA EQUIPMENT

Tool Number	Description
021-00055	Instrument Gauge System Tester
007-00001	Digital Volt-Ohmmeter

SECTION 13-03B Gauge, Fuel, F-Super Duty Commercial Chassis

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Fuel Indicating Gauge.....	13-03B-2	Gauge Bench Test for Open Windings	13-03B-3
Fuel Level Indicating System	13-03B-1	REMOVAL AND INSTALLATION	
DIAGNOSIS AND TESTING		Fuel Gauge.....	13-03B-5
Calibration Test (Without Tester)	13-03B-3	Sending Units Secured With Metal Locking	
Diagnosis Guide	13-03B-3	Ring	13-03B-4
Fuel Gauge, Resistance	13-03B-3	SPECIAL SERVICE TOOLS/EQUIPMENT	13-03B-6
Fuel Tank Damage.....	13-03B-3	VEHICLE APPLICATION	13-03B-1

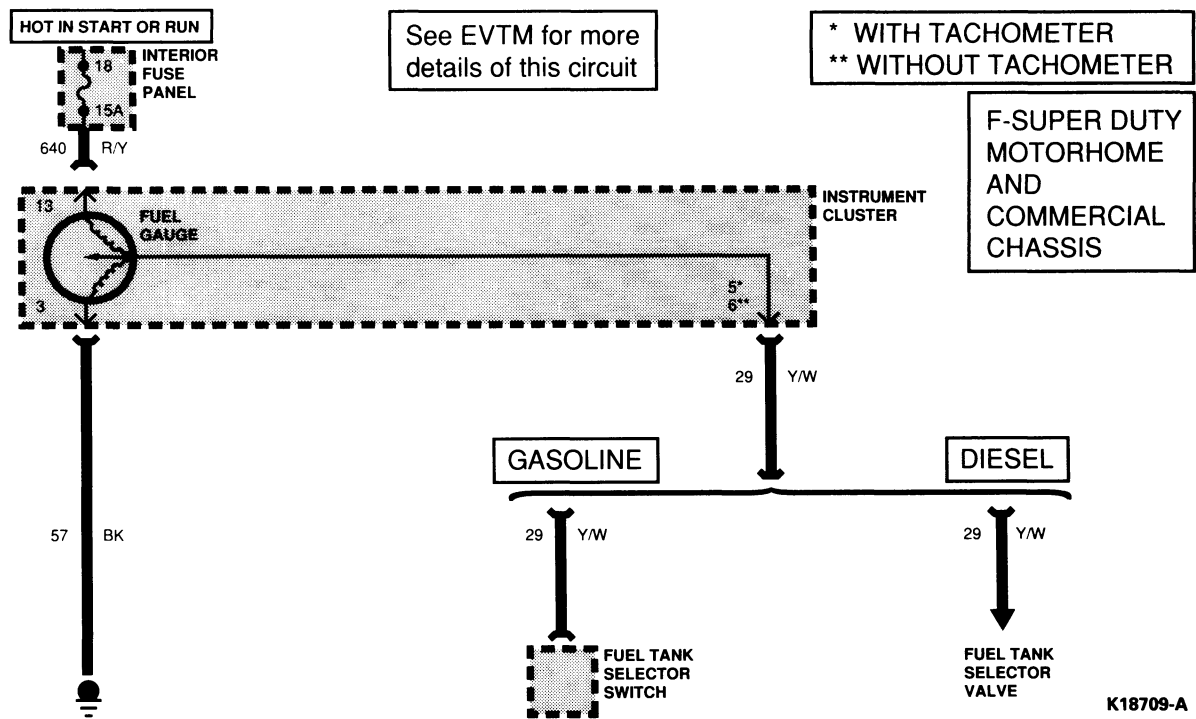
VEHICLE APPLICATION

F-Super Duty Commercial Chassis

DESCRIPTION AND OPERATION

Fuel Level Indicating System

The fuel level indicating system is a magnetic gauge system. It consists of a magnetic fuel gauge mounted in the instrument cluster and a sender unit located in the fuel tank. No instrument voltage regulator is used with this system.

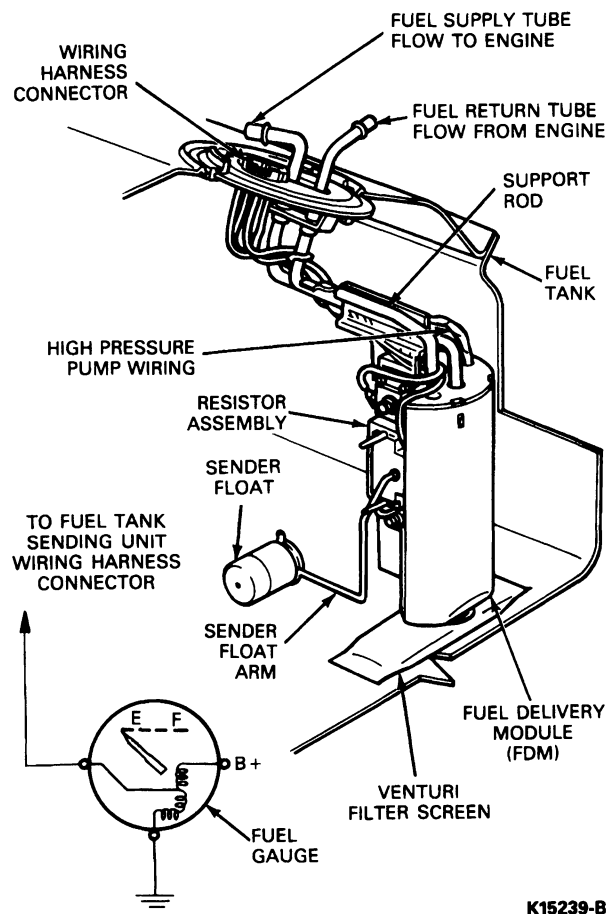


DESCRIPTION AND OPERATION (Continued)**Fuel Indicating Gauge**

The magnetic gauge movement consists of three primary coils, one of which is wound at a 90-degree angle to the other two. The coils form a magnetic field which varies in direction according to the variable resistance of the sender unit which is connected between two of them. A primary magnet, to which a shaft and pointer are attached, rotates to align to this primary field, resulting in pointer position. The bobbin/coil assembly is pressed into a metal housing which has two holes for dial mounting. There is no adjustment, calibration or maintenance required for these gauges.

Fuel Sender

The fuel sender consists of a variable screened resistor made up of a ceramic substrate. It is controlled by the action of an attached float in the fuel tank. When the fuel level is low, resistance in the sender is low. When the fuel level is high, resistance in the sender is high. As the float moves from empty to full, the resistance will gradually and continuously increase.

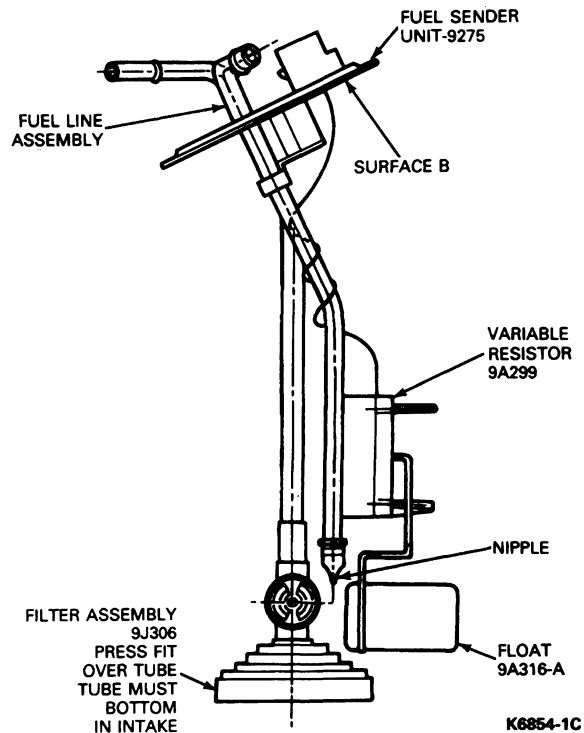
Fuel Indicating System

The electric fuel delivery system used on the 7.5L Multiport Fuel Injection (MFI) engines consists of a fuel delivery module (FDM) assembly. The FDM unit includes a high pressure fuel pump, venturi jet pump, supply check valve, and a shuttle selector valve all located internally to an in-tank reservoir assembly mounted from the fuel tank sender flange. The fuel sending unit attached to the reservoir body is a separately serviceable component.

In addition, the FDM system achieves a significant reduction in fuel system complexity and simplifies fuel line routing. The in-line fuel filter is located on the left-hand frame rail to provide service access.

The fuel sender for the 7.3L diesel operates the same as that of the 7.5L, except for the following differences. The sender electrical connector has two pins instead of four as there is no electric fuel pump. The venturi filter screen is replaced by an inverted flexible cone-like member. The flexible cone ensures fuel is always being taken from the bottom of the tank. The cone has as part of its assembly a relief-bypass valve. If the intake becomes obstructed at low temperatures the relief valve opens, allowing fuel to bypass the filter.

The fuel senders used with all engines equipped with MFI, as well as the 7.3L diesel engine, have a fuel return port which allows excess fuel delivered to the engine to be returned to the fuel tank.

Fuel Sender, 7.3L Diesel Engine

DIAGNOSIS AND TESTING

Calibration Test (Without Tester)

If only the fuel gauge is inoperative or appears to be out of calibration, a calibration test can be conducted on the vehicle fuel gauge system.

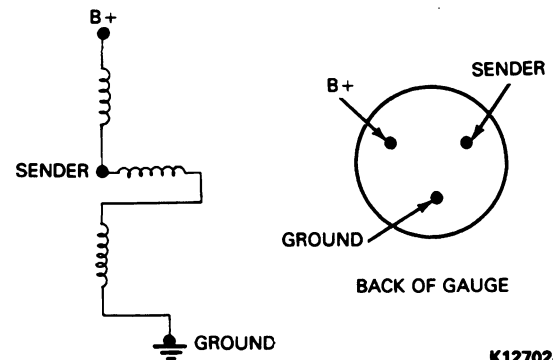
Fuel Gauge, Resistance

With the sending unit float arm in the empty stop position, resistance should be 15 ohms (below E). With the sending unit float arm in the full stop position, resistance should be 160 ohms (above F). The fuel gauge should read empty at 22.5 ohms and full at 145 ohms.

Gauge Bench Test for Open Windings

To test the gauge for open windings, remove the gauge from the vehicle. Connect the gauge to an ohmmeter such as Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, and read the resistance. Battery positive to sender resistance should be 80 to 90 ohms and sender to ground should be 190 to 200 ohms. If the ohmmeter reads open or low resistance, replace the gauge.

Fuel Gauge Bench Test Connection Points



K12702-1A

Fuel Tank Damage

If fuel indicating system components are functioning properly and inaccurate indications continue, check the fuel tank for damage which may have changed the fuel sender mounting angle and/or damaged the fuel sender. Also inspect the vent hoses for kinks or obstructions.

Diagnosis Guide

Fuel Tank Sending Unit, All Models

Refer to the Diagnosis Guides when diagnosing fuel tank sending unit related problems.

CONDITION	POSSIBLE SOURCE	ACTION
Gauge shows full or partial tank when tank is empty.	<ul style="list-style-type: none"> Wrong sender installed. Sender arm is bent or obstructed. Improper sender calibration. Improper gauge calibration. 	<ul style="list-style-type: none"> Check part number. Install correct sender. Check sender mounting angle. Bend sender arm gently to correct position. Test for correct resistance values and replace as needed. Perform calibration test as outlined in this section and replace as needed.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Gauge reads full at all fuel levels.	<ul style="list-style-type: none"> ● Open circuit (F-Series). ● Sender arm movement obstructed. 	<ul style="list-style-type: none"> ● Check and repair wiring and / or connectors as necessary. ● Check for correct part number and correct angle. Bend sender arm gently away from obstruction or remove obstruction if possible.
Gauge reading fluctuates (erratic). NOTE: Some needle movement toward empty during braking, accelerating or cornering is normal.	<ul style="list-style-type: none"> ● Loose connection or damaged wiring. ● Wear spot on sender variable resistor. ● Leaking sender float. 	<ul style="list-style-type: none"> ● Tighten all connections and terminations. Check and repair wiring for shorts or opens. ● Check sender for smooth electrical resistance change as arm is moved through full range. If resistance readings hesitate or jump, replace sender / float assembly. ● Replace float.
Fuel gauge shows empty at all levels of fill.	<ul style="list-style-type: none"> ● Loose or dirty wiring connections or short to ground in wiring. ● Leaking sender float. ● Missing sender float. ● Short circuit (F-Series). ● Sender arm movement obstructed. 	<ul style="list-style-type: none"> ● Check wiring connectors and sender terminals. Repair, clean or tighten as needed. ● Replace float. ● Install float. Make sure float is securely retained on sender arm. ● Test for correct resistance values and replace if needed. ● Reinstall sender properly. Bend arm to correct position if needed.
Fuel gauge will not read full when tank is full.	<ul style="list-style-type: none"> ● Wrong sender installed. ● Sender arm movement obstructed. ● Leaking float. ● Sender or gauge calibration. ● Fuel tank not refilling to rated capacity. 	<ul style="list-style-type: none"> ● Check part number. Install correct part. ● Reinstall sender to correct operation. Bend send arm slightly away from obstruction or remove obstruction. ● Install new float. ● Test for correct resistance valve and replace if needed. ● Test for correct refill capacity. Also check vent lines for kinks or obstructions. Replace / repair as required.

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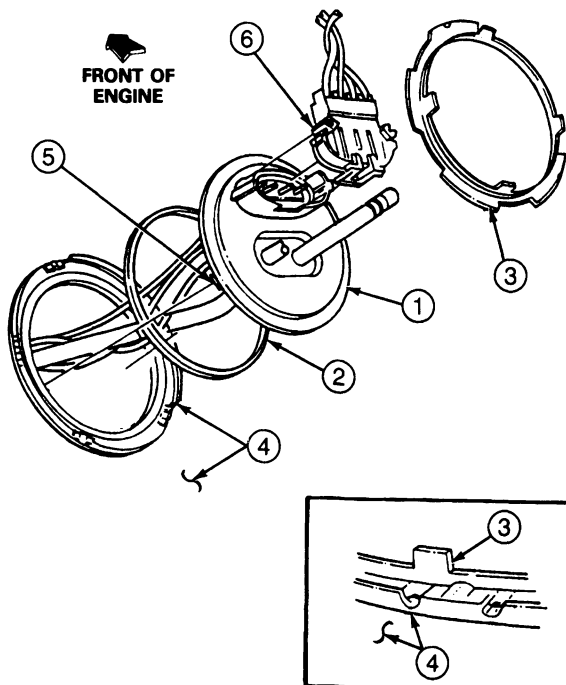
REMOVAL AND INSTALLATION**Sending Units Secured With Metal Locking Ring****Removal**

1. Remove the fuel tank. Refer to Section 10-01A.
2. Disconnect the wiring connector from the fuel system sender.
3. Remove any dirt that has accumulated around the sender so that it will not enter the tank or lines.

4. Loosen the quick connect fittings and disconnect the fuel tank line at the sender.
5. Turn the fuel sender locking ring counterclockwise with Fuel Tank Sender Wrench T74P-9275-A. Remove the locking ring, sender and sealing gasket.

REMOVAL AND INSTALLATION (Continued)

Sending Unit Secured with Metal Locking Ring



K17853-A

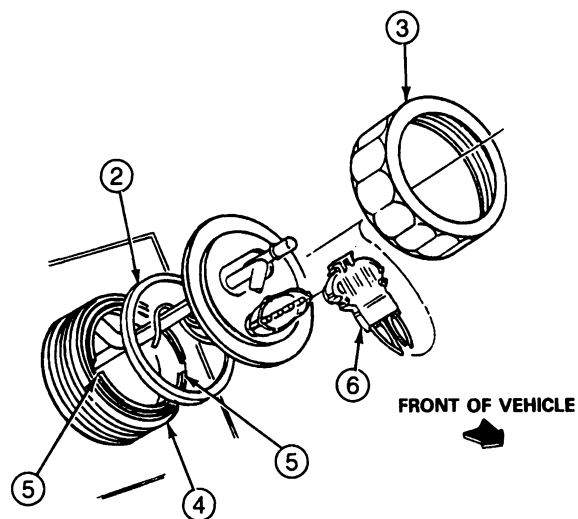
Item	Part Number	Description
1	9H307	Fuel Pump and Sending Unit (Gasoline Engines)
1	9275	Fuel Sending Unit (Diesel Engines)
2	9417	Gasket
3	90383	Locking Ring
4	—	Retaining Ring (Part of 9002 Fuel Tank Assembly)
5	—	Locating Tabs (Part of 9H307 or 9275 Fuel Pump and Sending Unit)
6	14405 or 14406	Wiring Assembly

TK17853A

Installation

1. Clean the fuel sender mounting surface on the fuel tank.
2. Place a new sealing gasket in the groove of the fuel tank. Install the fuel sender into the fuel tank so that the tabs of the sender are positioned into slots of the fuel tank. The sealing gasket must remain in place during and after fuel sender installation.
3. Holding the fuel sender and sealing gasket in place, install and rotate the locking ring clockwise until the stop is against the retainer ring tab.
4. Connect the fuel sender wire and the fuel tank line.

5. Install the fuel tank. Refer to Section 10-01A.
6. Refill the tank with the fuel removed during the removal procedure. Check for proper fuel gauge operation and for leaks while refilling.



K17093-A

Item	Part Number	Description
1	9H307	Fuel Pump and Sending Unit (Gasoline Engines)
1	9275	Fuel Pump and Sending Unit (Diesel Engine)
2	9417	Gasket
3	9A307	Locking Ring
4	9002	Fuel Tank
5	—	Locating Tabs (Part of 9H307 or 9275 Fuel Pump Sending Unit)
6	14405 or 14406	Wiring Assembly

TK17093A

Fuel Gauge

Removal


1. Disconnect battery ground cable.
2. Remove instrument cluster. Refer to Section 13-01B.
3. Remove the six screws attaching the bezel, lens and mask to the backplate and remove the bezel, lens and mask.
4. Remove two screws attaching the fuel gauge to the backplate and remove the gauge from the backplate.

REMOVAL AND INSTALLATION (Continued)

5. For installation, follow removal procedures in reverse order. When installing voltmeter, make certain the gauge pins correctly seat into the backplate retaining clips.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

SPECIAL SERVICE TOOLS / EQUIPMENT

Tool Number/ Description	Illustration
T74P-9275-A Fuel Tank Sender Wrench	 T74P-9275-A

ROTUNDA EQUIPMENT

Tool Number	Description
021-00055	Instrument Gauge System Tester
007-00001	Digital Volt-Ohmmeter

SECTION 13-04A Charging System Gauge / Warning Light

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Charge Indicator Lamp System	13-04A-1	Voltmeter	13-04A-2
Voltmeter	13-04A-1	REMOVAL AND INSTALLATION	
DIAGNOSIS AND TESTING		Charge Indicator Lamp	13-04A-3
Charge Indicator Lamp System	13-04A-2	Fuel / Volt Gauge	13-04A-3
Instrument Cluster Service	13-04A-3	VEHICLE APPLICATION	13-04A-1

VEHICLE APPLICATION

F-150-250-350, E-150-250-350, Bronco, F-Super Duty Chassis Cab, F-Super Duty Motorhome Chassis, E-350 Motorhome and Commercial Chassis Vehicles (All Vehicles Except F-Super Duty Chassis)

DESCRIPTION AND OPERATION

Charge Indicator Lamp System

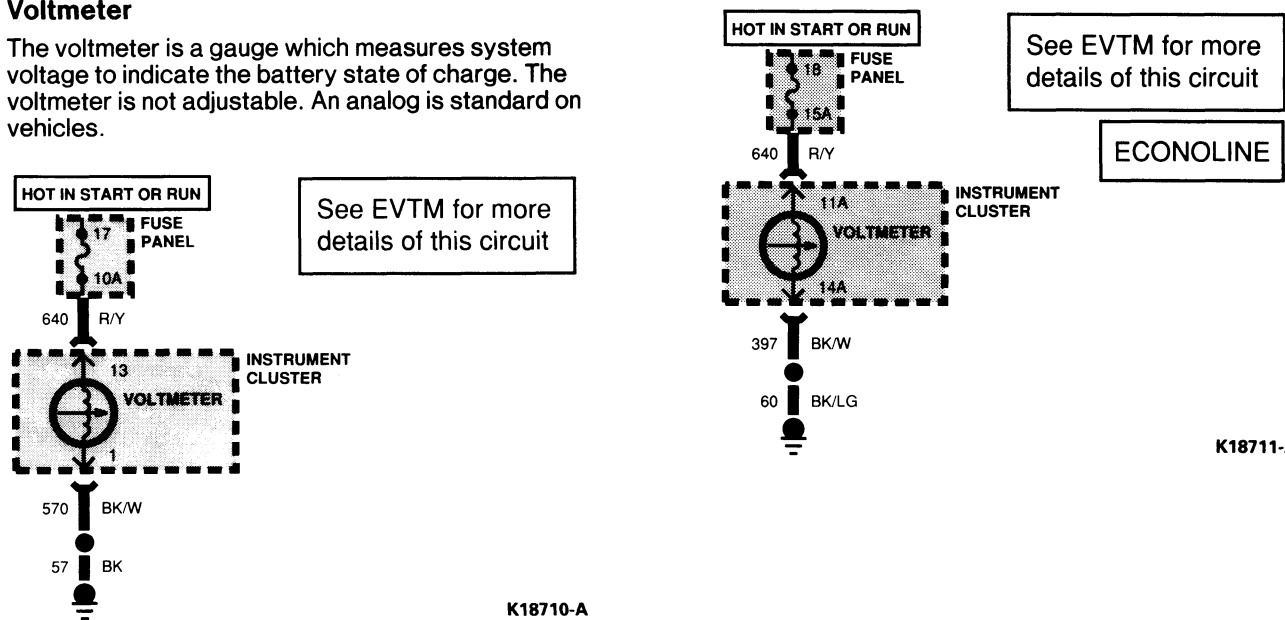
A red alternator charge indicator is located in the instrument cluster. This indicator glows when there is no alternator output.

If the system is working normally, the following conditions will be present:

- With ignition switch OFF, battery charge indicator symbol is off.
- With ignition switch in RUN (engine not running), charge indicator (alternator) is on.
- With ignition switch in RUN (engine running), charge indicator is off.

Voltmeter

The voltmeter is a gauge which measures system voltage to indicate the battery state of charge. The voltmeter is not adjustable. An analog is standard on vehicles.



DIAGNOSIS AND TESTING

Charge Indicator Lamp System

Normal Charge Indicator

With ignition switch in the OFF position, charge indicator (battery symbol) lamp is off.

With ignition switch in RUN (engine not running), charge indicator (battery symbol) lamp is on.

With ignition switch in RUN (engine running), charge indicator (battery symbol) lamp is off.

1. If the charge indicator lamp does not light with the ignition key in the RUN position (engine not running), check the "I" wiring circuit (ignition switch to regulator "I" terminal), for an open circuit or burned out charge indicator lamp.
2. If the charge indicator lamp does not light, disconnect the wiring plug connector at the regulator and connect a jumper wire from the "I" terminal of the regulator wiring plug to the negative battery post cable clamp.
3. The charge indicator lamp should light with the ignition key turned to the RUN position (engine not running).
4. If the charge indicator bulb does not light, check the bulb for continuity and replace if necessary.
5. If the bulb is not burned out, an open circuit exists between the ignition switch and the regulator.
6. Check the 500-ohm resistor across the charge indicator lamp.

For additional diagnosis and testing procedures refer to Section 14-00.

Voltmeter

To test the voltmeter, turn the ignition key on, turn the headlamps on, and set the heater blower / fan on high with the engine stopped. The gauge pointer should move toward the lower portion of the NORMAL BAND (the white marked area). If no movement of needle is observed, check the fuse and the battery-to-circuit breaker and circuit breaker-to-cluster wire connections. If connections are tight and wire continuity is good, remove the cluster from the vehicle. Check for flex circuit continuity and confirm flex circuit-to-clip and clip-to-gauge contact. If all connections are good, replace the instrument cluster. Refer to Instrument Cluster Replacement in Section 13-01 for instrument cluster ordering information.

VOLTMETER SYSTEM — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	OPERATION CHECK	Inoperative	GO to A2.
		Erratic or wrong	GO to A4
A2	FUSE CONTINUITY CHECK	No continuity	REPLACE fuse. GO to A1
		Continuity	GO to A3
A3	FUSE VOLTAGE CHECK	Less than battery voltage	REPAIR / REPLACE harness / ignition switch. GO to A1.
		Battery voltage	GO to A4
A4	VOLTMETER FEED / GROUND CHECK	Less than battery voltage / bad ground	REPAIR / REPLACE instrument panel harness or ground circuits as required. GO to A1
		Battery voltage / good ground	REPLACE instrument cluster. REFER to Section 13-01A. GO to A1

TK17783B

DIAGNOSIS AND TESTING (Continued)**Instrument Cluster Service**

Instrument cluster components that are serviceable at the dealership level are:

- Bulb and socket assemblies — base P/N 13B765
- Oil/temperature gauge assembly — base P/N 10E872
- Fuel/volt gauge assembly — P/N 10E871
- Tachometer (if applicable) — base P/N 17360
- Fuel anti-slosh low fuel module (if applicable) — base P/N 10E849
- Cluster lens — base P/N 10B885
- Cluster mask — base P/N 10894
- Lens attaching screws — base P/N 804988

NOTE: The instrument cluster must be serviced as a complete assembly if it is determined that any of the following components are faulty:

- Speedometer / odometer assembly
- Flex (printed) circuit assembly
- Flex circuit gauge clips
- Instrument cluster backplate

Instructions for ordering and handling a replacement instrument cluster are provided in Section 13-01A.

In addition to the above components, the following components are serviceable on Econoline Chassis and Motorhome vehicles only:

- Fuel label or label (blank) — base P/N 9A095
- Bezel — base P/N 10876
- Right- and left-hand jewels — base P/N 807025
- Screws — base P/N 807025

NOTE: The instrument cluster requires special handling to avoid damaging internal components. The cluster must be kept face up or in the in-vehicle position. Leaving the cluster face down may result in a loss of dampening fluid used in the gauges. The lost fluid could stain the cluster face or result in excessive pointer waiver.

The instrument cluster lenses should be cleaned with Ford Glass Cleaner E4AZ-19C507-A (ESR-M14P5-A) or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been especially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions shown on the container for best results.

Fuel/Volt Gauge**Removal and Installation**

1. Disconnect battery negative cable and remove instrument cluster from instrument panel. Refer to Section 13-01A.
2. Remove nine screws attaching the lens and mask to backplate, then remove lens and mask.
3. Remove gauge from backplate by grasping outside edges of dial and lifting.

NOTE: Gauges are attached to backplate by retaining clips.

For installation, follow removal steps in reverse order. When installing gauge, make certain gauge pins are properly seated into backplate retaining clips. Check system operation.

Charge Indicator Lamp

1. Remove instrument cluster assembly to access indicator bulb socket. Refer to Section 13-01.
2. Turn the bulb and socket assembly one-quarter turn counterclockwise and remove.
3. To install, reverse this procedure.

REMOVAL AND INSTALLATION

CAUTION: The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/or cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.

SECTION 13-04B Charging System Gauge / Warning Light, F-Super Duty Commercial Chassis

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Charge Indicator Lamp System	13-04B-1	Voltmeter	13-04B-2
Voltmeter	13-04B-1	REMOVAL AND INSTALLATION	
DIAGNOSIS AND TESTING		Charge Indicator Lamp	13-04B-3
Charge Indicator Lamp System	13-04B-1	VEHICLE APPLICATION	13-04B-1

VEHICLE APPLICATION

F-Super Duty Commercial Chassis Vehicles

DESCRIPTION AND OPERATION

Charge Indicator Lamp System

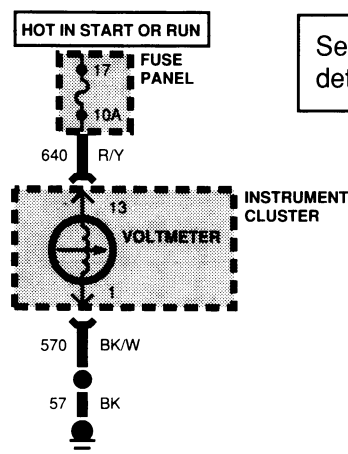
A red alternator charge indicator is located in the instrument cluster. This indicator glows when there is no alternator output.

If the system is working normally, the following conditions will be present:

- With ignition switch OFF, battery charge indicator symbol is off.
- With ignition switch in RUN (engine not running), charge indicator (alternator) is on.
- With ignition switch in RUN (engine running), charge indicator is off.

Voltmeter

The voltmeter is a gauge which measures system voltage to indicate the battery state of charge. The voltmeter is not adjustable. An analog is standard on vehicles.



DIAGNOSIS AND TESTING

Charge Indicator Lamp System

Normal Charge Indicator

With ignition switch in the OFF position, charge indicator (battery symbol) lamp is off.

With ignition switch in RUN (engine not running), charge indicator (battery symbol) lamp is on.

With ignition switch in RUN (engine running), charge indicator (battery symbol) lamp is off.

1. If the charge indicator lamp does not light with the ignition key in the RUN position (engine not running), check the "I" wiring circuit (ignition switch to regulator "I" terminal), for an open circuit or burned out charge indicator lamp.

DIAGNOSIS AND TESTING (Continued)

2. If the charge indicator lamp does not light, disconnect the wiring plug connector at the regulator and connect a jumper wire from the "I" terminal of the regulator wiring plug to the negative battery post cable clamp.
3. The charge indicator lamp should light with the ignition key turned to the RUN position (engine not running).

4. If the charge indicator bulb does not light, check the bulb for continuity and replace if necessary.
5. If the bulb is not burned out, an open circuit exists between the ignition switch and the regulator.
6. Check the 500-ohm resistor across the charge indicator lamp.

For additional diagnosis and testing procedures refer to Section 14-00.

Voltmeter

To test the voltmeter, turn the ignition key on, turn the headlamps on, and set the heater blower / fan on high with the engine stopped. The gauge pointer should move toward the lower portion of the NORMAL BAND (the white marked area). If no movement of needle is observed, check the fuse and the battery-to-circuit breaker and circuit breaker-to-cluster wire connections. If connections are tight and wire continuity is good, remove the cluster from the vehicle. Check for flex circuit continuity and confirm flex circuit-to-clip and clip-to-gauge contact. If all connections are good, replace gauge.

VOLTMETER SYSTEM — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	INOPERATIVE / ERRATIC / WRONG INDICATION		
A2	OPERATION CHECK		
	<ul style="list-style-type: none"> Check gauge operation (verify within 1 volt of battery voltage.) 	Inoperative Erratic or wrong	GO to A3. GO to A5.
A3	FUSE VOLTAGE CHECK		
	<ul style="list-style-type: none"> Check for battery voltage at warning indicator fuse. 	Less than battery voltage Battery voltage	REPAIR / REPLACE harness / ignition switch. GO to A2. GO to A4.
A4	FUSE CONTINUITY CHECK		
	<ul style="list-style-type: none"> Check fuse for continuity. 	No continuity Continuity	REPLACE fuse. GO to A2. GO to A5.
A5	VOLTMETER FEED / GROUND CHECK		
	<ul style="list-style-type: none"> Remove voltmeter from cluster as outlined in Section 13-01. Check battery voltage / ground at voltmeter terminal clips (harness connected, key on). 	Less than battery voltage / bad ground Battery voltage / good ground	REPAIR / REPLACE instrument panel harness or ground circuits as required. GO to A2. GO to A6.
A6	CONNECTION CHECK		
	<ul style="list-style-type: none"> Confirm contact between voltmeter terminals and cluster clips in 12 volt / ground circuits. 	Loose Tight	REPLACE clips. GO to A2. REPLACE instrument cluster. Refer to Section 13-01. GO to A2.

TCK16301B

REMOVAL AND INSTALLATION

CAUTION: The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/or cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ford Glass Cleaner E4AZ-19C507-A (ESR-M14P5-A) or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been especially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions shown on the container for best results.

Charge Indicator Lamp

To remove the indicator bulb socket remove the instrument cluster assembly to gain access to indicator bulb socket. Refer to Section 13-01. Turn the bulb and socket assembly one-quarter turn counterclockwise and remove. To install, reverse this procedure.

SECTION 13-05A Gauges, Engine Operation

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING AND INSPECTION	13-05A-13	REMOVAL AND INSTALLATION	
DESCRIPTION AND OPERATION		Oil Pressure Switch	13-05A-11
Magnetic Gauges	13-05A-1	Oil / Temp Gauge	13-05A-13
DIAGNOSIS AND TESTING		Tachometer	13-05A-13
Coolant Temperature Gauge	13-05A-5	Temperature Sending Unit	13-05A-10
Diagnosis Guides	13-05A-6	SPECIAL SERVICE TOOLS/EQUIPMENT	13-05A-13
Magnetic Gauges	13-05A-4	SPECIFICATIONS	13-05A-13
		VEHICLE APPLICATION	13-05A-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, Bronco, F-Super Duty Chassis Cab, F-Super Duty Motorhome Chassis, E-350 Commercial and Motorhome Chassis Vehicles (All Except F-Super Duty Commercial Chassis Vehicles)

DESCRIPTION AND OPERATION

Magnetic Gauges

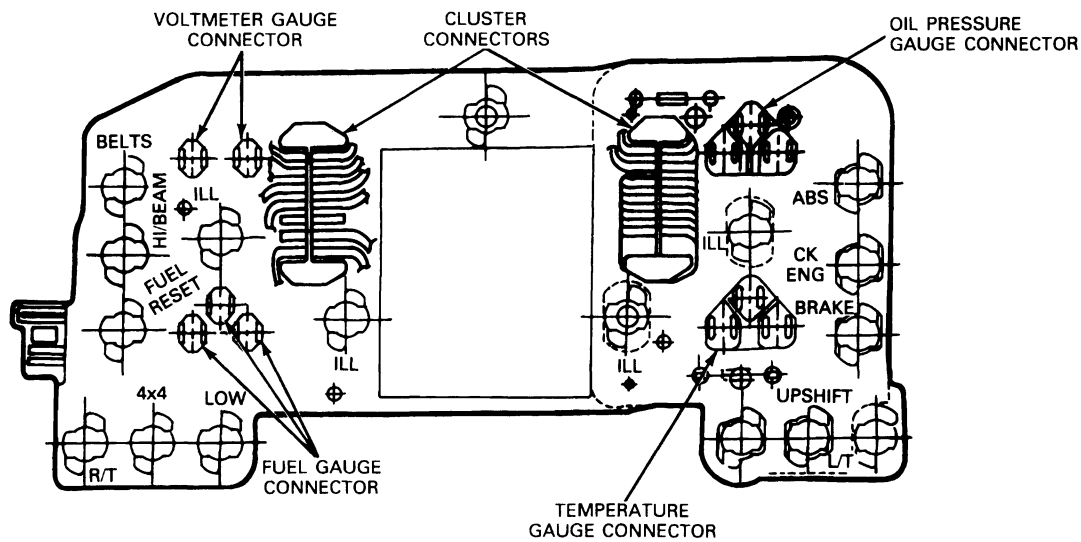
Fuel, Temperature and Oil Pressure

The magnetic gauge movement consists of three primary coils, one of which is wound at a 90-degree angle to the other two. The coils form a magnetic field which varies in direction according to the variable resistance of the sender unit (fuel and temperature systems only; the oil pressure system uses a switch in place of sender and a fixed resistor on the cluster flexible circuit) which is connected between two. A primary magnet, to which a shaft and pointer are attached, rotates to align to this primary field, resulting in pointer position. The bobbin / coil assembly is pressed into a metal housing which has two holes for dial mounting. There is no adjustment, calibration or maintenance required for these gauges.

NOTE: An instrument voltage regulator (IVR) is not required for this system. Refer to diagnostic procedure.

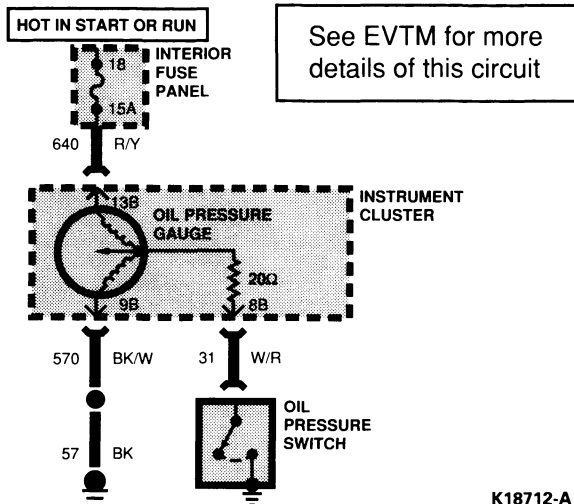
DESCRIPTION AND OPERATION (Continued)

Oil Pressure Gauge Location, F-Series



K17257-B

Oil Pressure Indicating System Schematic



K18712-A

NOTE: The 20-ohm resistor is located on the instrument cluster backplate flexible circuit.

DESCRIPTION AND OPERATION (Continued)

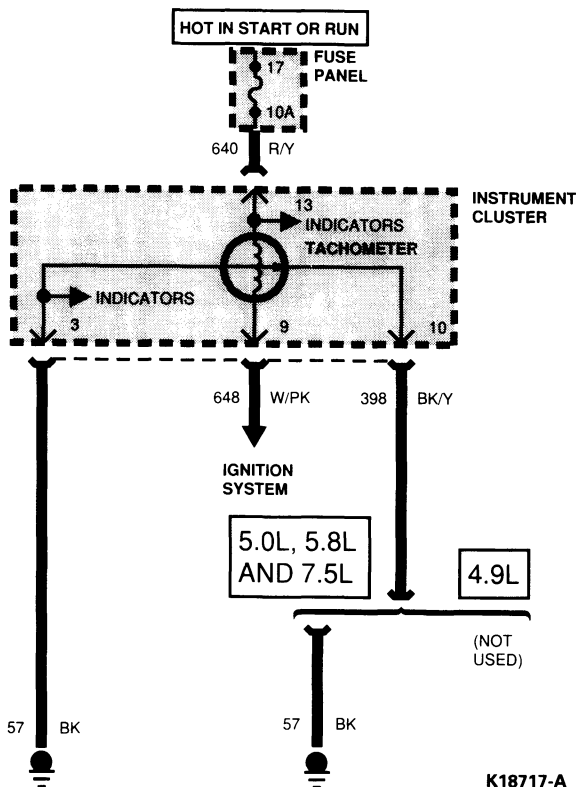
Tachometer, Gasoline Engines

The tachometer is an electrically operated instrument which indicates engine speed in revolutions per minute (rpm). It is mounted in the instrument cluster assembly.

NOTE: Tachometer not available on E-Series vehicles.

GASOLINE
WITH
TACHOMETER

See EVTM for more
details of this circuit

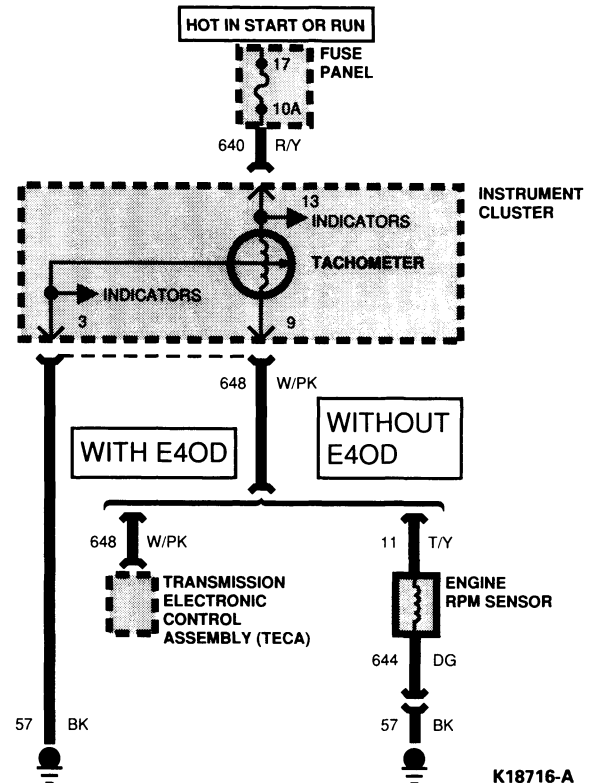
**Tachometer, Diesel Engine**

The tachometer is an electrically operated instrument which indicates engine speed in revolutions per minute (rpm). It is mounted in the instrument cluster assembly.

The tachometer receives its signal from a variable reluctance sensor, mounted in the injection pump timing gear cover.

DIESEL
WITH
TACHOMETER

See EVTM for more
details of this circuit



DIAGNOSIS AND TESTING

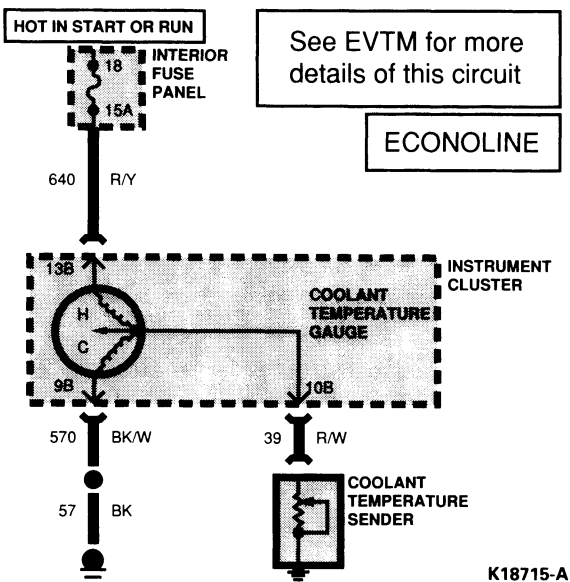
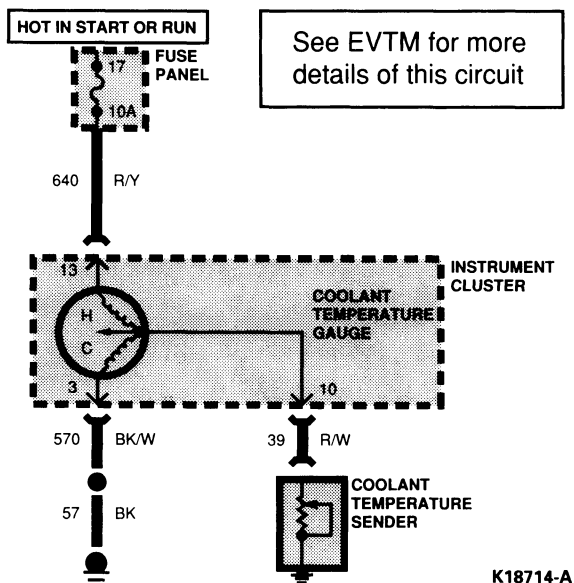
For diagnosis and testing of the temperature gauge and sending unit, use a test lamp and Rotunda Instrument Gauge System Tester 021-00055 or equivalent. Refer to the following illustrations and diagnosis guides for the test schematics and steps to check the gauge and sending unit.

DIAGNOSIS AND TESTING (Continued)

Magnetic Gauges

Calibration Test

The Rotunda Instrument Gauge System Tester Model 021-00055 or equivalent is used to diagnose problems in the oil pressure and coolant temperature gauge.



The Rotunda Instrument Gauge System Tester Model 021-00055 or equivalent can be used to diagnose problems in the magnetic gauge system as well as in the bimetal gauge system.

Test Set Up

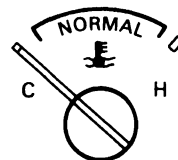
CAUTION: During in-vehicle tests, do not let tester terminal studs designated by arrows come in contact with vehicle ground. The gauge will be shorted to the ground, preventing an accurate test and possibly damaging the gauge.

1. Disconnect connector from the sender and hook onto the matching terminals on the tester.
2. Turn the vehicle ignition switch to ON position.

Calibration Test (Without Tester)

Test the temperature gauge with a 9.7-ohm resistor for high calibration, the oil gauge with a short circuit for mid-scale check and a 73-ohm resistor for low calibration as follows:

1. Turn the ignition switch to ON. For temperature, connect a 9.7-ohm resistor between the gauge lead and ground.
2. For oil gauge, short the gauge lead directly to engine ground.
3. The centerline of the pointer should fall within the band around the H mark for temperature, and slightly above mid-scale for oil.

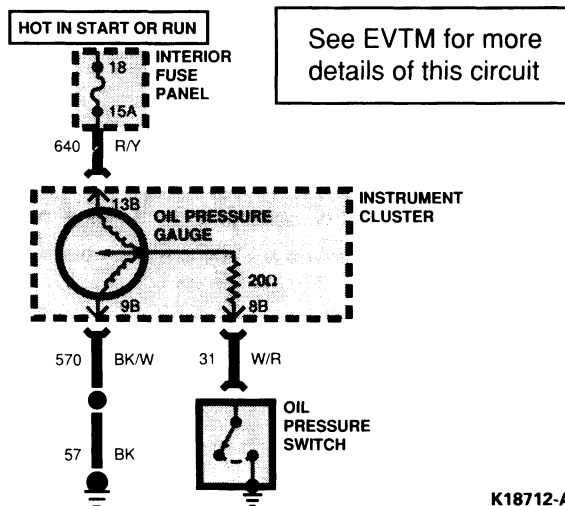


K17256-A

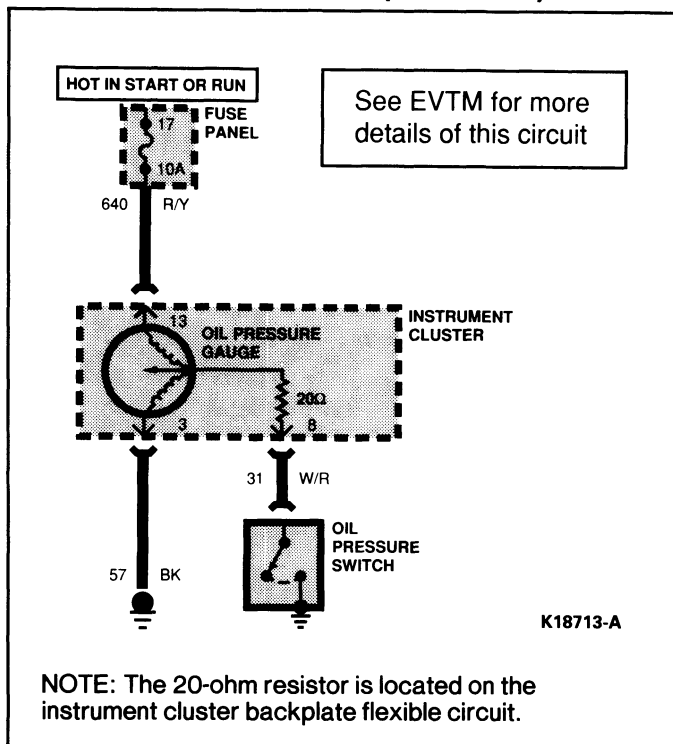
Oil Pressure Gauge

With the connector disconnected at the oil pressure switch and ignition ON, the center line of the pointer should fall on or below the L mark.

- If the gauge tests within calibration, replace sender.
- If the gauge still tests out of calibration, replace instrument cluster. Refer to Section 13-01 for ordering information.

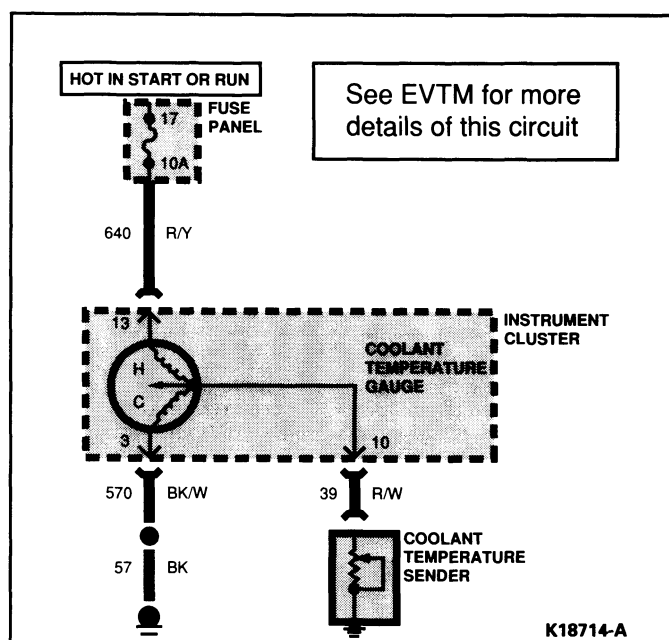


DIAGNOSIS AND TESTING (Continued)

**Coolant Temperature Gauge**

Connect a 73-ohm resistor between the gauge lead and ground. The center line of the pointer should fall within the band around the C mark.

- If gauge tests within calibration, replace sender.
- If gauge still tests out of calibration, replace gauge.

**Coolant Warning**

If the temperature indicating system is still not indicating properly, check the engine coolant level to make certain that coolant level is still at full point. Also verify that thermostat is operating and that fan belt tension is within specification.

DIAGNOSIS AND TESTING (Continued)

Diagnosis Guides

TEMPERATURE / OIL GAUGE INOPERATIVE, POINTER DOES NOT MOVE — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Observe gauge performance. Does gauge pointer move? 	Yes	GO to D1 for temperature gauge. GO to E1 for oil gauge.
		No	GO to A2 .
A2	VERIFY CLUSTER PERFORMANCE		
	<ul style="list-style-type: none"> With the ignition on, observe the other gauges and warning indicators for proper operation. Are gauges and warning indicators working properly? 	Yes	GO to C1 .
		No	GO to B1 .

TK17761B

TEMPERATURE / OIL GAUGE INOPERATIVE — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	VERIFY POWER AT FUSE PANEL		
	<ul style="list-style-type: none"> Using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, verify system voltage at load side of warning indicator fuse. Is there system voltage present at load side of fuse? 	Yes	GO to C1 .
		No	GO to B2 .
B2	VERIFY POWER AT FUSE PANEL		
	<ul style="list-style-type: none"> Using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, verify system voltage at feed side of warning indicator fuse. Is there system voltage present at feed side of fuse? 	Yes	REPLACE fuse. GO to A1 .
		No	SERVICE wiring to fuse panel. GO to A1 .

TK17762B

TEMPERATURE / OIL GAUGE INOPERATIVE — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	VERIFY POWER AT CLUSTER		
	<ul style="list-style-type: none"> Partially remove cluster from IP. Using Rotunda Digital Volt-Ohmmeter 014-00407 or equivalent, verify system voltage at cluster connector and/or gauge terminal. Inspect cluster connector for damage. Is voltage present at cluster connector and gauge? 	Yes	GO to C2 .
		No	SERVICE as required. GO to A1 .
C2	VERIFY GROUND CIRCUITRY AT CLUSTER		
	<ul style="list-style-type: none"> Using Rotunda Digital Volt-Ohmmeter 014-00407 or equivalent, check continuity of cluster and gauge ground circuitry. Is there low ground resistance? 	Yes	GO to D1 for temperature gauge. GO to E1 for oil gauge.
		No	SERVICE as required. GO to A1 .

TK17763B

TEMPERATURE GAUGE INACCURATE — TEST D

TEST STEP		RESULT	ACTION TO TAKE
D1	TEST SENDER CIRCUIT AT LOW		
	<ul style="list-style-type: none"> Insert Rotunda Instrument Gauge, System Tester 021-00055 or equivalent. Disconnect connector at sender and connect tester to cluster side of connector. Set to 74 ohms. Does temperature gauge read C? 	Yes	GO to D2 .
		No	GO to D3 .
D2	TEST SENDER CIRCUIT AT HIGH		
	<ul style="list-style-type: none"> Set Gauge System Tester to 10 ohms. Does temperature gauge read H? 	Yes	REPLACE sender.
		No	GO to D3 .

DIAGNOSIS AND TESTING (Continued)**TEMPERATURE GAUGE INACCURATE — TEST D (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
D3	CHECK SENDER CIRCUIT WIRING		
	<ul style="list-style-type: none"> Check sender circuit wiring and cluster flex circuit for shorts or opens with Rotunda Digital Volt-Ohmmeter 014-00407 or equivalent. Any shorts or open circuits found? 	Yes	SERVICE wiring, or REPLACE cluster. GO to A1. REFER to Section 13-01A for instrument cluster ordering information.
		No	REPLACE cluster. REFER to Section 13-01A for instrument cluster ordering information.

TK17764B

OIL GAUGE INACCURATE — TEST E

TEST STEP		RESULT	ACTION TO TAKE
E1	TEST SENDER CIRCUIT AT LOW		
	<ul style="list-style-type: none"> Place ignition switch in the ON position with engine OFF. Observe gauge performance. Does gauge read L or less? 	Yes	GO to E2.
		No	GO to E3.
E2	CHECK GAUGE RESPONSE		
	<ul style="list-style-type: none"> Disconnect oil pressure switch and short the lead to engine ground. Does gauge read mid-scale? 	Yes	REPLACE sender / switch.
		No	GO to E3.
E3	CHECK SENDER / SWITCH WIRING		
	<ul style="list-style-type: none"> Check sender / switch wiring and cluster flex circuit for shorts or opens using Rotunda Digital Volt-Ohmmeter 014-00407 or equivalent. Any shorts or open circuits found? 	Yes	SERVICE wiring or REPLACE cluster. REFER to Section 13-01A for instrument cluster ordering information. GO to A1.
		No	REPLACE cluster. REFER to Section 13-01A for instrument cluster ordering information. GO to A1.

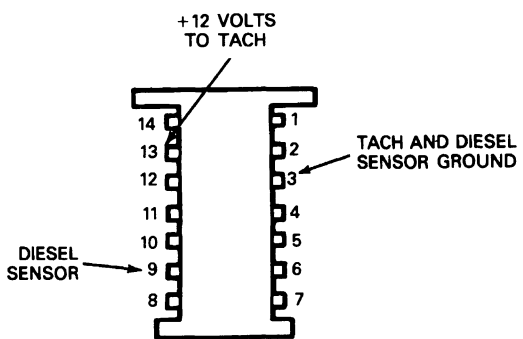
TK17765B

INOPERATIVE, ERRATIC, WRONG INDICATION, TACHOMETER, DIESEL ENGINES — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Check complaint. Is tachometer erratic or inoperative? 	Yes	GO to F2.
		No	VERIFY condition with road test.
F2	CHECK FUSE		
	<ul style="list-style-type: none"> Check fuse. Is fuse blown? 	Yes	REPLACE fuse. If fuse blows again, CHECK for short in circuit.
		No	GO to F3.
F3	CHECK WIRING		
	<ul style="list-style-type: none"> Check for loose wiring connections in engine compartment or at instrument cluster. Are connections loose? 	Yes	SECURE loose connections.
		No	GO to F4.

DIAGNOSIS AND TESTING (Continued)

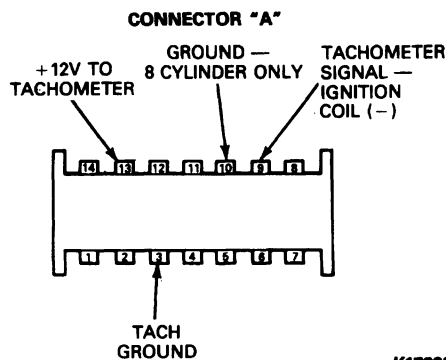
INOPERATIVE, ERRATIC, WRONG INDICATION, TACHOMETER, DIESEL ENGINES — TEST F (Continued)

TEST STEP		RESULT	ACTION TO TAKE
F4	MAKE RESISTANCE / VOLTAGE CHECKS		
	<ul style="list-style-type: none"> Remove instrument cluster and make resistance and voltage checks at 14401 wiring harness connector as follows:  <p>CONNECTOR "A" (LH SIDE — AS SEEN FROM REAR OF CLUSTER) K17291-A</p> <ul style="list-style-type: none"> Check Pin No. 3 (of Connector A) resistance to chassis ground — should read 1 ohm or less. Check Pin No. 9 (of Connector A) resistance to corresponding terminal of diesel sensor mating connector or Powertrain Control Module (PCM) pin — should be 1 ohm or less. On vehicles equipped with E4OD transmission, check sensor wires to Powertrain Control Module (PCM) module for 1 ohm or less. Perform Powertrain Control Module (PCM) test. Connect battery. Turn ignition to the RUN position. Check for + 12 volts at Pin No. 13 (of Connector A). Turn ignition OFF. Disconnect battery. <ul style="list-style-type: none"> Are resistances / voltages within specifications? 	<p>Yes</p> <p>No</p>	<p>Condition is not in tachometer. SERVICE wiring.</p> <p>GO to F5.</p>
F5	CHECK PRINTED CIRCUIT		
	<ul style="list-style-type: none"> Inspect printed circuit for damage, poor connections or open circuits. Is printed circuit open or damaged? 	<p>Yes</p> <p>No</p>	<p>REPLACE instrument cluster.</p> <p>GO to F6.</p>
F6	CHECK DIESEL SENSOR MOUNTING AND/OR CONNECTOR		
	<ul style="list-style-type: none"> Check to see that sensor is not loose in its mounting (in injection pump timing gear cover). Check for loose connection. Loose sensor or connection found? 	<p>Yes</p> <p>No</p>	<p>TIGHTEN sensor to 20-27 N·m (15-20 ft-lb) and/or connector.</p> <p>GO to F7.</p>
F7	CHECK DIESEL SENSOR FOR DAMAGE		
	<ul style="list-style-type: none"> Remove sensor and check for physical damage to sensor face (resulting from contact with timing gear). <p>NOTE: Checking continuity across the terminals of the diesel sensor will show infinite resistance.</p> <ul style="list-style-type: none"> Is continuity resistance infinite? 	<p>Yes</p> <p>No</p>	<p>REPLACE sensor.</p> <p>GO to F8.</p>
F8	CHECK DIESEL SENSOR RESISTANCE		
	<ul style="list-style-type: none"> Remove sensor and check DC resistance across sensor terminals (with sensor in free air — no ferrous materials in its immediate vicinity). Resistance should be 2000-3000 ohms. Is resistance outside of specifications? 	<p>Yes</p> <p>No</p>	<p>REPLACE sensor.</p> <p>REPLACE tachometer.</p>

TK17766B

DIAGNOSIS AND TESTING (Continued)**INOPERATIVE, ERRATIC, WRONG INDICATION, TACHOMETER, GASOLINE ENGINE — TEST G**

TEST STEP		RESULT	ACTION TO TAKE
G1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Check complaint. Is tachometer erratic or inoperative? 	Yes No	GO to G2. VERIFY condition with road test.
G2	CHECK FUSE		
	<ul style="list-style-type: none"> Check fuse. Is fuse blown? 	Yes No	REPLACE fuse. If fuse blows again, CHECK for short in circuit. GO to G3.
G3	CHECK WIRING		
	<ul style="list-style-type: none"> Check for loose wiring connections in engine compartment or at instrument cluster. Are connections loose? 	Yes No	SECURE loose connections. GO to G4.
G4	CHECK PRINTED CIRCUIT		
	<ul style="list-style-type: none"> Inspect printed circuit for damage, poor connections, or open circuits. Is printed circuit open or damaged? 	Yes No	REPLACE instrument cluster. Refer to Section 13-01A for instrument cluster ordering information. GO to G5.
G5	MAKE RESISTANCE / VOLTAGE CHECKS		
	<ul style="list-style-type: none"> Remove instrument cluster and make resistance and voltage checks (using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent) at 14401 wiring harness connector as follows: 	Yes No	Condition is not in tachometer. SERVICE wiring. REPLACE cluster. REFER to Section 13-01A for instrument cluster ordering information.



- Check Pin No. 3 (Connector A) resistance to chassis ground — should read 1 ohm or less.
- Check Pin No. 10 (Connector A) resistance to chassis ground — should read 1 ohm or less, if vehicle has 8-cylinder engine. Open circuit if 6-cylinder engine.
- Check Pin No. 9 (Connector A) resistance to negative terminal of ignition coil should be 1 ohm or less.
- Connect battery. Turn ignition switch ON. Check for + 12 volts at Pin No. 13 (Connector A). Turn ignition OFF. Disconnect battery.
- Are resistances / voltages within specifications?

TK17767B

REMOVAL AND INSTALLATION

Temperature Sending Unit

Removal and Installation

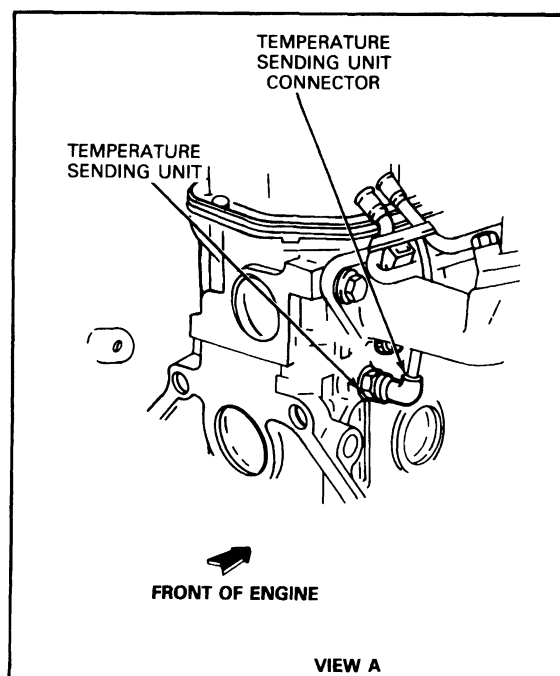
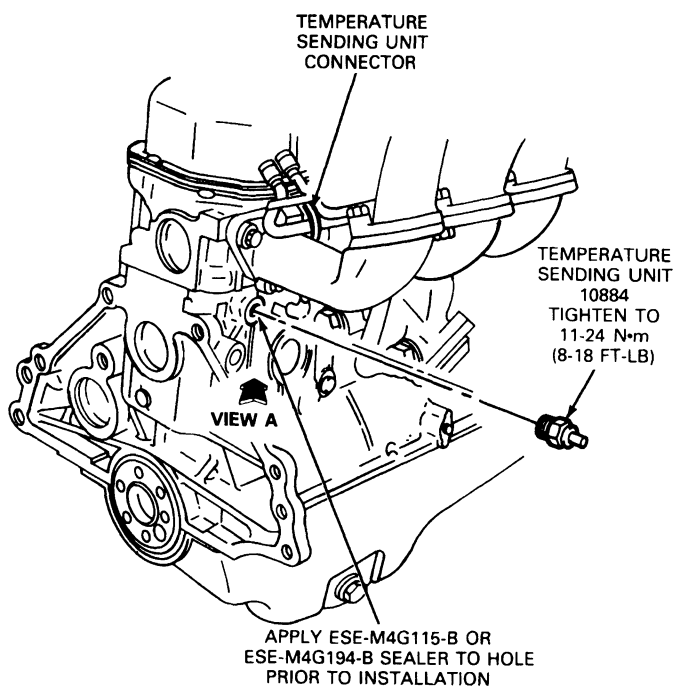
1. Remove radiator cap, to relieve any pressure and then replace cap. This reduces coolant loss during sender replacement.

CAUTION: Do not remove the radiator cap on a hot engine.

2. Disconnect the temperature sending unit wire at the sending unit.

3. Prepare the new temperature sending unit for installation by applying the Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A, ESR-M18P7-A) or equivalent, or a small amount of electrically conductive sealer to the threads.
4. Remove the temperature sending unit from the cylinder head and immediately install the new temperature sending unit. Tighten to 11-24 N·m (8-18 ft·lb).
5. Connect the wire to the temperature sending unit.
6. Refill cooling system to replace lost coolant.
7. Start the engine and check the sending unit operation.

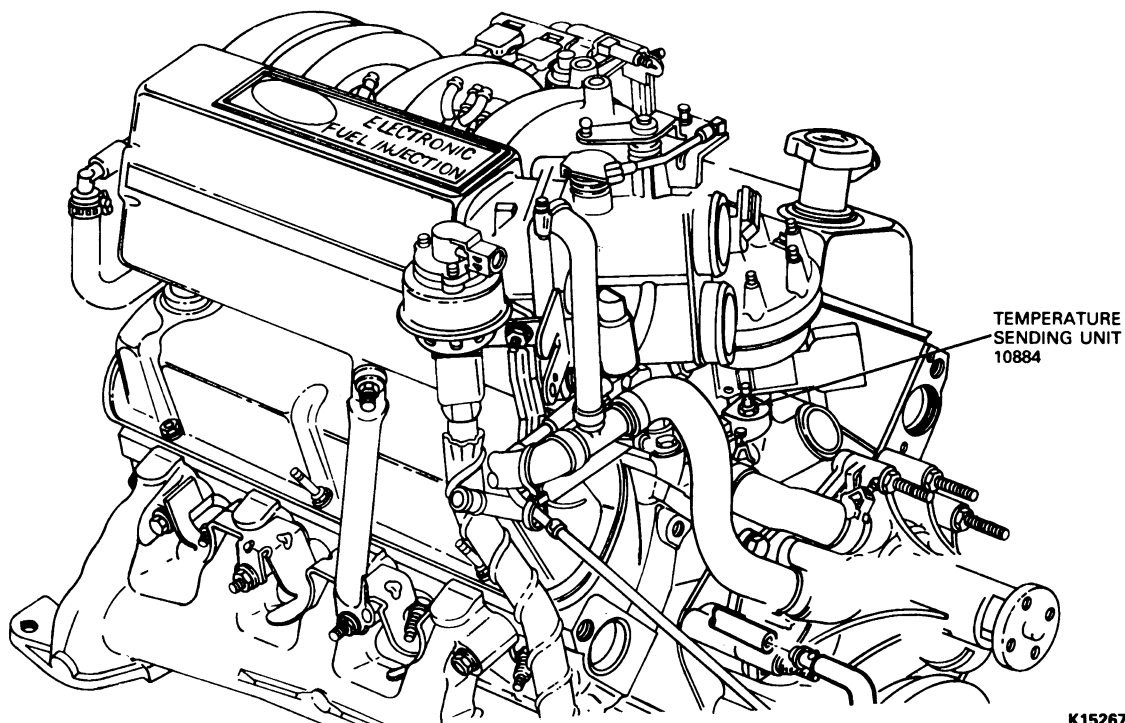
Temperature Sending Unit, 4.9L Engine



K15266-C

REMOVAL AND INSTALLATION (Continued)

Temperature Sending Unit, 5.0L and 5.8L Shown, 7.5L Similar

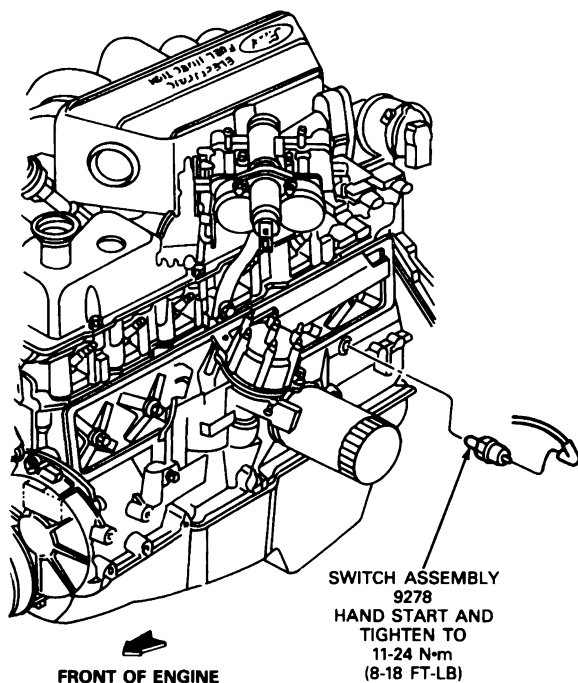
**Oil Pressure Switch****Removal and Installation**

The oil pressure switches are mounted in different ways and locations. The following illustrations show installation for oil pressure switches.

1. Disconnect the wire at the switch terminal.
2. Prepare the new oil switch for installation by applying Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A, ESR-M18P7-A) or equivalent, or a small amount of electrically conductive sealer to the threads.
3. Remove the oil pressure switch from its mounting and immediately install the new oil pressure switch. Tighten to 11-24 N·m (8-18 ft·lb).
4. Connect wire to oil pressure switch.
5. Start the engine and check the operation of the switch.

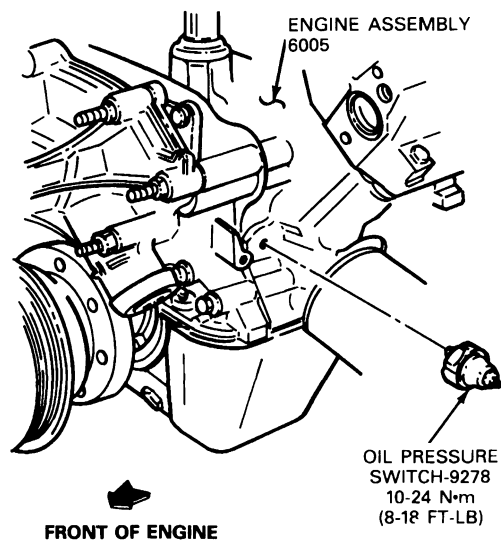
REMOVAL AND INSTALLATION (Continued)

Oil Pressure Switch, 4.9L Engine



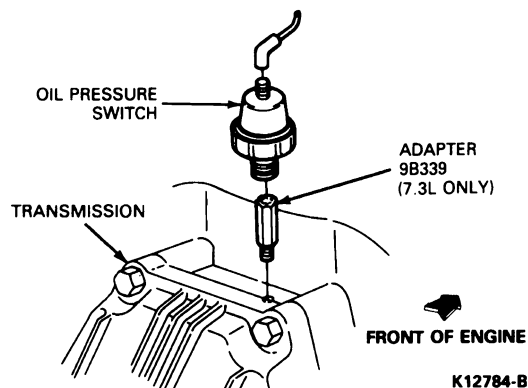
K15263-C

Oil Pressure Switch, Typical 5.0 / 5.8L Engines



K17259-B

Oil Pressure Switch Unit, 7.3L Diesel / 7.5L Gas Engine



Instrument cluster components that are serviceable at the dealership level are:

- Bulb and socket assemblies — base P/N -13B765-
- Oil temperature gauge assembly — base P/N -10E872-
- Fuel / volt gauge assembly — base P/N -10E871-
- Tachometer (if applicable) — base P/N -17360-
- Fuel anti-slosh low fuel module (if applicable) — base P/N -10E849
- Cluster lens — base P/N -10B885-
- Cluster mask — base P/N -10894-
- Lens attaching screws — base P/N -804988-

NOTE: The instrument cluster must be serviced as a complete assembly if it is determined that any of the following components are faulty.

- Speedometer / odometer assembly
- Flex (printed) circuit assembly
- Flex circuit / gauge clips
- Instrument cluster backplate

Instructions for ordering and handling a replacement instrument cluster are provided in Section 13-01A.

In addition to the above components, the following components are serviceable on Econoline Chassis and Motorhome vehicles only:

- Fuel label or label (blank) — base P/N -9A095-
- Bezel - base P/N -10876
- Right- and left-hand jewels - base P/N -807025-
- Screws - base P/N -807025-

If the diagnostic procedures outlined in this section result in a determination that any other instrument cluster component is faulty, the complete instrument cluster must be replaced. Refer to Section 13-01 for instrument cluster ordering information.

REMOVAL AND INSTALLATION (Continued)

The service cluster received will be pre-programmed with the vehicle mileage (eliminating the need for "circled S" odometers) and the PSOM speed signal conversion constant.

NOTE: The Instrument Cluster requires special handling to avoid damaging internal components. The cluster **MUST** be kept **FACE UP** or in the in-vehicle position. Leaving the cluster face down may result in a loss of dampening fluid used in the gauges. The lost fluid could stain the cluster face or result in excessive pointer waiver.

Tachometer**Removal and Installation**

1. Disconnect the battery ground cable and remove the instrument cluster from the instrument panel. Refer to Section 13-01A.
2. Remove the nine screws attaching the lens and mask to the backplate; then remove the lens and mask.
3. Remove the tachometer from the backplate by grasping the outside edges of the dial and lifting (tachometer is retained to backplate by retaining clips).

For installation, follow the removal procedures in reverse order. When installing tachometer, make certain the tachometer pins correctly seat into the backplate retaining clips. Check operation.

Oil/Temp Gauge**Removal and Installation**

1. Disconnect the battery ground cable and remove the instrument cluster from the instrument panel. Refer to Section 13-01A.
2. Remove the nine screws attaching the lens and mask to the backplate; then remove the lens and mask.
3. Remove the gauge from the backplate by grasping the outside edges of the dial and lifting (gauges are retained to backplate by retaining clips).

For installation, follow the removal procedures in reverse order. When installing gauge, make certain the gauge pins correctly seat into the backplate retaining clips. Check operation.

CLEANING AND INSPECTION

CAUTION: The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/or Cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ford Ultra Clear Spray Glass Cleaner (E4AZ-19C507-AA (ESR-M14P5-A) or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been specially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions shown on the container for best results.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N-m	Lb-Ft
Temperature Sending Unit	11-24	8-18
Oil Pressure Switch	11-24	8-18

ALL GAUGES

Size (Less Terminals)	29 mm diameter x 25 mm length (1.4 in diameter x 1 in length)
Weight (Less Dial and Pointer)	40 grms (1.4 ounces)
Mounting	Flange on Steel Body
Operating Temperature	-30°C to 80°C (-86°F to 176°F)
Pointer Travel	85° (Fuel Gauge) 90° (Oil Gauge) 90° (Temp Gauge)
Electrical Connection	Three Pin Terminals
Operating Voltage	11-16 VDC

CK16320-A

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
021-00055	Instrument Gauge System Tester
014-00407	Digital Volt-Ohmmeter

SECTION 13-05B Gauges, Engine Operation, F-Super Duty Commercial Chassis

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING AND INSPECTION	13-05B-12	REMOVAL AND INSTALLATION (Cont'd.)	
DESCRIPTION AND OPERATION		Oil Pressure Gauge	13-05B-11
Magnetic Gauges	13-05B-1	Oil Pressure Switch	13-05B-11
DIAGNOSIS AND TESTING		Tachometer, Diesel Engine	13-05B-11
Coolant Temperature Gauge	13-05B-5	Tachometer, Gasoline Engines	13-05B-11
Diagnosis Guides	13-05B-6	Temperature Sending Unit	13-05B-10
Magnetic Gauges	13-05B-4	SPECIAL SERVICE TOOLS/EQUIPMENT	13-05B-12
REMOVAL AND INSTALLATION		SPECIFICATIONS	13-05B-12
Coolant Temperature Gauge	13-05B-11	VEHICLE APPLICATION	13-05B-1

VEHICLE APPLICATION

F-Super Duty Commercial Chassis

DESCRIPTION AND OPERATION

Magnetic Gauges

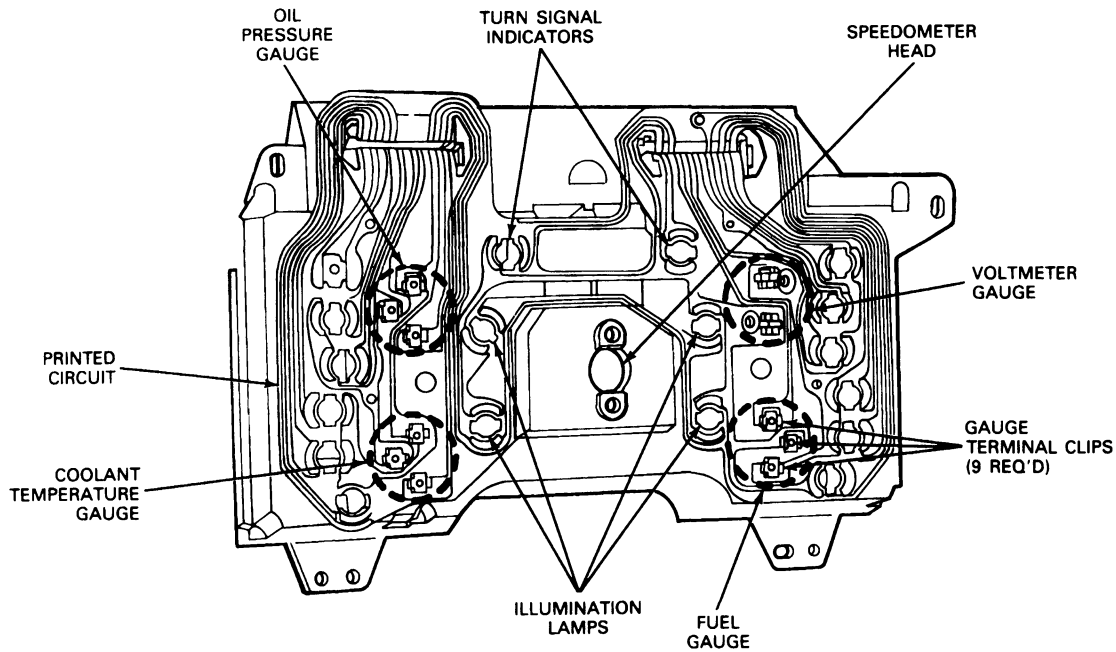
Fuel, Temperature and Oil Pressure

The magnetic gauge movement consists of three primary coils, one of which is wound at a 90-degree angle to the other two. The coils form a magnetic field which varies in direction according to the variable resistance of the sender unit (fuel and temperature systems. The oil pressure system uses a switch and a fixed resistor; the resistor is attached to the engine harness.) A primary magnet, to which a shaft and pointer are attached, rotates to align to this primary field, resulting in pointer position. The bobbin/coil assembly is pressed into a metal housing which has two holes for dial mounting. There is no adjustment, calibration or maintenance required for these gauges.

NOTE: An instrument voltage regulator (IVR) is not required for this system. Refer to diagnostic procedure.

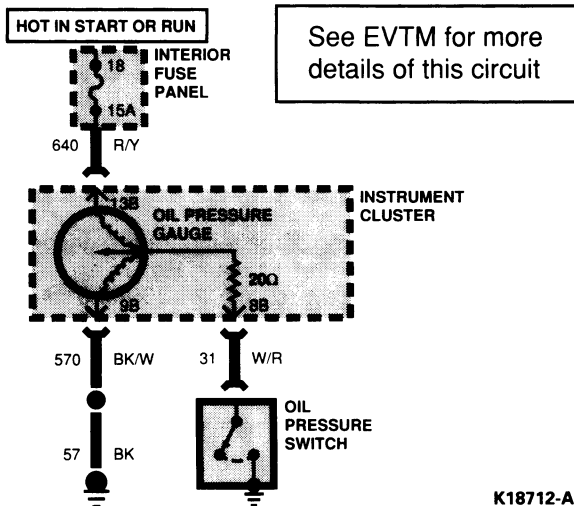
DESCRIPTION AND OPERATION (Continued)

Oil Pressure Gauge Location



K14216-A

Oil Pressure Indicating System Schematic



K18712-A

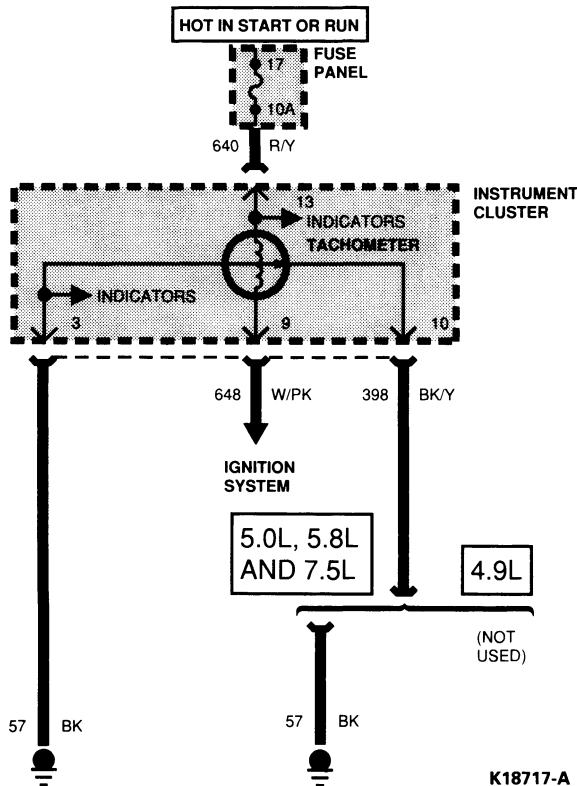
NOTE: The 20-ohm resistor is located in jumper wire assembly at oil pressure switch.

Tachometer, Gasoline Engines

The tachometer is an electrically operated instrument which indicates engine speed in revolutions per minute (rpm). It is mounted in the instrument cluster assembly.

DESCRIPTION AND OPERATION (Continued)

Tachometer, Gas Engine (Signal from Ignition Coil)

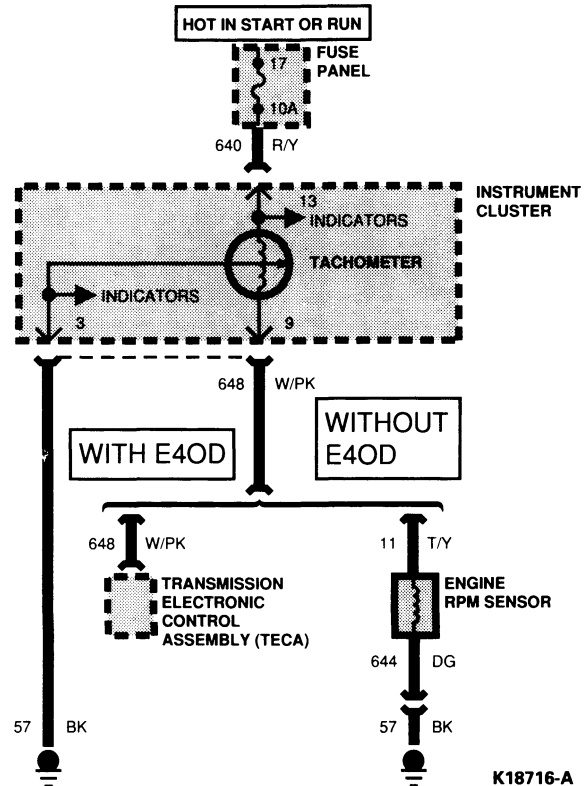
GASOLINE
WITH
TACHOMETERSee EVTM for more
details of this circuit

Tachometer, Diesel Engine

The tachometer is an electrically operated instrument which indicates engine speed in revolutions per minute (rpm). It is mounted in the instrument cluster assembly.

The tachometer receives its signal from a variable reluctance sensor, mounted in the injection pump timing gear cover.

Manual Transmission Application

DIESEL
WITH
TACHOMETERSee EVTM for more
details of this circuit

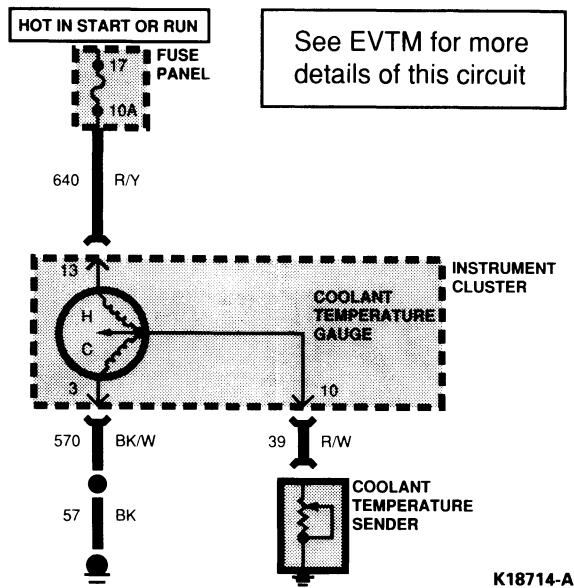
DIAGNOSIS AND TESTING

For diagnosis and testing of the temperature gauge and sending unit, use a test lamp and Rotunda Instrument Gauge System Tester 02 1-00055 or equivalent. Refer to the following illustrations and diagnosis guides for the test schematics and steps to check the gauge and sending unit.

DIAGNOSIS AND TESTING (Continued)

Magnetic Gauges**Calibration Test**

The Rotunda Instrument Gauge System Tester Model 021-00055 or equivalent is used to diagnose problems in the oil pressure (or coolant temperature) gauge.



Prior to performing system test the following tester check should be made.

- Set tester ground wire to the negative (-) terminal of 12-volt battery and touch one of the tester terminals marked with an arrow to the positive (+) battery terminal.

The Rotunda Instrument Gauge System Tester Model 021-00055 or equivalent can be used to diagnose problems in the magnetic gauge system as well as in the bimetal gauge system.

Test Set Up

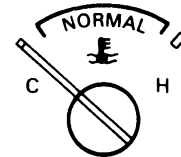
CAUTION: During in-vehicle tests, do not let tester terminal studs designated by arrows come in contact with vehicle ground. The gauge will be shorted to the ground, preventing an accurate test and possibly damaging the gauge.

1. Disconnect connector from the sender and hook onto the matching terminals on the tester.
2. Turn the vehicle ignition switch to ON position.

Calibration Test (Without Tester)

Test the temperature gauge with a 9.7-ohm resistor for high calibration, the oil gauge with a short circuit for mid-scale check and a 73-ohm resistor for low calibration as follows:

Turn the ignition switch to ON. For temperature, connect a 9.7-ohm resistor between the gauge lead and ground. For oil gauge, short the gauge lead directly to engine ground. The centerline of the pointer should fall within the band around the "H" mark for temperature, and slightly above mid-scale for oil.

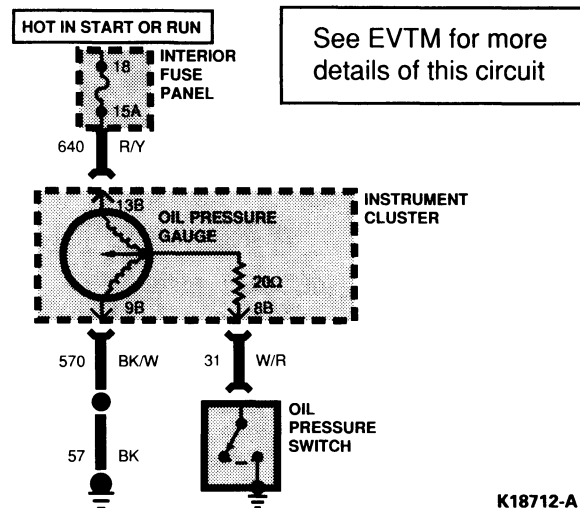


K17256-A

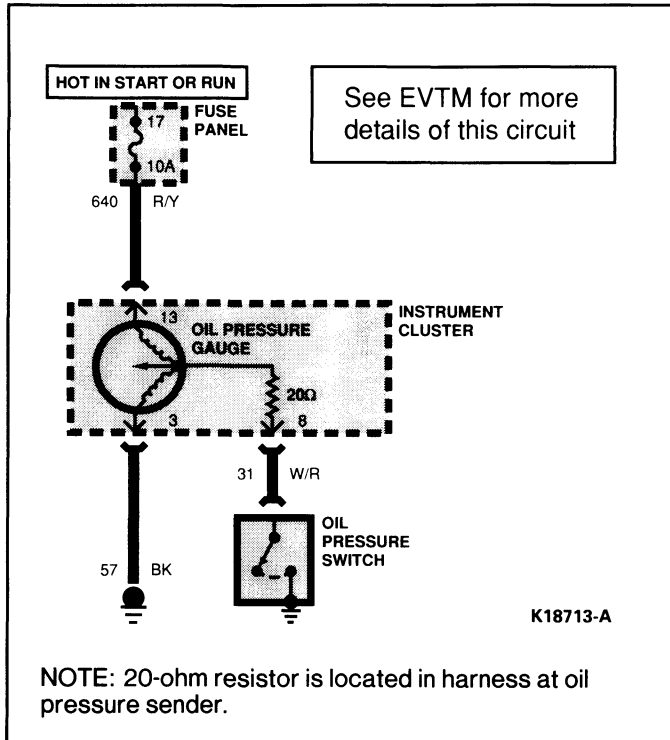
Oil Pressure Gauge

Connect a 73-ohm resistor between the gauge lead and ground. The centerline of the pointer should fall on or below the L mark.

- If the gauge tests within calibration, replace the sender.
- If the gauge still tests out of calibration, replace the gauge.

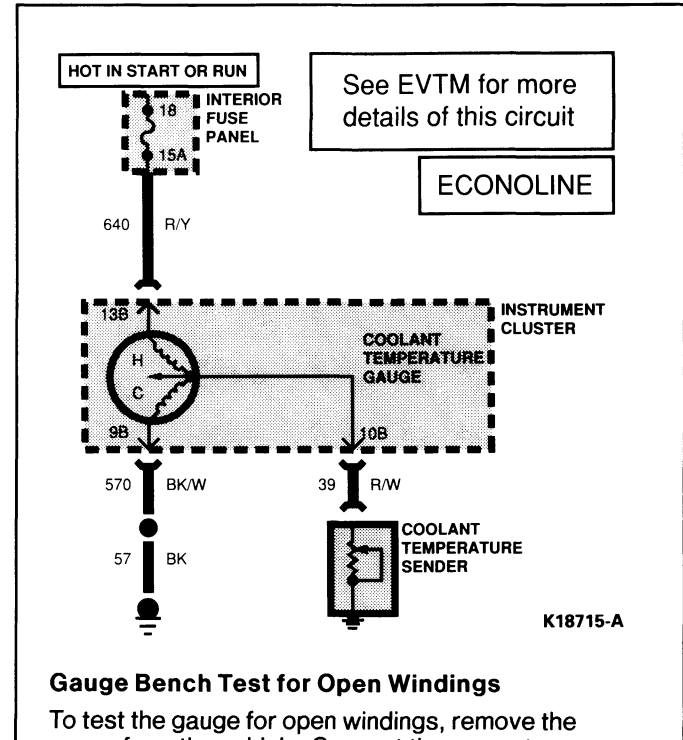
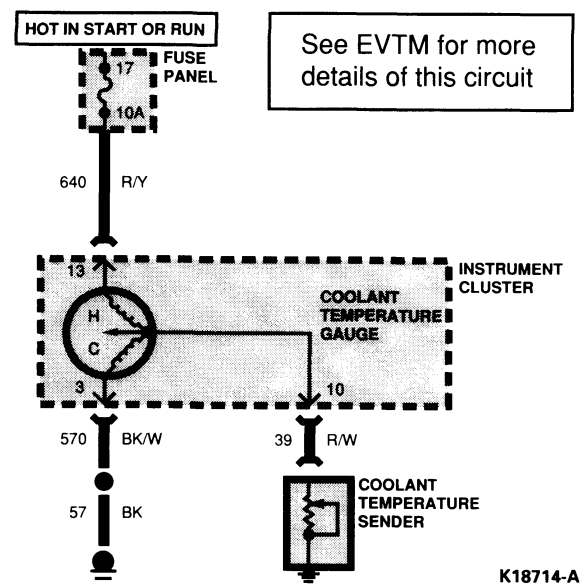


DIAGNOSIS AND TESTING (Continued)

**Coolant Temperature Gauge**

Connect a 73-ohm resistor between the gauge lead and ground. The centerline of the pointer should fall within the band around the C mark.

- If the gauge tests within calibration, replace the sender.
- If the gauge still tests out of calibration, replace the gauge.

**Gauge Bench Test for Open Windings**

To test the gauge for open windings, remove the gauge from the vehicle. Connect the gauge to an ohmmeter and read the resistance. The coil resistance from the back of gauge "B+" to "S" will be approximately 60 ohms. From "S" to "G" it will be approximately 52 ohms. If the gauge reads open or short, replace gauge.

The Rotunda Instrument Gauge System Tester Model 021-00055 or equivalent can be used to diagnose problems in the magnetic gauge system.

Coolant Warning

If the temperature indicating system is still not indicating properly, check the engine coolant level to make certain that coolant level is still at full point. Also verify that thermostat is operating and that fan belt tension is within specification.

DIAGNOSIS AND TESTING (Continued)**Diagnosis Guides****TEMPERATURE / OIL GAUGE INOPERATIVE, POINTER DOES NOT MOVE — TEST A**

TEST STEP		RESULT	ACTION TO TAKE
A1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Observe gauge performance. 	Gauge pointer does not move Gauge pointer moves	GO to A2 . GO to D1 for temperature gauge. GO to E1 for oil gauge.
A2	VERIFY CLUSTER PERFORMANCE		
	<ul style="list-style-type: none"> With the ignition on, observe the other gauges and warning indicators for proper operation. 	Gauges and warning indicators operate correctly Gauges and warning indicators do not operate correctly	GO to C1 . GO to B1 .

TCK17761A

TEMPERATURE / OIL GAUGE INOPERATIVE — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	VERIFY POWER AT FUSE PANEL		
	<ul style="list-style-type: none"> Using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, verify system voltage at load side of warning indicator fuse. 	System voltage present at load side of fuse System voltage not present at load side fuse	GO to C1 . GO to B2 .
B2	VERIFY POWER AT FUSE PANEL		
	<ul style="list-style-type: none"> Using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, verify system voltage at feed side of warning indicator fuse. 	System voltage present at feed side of fuse System voltage not present at feed side of fuse	REPLACE fuse. GO to A1 . SERVICE wiring to fuse panel. GO to A1 .

TCK17762A

TEMPERATURE / OIL GAUGE INOPERATIVE — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	VERIFY POWER AT CLUSTER		
	<ul style="list-style-type: none"> Partially remove cluster from IP. Using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, verify system voltage at cluster connector and/or gauge terminal. Inspect cluster connector for damage. 	Voltage present at cluster connector and gauge terminal System voltage not present at cluster connector and/or gauge terminal	GO to C2 . SERVICE as required. GO to A1 .
C2	VERIFY GROUND CIRCUITRY AT CLUSTER		
	<ul style="list-style-type: none"> Using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, check continuity of cluster and gauge ground circuitry. 	Ground circuitry good Excessive resistance in ground circuitry	GO to D1 for temperature gauge. GO to E1 for oil gauge. SERVICE as required. GO to A1 .

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DIAGNOSIS AND TESTING (Continued)

TEMPERATURE GAUGE INACCURATE — TEST D

TEST STEP		RESULT	ACTION TO TAKE
D1	TEST SENDER CIRCUIT AT LOW		
	<ul style="list-style-type: none"> Insert Rotunda Instrument Gauge, System Tester 021-00055 or equivalent. Disconnect connector at sender and connect tester to cluster side of connector. Set to 74 ohms. 	Gauge reads C Gauge does not read C	GO to D2 . GO to D3 .
D2	TEST SENDER CIRCUIT AT HIGH		
	<ul style="list-style-type: none"> Set Gauge System Tester to 10 ohms. 	Gauge reads H Gauge does not read H	REPLACE sender. GO to D3 .
D3	CHECK SENDER CIRCUIT WIRING		
	<ul style="list-style-type: none"> Check sender circuit wiring and cluster flex circuit for shorts or opens with Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent. 	Wiring and /or flex circuit OK Wiring and /or flex circuit not OK	REPLACE gauge. SERVICE wiring or REPLACE flex circuit. GO to A1 .

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OIL GAUGE INACCURATE — TEST E

TEST STEP		RESULT	ACTION TO TAKE
E1	TEST SENDER CIRCUIT AT LOW		
	<ul style="list-style-type: none"> Place ignition switch in the ON position with engine OFF. Observe gauge performance. 	Gauge reads L or below Gauge does not read L or below	GO to E2 . GO to E3 .
E2	CHECK GAUGE RESPONSE		
	<ul style="list-style-type: none"> Disconnect oil pressure switch and short the lead to engine ground. 	Gauge reads around the "O" in NORM band Gauge does not read around "O" in NORM band	REPLACE sender / switch. GO to E3 .
E3	CHECK SENDER / SWITCH WIRING		
	<ul style="list-style-type: none"> Check sender / switch wiring and cluster flex circuit for shorts or opens using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent. 	Wiring / flex circuit OK Wiring or flex circuit not OK	REPLACE gauge. GO to A1 . SERVICE wiring / flex circuit. GO to A1 .

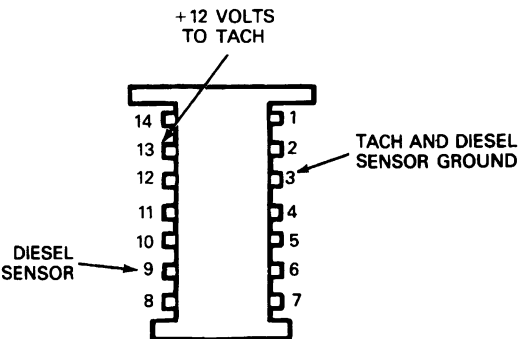
TCK17769A

INOPERATIVE, ERRATIC, WRONG INDICATION, TACHOMETER, DIESEL ENGINES — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Check complaint. 	Inoperative Erratic and /or wrong indication	GO to F2 . GO to F3 .
F2	CHECK FUSE		
	<ul style="list-style-type: none"> Check fuse. 	Fuse blown Fuse is good	REPLACE fuse. If fuse blows again, CHECK for short in circuit. GO to F3 .
F3	CHECK WIRING		
	<ul style="list-style-type: none"> Check for loose wiring connections in engine compartment or at instrument cluster. 	Loose connections Connections secure	SECURE loose connections. GO to F4 .

DIAGNOSIS AND TESTING (Continued)

INOPERATIVE, ERRATIC, WRONG INDICATION, TACHOMETER, DIESEL ENGINES — TEST F (Continued)

TEST STEP		RESULT	ACTION TO TAKE
F4	MAKE RESISTANCE CHECKS		
<ul style="list-style-type: none"> Remove instrument cluster and make resistance and voltage checks at 14401 wiring harness connector as follows:  <p>CONNECTOR "A" (LH SIDE — AS SEEN FROM REAR OF CLUSTER) K17291-A</p> <ul style="list-style-type: none"> Check Pin No. 3 (of Connector A) resistance to chassis ground — should read 1 ohm or less. Check Pin No. 9 (of Connector A) resistance to corresponding terminal of diesel sensor mating connector or EDIS module pin — should be 1 ohm or less. On vehicles equipped with E4OD transmission, check sensor wires to EDIS module for 1 ohm or less. Perform EEC-IV module test. Connect battery. Turn ignition to the RUN position. Check for + 12 volts at Pin No. 13 (of Connector A). Turn ignition OFF. Disconnect battery. 		Open or shorted Wiring OK	Condition is not in tachometer. SERVICE wiring. GO to F5.
F5	CHECK RETENTION CLIPS		
<ul style="list-style-type: none"> Check for loose tachometer retention clips on rear of instrument cluster, or damaged printed circuit. 		Clips loose Clips tight	TIGHTEN clips and/or REPLACE printed circuit. GO to F6.
F6	CHECK DIESEL SENSOR MOUNTING AND/OR CONNECTOR		
<ul style="list-style-type: none"> Check to see that sensor is not loose in its mounting (in injection pump timing gear cover). Check for loose connection. 		Sensor and / or connector loose Sensor and connector tight	TIGHTEN sensor to 20-27 N·m (15-20 ft-lb) and / or connector. GO to F7.
F7	CHECK DIESEL SENSOR FOR DAMAGE		
<ul style="list-style-type: none"> Remove sensor and check for physical damage to sensor face (resulting from contact with timing gear). <p>NOTE: Checking continuity across the terminals of the diesel sensor will show infinite resistance.</p>		Sensor damaged Sensor not damaged	REPLACE sensor. GO to F8.
F8	CHECK DIESEL SENSOR RESISTANCE		
<ul style="list-style-type: none"> Remove sensor and check DC resistance across sensor terminals (with sensor in free air — no ferrous materials in its immediate vicinity). Resistance should be 2000-3000 ohms. 		Sensor resistance outside specification Sensor resistance OK	REPLACE sensor. GO to F9.

DIAGNOSIS AND TESTING (Continued)

INOPERATIVE, ERRATIC, WRONG INDICATION, TACHOMETER, DIESEL ENGINES — TEST F (Continued)

TEST STEP		RESULT	ACTION TO TAKE
F9	E4OD AUTOMATIC TRANSMISSION APPLICATIONS ONLY DPC-100 TRANSMISSION CONTROLLER SIGNAL CHECK		
	<ul style="list-style-type: none"> Reconnect battery cable and start engine, and allow engine to idle. Check RMS AC voltage of DPC-100 controller output signal (Pin 6 of Connector A, at instrument cluster). Voltage value should be at least 300 mV. 	No signal output Signal OK	REPLACE EEC-4 Processor Unit. REPLACE tachometer.

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INOPERATIVE, ERRATIC, WRONG INDICATION, TACHOMETER, GASOLINE ENGINE — TEST G

TEST STEP		RESULT	ACTION TO TAKE
G1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Check complaint. 	Inoperative Erratic and / or wrong indication	GO to G2. GO to G3.
G2	CHECK FUSE		
	<ul style="list-style-type: none"> Check fuse. Is fuse OK? 	No Yes	REPLACE fuse. If fuse blows again, CHECK for short in circuit. GO to G3.
G3	CHECK WIRING		
	<ul style="list-style-type: none"> Check for loose wiring connections in engine compartment or at instrument cluster. Is wiring OK? 	No Yes	SECURE loose connections. GO to G4.
G4	MAKE RESISTANCE CHECKS		
	<ul style="list-style-type: none"> Remove instrument cluster and make resistance and voltage checks (using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent) at 14401 wiring harness connector as follows: <div> <p style="text-align: center;">CONNECTOR "A"</p> <p style="text-align: center;">K17292-A</p> </div> <ul style="list-style-type: none"> Check Pin No. 3 (Connector A) resistance to chassis ground — should read 1 ohm or less. Check Pin No. 10 (Connector A) resistance to chassis ground — should read 1 ohm or less, if vehicle has 8-cylinder engine. Open circuit if 6-cylinder engine. Check Pin No. 9 (Connector A) resistance to negative terminal of ignition coil should be 1 ohm or less. Connect battery. Turn ignition switch ON. Check for + 12 volts at Pin No. 13 (Connector A). Turn ignition OFF. Disconnect battery. 	Not within specifications Within specifications	Condition is not in tachometer. SERVICE wiring. GO to G5.

DIAGNOSIS AND TESTING (Continued)

INOPERATIVE, ERRATIC, WRONG INDICATION, TACHOMETER, GASOLINE ENGINE — TEST G (Continued)

TEST STEP		RESULT	ACTION TO TAKE
G5	CHECK TACHOMETER CONNECTIONS		
	<ul style="list-style-type: none"> Check for loose or missing cluster connection clips, or damaged printed circuit. Are connections and printed circuit OK? 	No	RESEAT (or replace missing) clips and / or REPLACE printed circuit.
		Yes	REPLACE tachometer.

TCK17774E

REMOVAL AND INSTALLATION

Temperature Sending Unit

Removal and Installation

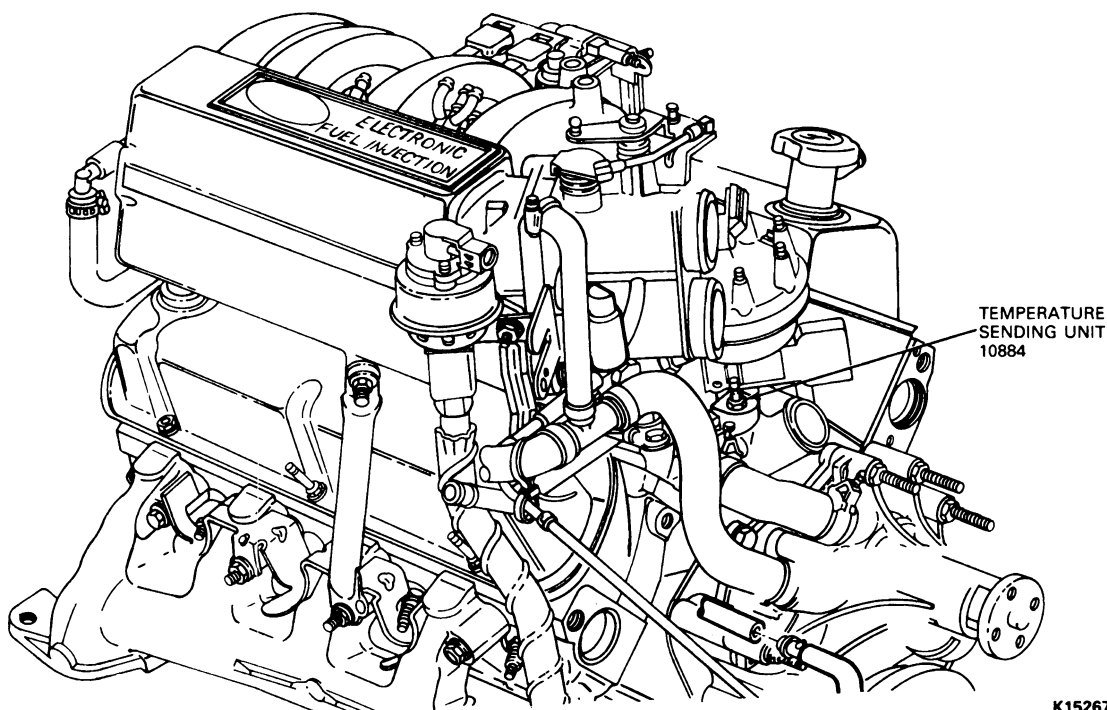
1. Remove radiator cap to relieve any pressure and then replace cap. This reduces coolant loss during sender replacement.

CAUTION: Do not remove the radiator cap on a hot engine.

2. Disconnect the temperature sending unit wire at the sending unit.

3. Prepare the new temperature sending unit for installation by applying Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G 194-A and ESR-M18P7-A) or equivalent, or a small amount of electrically conductive sealer to the threads.
4. Remove the temperature sending unit from the cylinder head and immediately install the new temperature sending unit. Tighten to 11-24 N·m (8-18 ft·lb).
5. Connect the wire to the temperature sending unit.
6. Refill cooling system to replace lost coolant.
7. Start the engine and check the sending unit operation.

Temperature Sending Unit, Typical 8 Cylinder

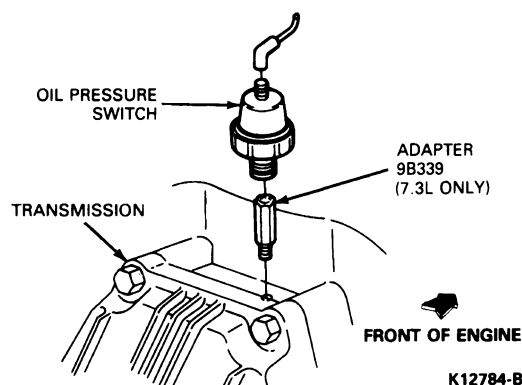


K15267-2A

REMOVAL AND INSTALLATION (Continued)**Oil Pressure Switch****Removal and Installation**

The oil pressure switches are mounted in different ways and locations. The following illustrations show installation for oil pressure switches

1. Disconnect the wire at the switch terminal.
2. Prepare the new oil switch for installation by applying Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G 194-A and ESR-M18P7-A) or equivalent, or a small amount of electrically conductive sealer to the threads.
3. Remove the oil pressure switch from its mounting and immediately install the new oil pressure switch. Tighten to 11-24 N·m (8-18 ft·lb).
4. Connect wire to oil pressure switch.
5. Start the engine and check the operation of the switch.

Oil Pressure Switch Unit**Oil Pressure Gauge****Removal and Installation**

1. Remove the instrument cluster. Refer to Section 13-01B.
2. Remove the seven screws attaching the bezel lens and mask assembly to the backplate; then remove the bezel lens and mask assembly.
3. Remove the three screws securing the oil pressure gauge assembly to the backplate, and remove the gauge.

For installation, follow removal procedures in reverse order. When installing gauge, make certain the gauge pins correctly seat into the backplate retaining clips.

Tachometer, Gasoline Engines**Removal**

1. Disconnect battery ground cable.
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
2. Remove instrument cluster. Refer to the procedures outlined in this section.
3. Remove seven screws attaching mask and lens to cluster backplate and remove mask and lens.
4. Remove tachometer by carefully prying tachometer dial away from cluster backplate (tachometer is retained to backplate by retaining clips).

Installation

1. Position tachometer cluster backplate, and push into position (making certain the four tachometer pins correctly seat in the cluster backplate clips).
2. Position lens and mask to the cluster backplate and install the seven attaching screws. Install the instrument cluster. Connect battery ground cable and check operation of the tachometer.

Coolant Temperature Gauge**Removal and Installation**

1. Remove the instrument cluster. Refer to Section 13-01B.
2. Remove the seven screws attaching the bezel lens and mask assembly to the backplate; then remove the bezel lens and mask.
3. Remove the two screws securing the coolant temperature gauge assembly to the backplate, and remove the gauge.

For installation, follow removal procedures in reverse order. When installing gauge, make certain the gauge pins correctly seat into the backplate retaining clips.

Tachometer, Diesel Engine**Removal**

1. Disconnect the battery ground cable.
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
2. Remove the instrument cluster. Refer to the procedures outlined in this section.

REMOVAL AND INSTALLATION (Continued)

3. Remove the six screws attaching the mask and lens to the cluster backplate and remove the mask and lens.
4. Remove tachometer by prying tachometer dial-away from cluster backplate (tachometer is retained to backplate by retaining clips).

Installation

1. Position the tachometer to the cluster backplate and push the tachometer assembly into the cluster backplate.
2. Position the lens and mask to the cluster backplate and install the seven attaching screws. Install the instrument cluster. Connect the battery ground cable and check the operation of the tachometer.

CLEANING AND INSPECTION

CAUTION: The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/ or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/ or Cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ford Ultra Clear Spray Glass Cleaner E4AZ-19C507-AA (ESR-M14P5-A) or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been specially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions shown on the container for best results.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N-m	Lb-Ft
Temperature Sending Unit	11-24	8-18
Oil Pressure Switch	11-24	8-18

ALL GAUGES

Size (Less Terminals)	29 mm diameter x 25 mm length (1.4 in diameter x 1 in length)
Weight (Less Dial and Pointer)	40 grms (11.4 ounces)
Mounting	Flange on Steel Body
Operating Temperature	- 30°C to 80°C (- 86°F to 176°F)
Pointer Travel	85° (Fuel Gauge) 90° (Oil Gauge) 90° (Temp Gauge)
Electrical Connection	Three Pin Terminals
Operating Voltage	11-16 VDC

CK16320-A

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
021-00055	Instrument Gauge System Tester
007-00001	Digital Volt-Ohmmeter

SECTION 13-06 Horns

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	13-06-1	REMOVAL AND INSTALLATION (Cont'd.)	
DIAGNOSIS AND TESTING		Horn Switch	13-06-4
Circuit Check for all Vehicles.....	13-06-1	Horn Switch Cover Assembly	13-06-3
REMOVAL AND INSTALLATION		SPECIAL SERVICE TOOLS/EQUIPMENT	13-06-6
Electric Horns.....	13-06-2	VEHICLE APPLICATION	13-06-1
Horn Relay	13-06-5		

VEHICLE APPLICATION

Bronco, F-150-250-350, F-Super Duty and
E-150-250-350 Vehicles

DESCRIPTION AND OPERATION

Dual horns are standard on the Bronco, F-150-250-350, F-Super Duty and E-150-250-350 Club Wagons. A single horn is standard on E-150-250-350 vans. The horn button completes the circuit direct to the horn(s). A horn relay is used on vehicles with speed control.

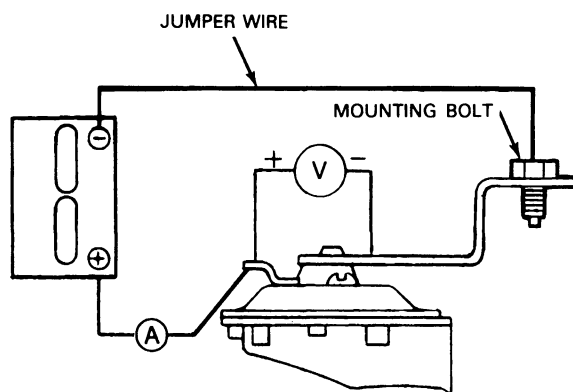
DIAGNOSIS AND TESTING

Circuit Check for all Vehicles

With Testing Equipment

Verify that the ground connection to the horn is good by checking that the torque on the mounting screw is 8-12 N·m (70-106 in-lb). Connect a wire from the positive terminal of the battery to the horn. If the horn blows normally, check the horn wiring and button. If it does not, proceed as follows.

Connect a voltmeter such as Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent and ammeter to the horn and vehicle battery. The voltmeter should read battery voltage. If the current reads zero amps (open circuit), replace the horn.



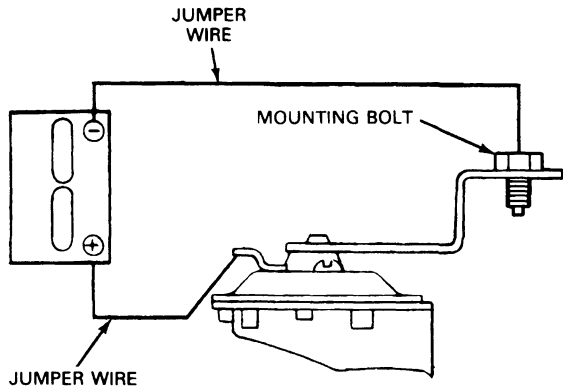
K1018-H

Without Test Equipment

Connect a jumper wire from the fastener bolt of the horn mounting bracket to the battery ground terminal. Connect another jumper wire from the horn terminal to the positive (+) terminal of the battery. If the horn does not sound, and there is no evidence of a spark at the battery terminal, replace the horn.

DIAGNOSIS AND TESTING (Continued)

If the horn passes the current test or function test and still does not blow when the horn pad is depressed, check the horn pad switch for continuity. Replace as necessary. Also check for an open or a short to ground in the horn wiring. Repair or replace the wiring as necessary.



K3300-C

REMOVAL AND INSTALLATION

Electric Horns

Econoline horn assemblies are mounted in front of the radiator to the bottom of the radiator support on the left side.

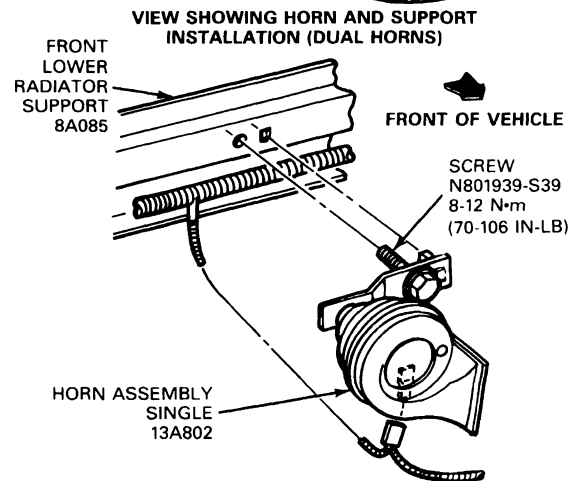
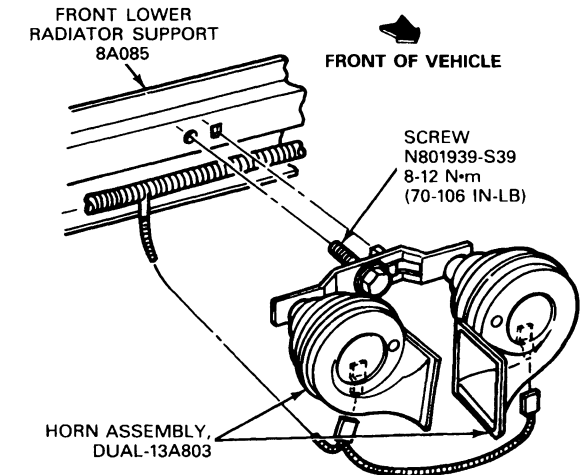
The Bronco, F-150-250-350 and F-Super Duty Chassis Cab high and low pitch horns are mounted to the right back side of the radiator support.

Removal and Installation

1. Disconnect wire from terminal.
2. Remove mounting bolt and horn.

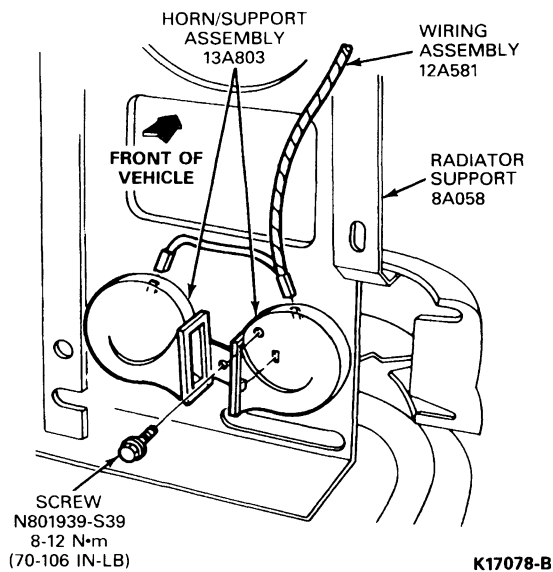
For installation, follow removal procedures in reverse order. Tighten mounting bolt to 8-12 N·m (70-106 in-lb).

Horn Installation, E-150-250-350



VIEW SHOWING HORN AND SUPPORT INSTALLATION (SINGLE HORN)

K17076-B

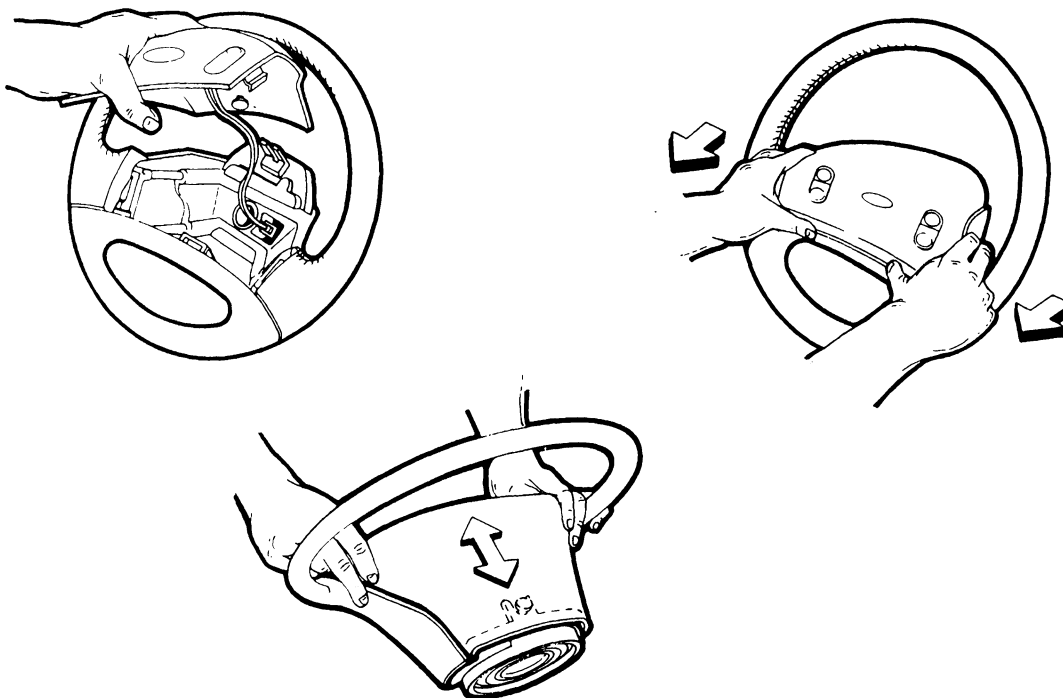
REMOVAL AND INSTALLATION (Continued)**Horn Installation, F-150-250-350, F-Super Duty and Bronco****Horn Switch Cover Assembly****E-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco (Non-Air Bag Wheel)****Removal and Installation**

1. Unsnap horn cover from steering wheel by grasping the sides of the horn cover and pulling toward yourself.
2. Disconnect the horn / speed control wire harness. Remove the horn cover from the steering wheel.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Horn Switch Cover Assembly, E-350, F-150-250-350, F-Super Duty Chassis Cab and Bronco (Non-Air Bag Wheel)



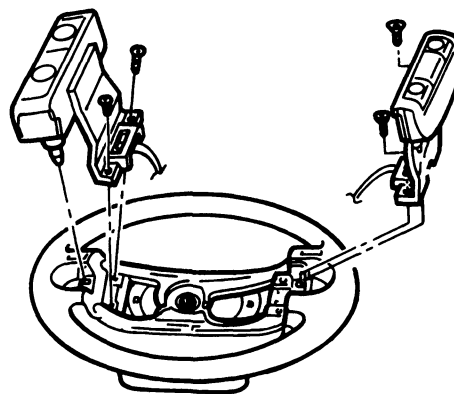
K17776-A

Horn Switch

E-150, E-250 (Steering Wheel with Air Bag)

Removal and Installation

1. Refer to Section 11-04A for steering wheel removal procedures.
2. Remove four screws in steering wheel, two at 3 o'clock and two at 9 o'clock position.
NOTE: On speed control steering wheels, these screws attach speed control switches to the steering wheel.

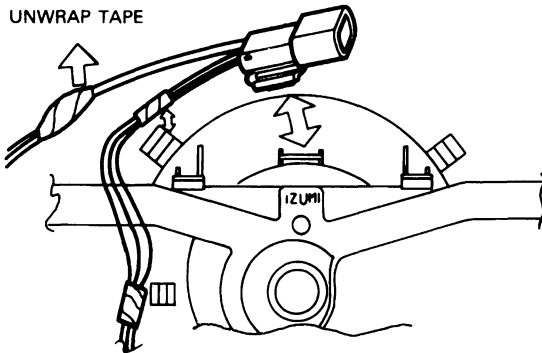


K17777-A

3. Remove wire harness clip from the blade connector at 12 o'clock position in steering wheel.

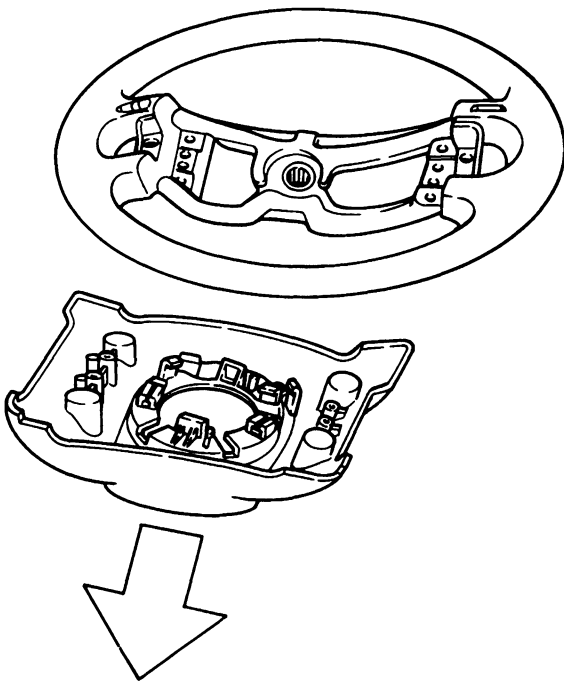
REMOVAL AND INSTALLATION (Continued)

4. Remove electrical tape from wire connectors in steering wheel, adjacent to each horn button. Lift wiring out of retention clips in steering wheel back cover.



K17778-A

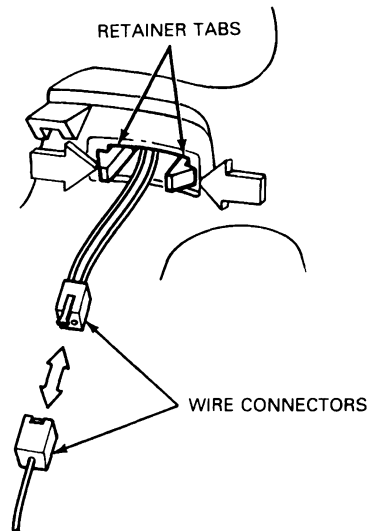
5. Remove steering wheel back cover by detaching retention clips at 11, 1, and 6 o'clock positions.



K17779-A

6. Remove horn button to be serviced by carefully squeezing together the two retainer tabs and pushing the horn switch up through the steering wheel. Disconnect horn button wires at each wire connector.

For installation procedures, follow removal procedures in reverse order.



K17780-B

Horn Relay

Bronco, F-150-250-350 and F-Super Duty

A horn relay is used only on vehicles equipped with speed control. It is located behind the instrument panel on the outboard (right) side of the glove box. The relay is mounted on the outboard attaching screw of the speed control amplifier module.

Removal and Installation

1. Remove electrical connector from relay.
2. Remove retaining screws and relay.

For installation, follow removal procedures in reverse order.

E-150-250-350

The E-150-250-350 horn relay is only used on speed control vehicles. It is located under the instrument panel to the left of the steering column on the fuse panel mounting bracket.

Removal and Installation

1. Remove electrical connector from relay.
2. Remove retaining screw and relay.

For installation, follow removal procedures in reverse order.

SPECIAL SERVICE TOOLS/EQUIPMENT

ROTUNDA EQUIPMENT	
Tool Number	Description
007-00001	Digital Volt-Ohmmeter

SECTION 13-09 Gauges / Warning Devices, Miscellaneous Electronics

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING	
Headlamps-On Warning (Available On Some Models)	13-09-2	Warning Chime / Buzzer System Diagnostic Procedure	13-09-2
Key-In-Ignition Warning	13-09-1	REMOVAL AND INSTALLATION	
Safety Belt Warning	13-09-1	Buzzer Module	13-09-7
		Warning Chime	13-09-6
		VEHICLE APPLICATION	13-09-1

VEHICLE APPLICATION

F-150-250-350, F-Super Duty Chassis Cab,
E-150-250-350 and Bronco

DESCRIPTION AND OPERATION

The warning chime / buzzer module produces a repetitive chime or steady buzzing sound for the following conditions:

- Fasten safety belt warning.
- Key-in-ignition warning with driver's door open.
- Headlamps-on warning (available on some models).

Safety Belt Warning

When the ignition switch is turned to RUN or START, power is supplied through Circuit 640 (R-Y) to the warning chime / buzzer module, which then supplies power through Circuit 450 (DG-LG) to illuminate the fasten belts indicator for six seconds, whether or not the driver's safety belt is fastened. If the driver's safety belt is NOT fastened during this time, the safety belt buckle switch remains closed, supplying ground through Circuit 85 (BR-LB) to the chime / buzzer module and causing it to sound for six seconds.

Key-In-Ignition Warning

The warning chime / buzzer sounds when the driver's door is open with the key in the ignition switch, and continues to sound until the key is removed or the door is closed. When the key is in the ignition, the key-in-ignition switch is closed and ground is supplied to the warning chime / buzzer module through Circuit 158 (BK-PK). When the driver's door is open, the driver's door courtesy lamp switch is closed and power is supplied to the module through Circuit 159 (R-PK).

DESCRIPTION AND OPERATION (Continued)**Headlamps-On Warning (Available On Some Models)**

The warning chime sounds when the main headlamp switch is in PARK or HEAD and the driver's door is open, and continues to sound until the switch is moved to OFF or the door is closed. When the main headlamps switch is in PARK or HEAD, power is supplied through Circuit 14 (BR) to the module. When the driver's door is open, the driver's door courtesy lamp switch is closed and power is supplied to the module through Circuit 159 (R-PK).

DIAGNOSIS AND TESTING**Warning Chime/Buzzer System Diagnostic Procedure**

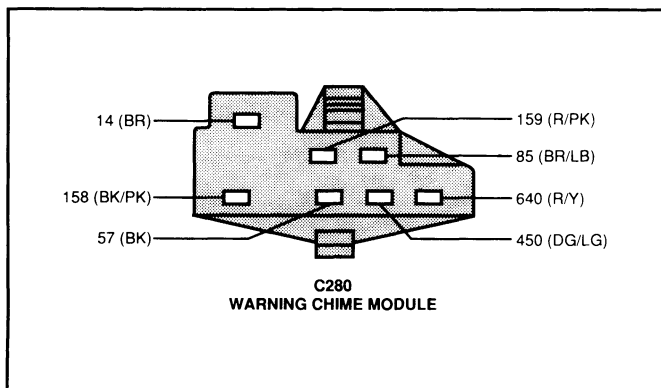
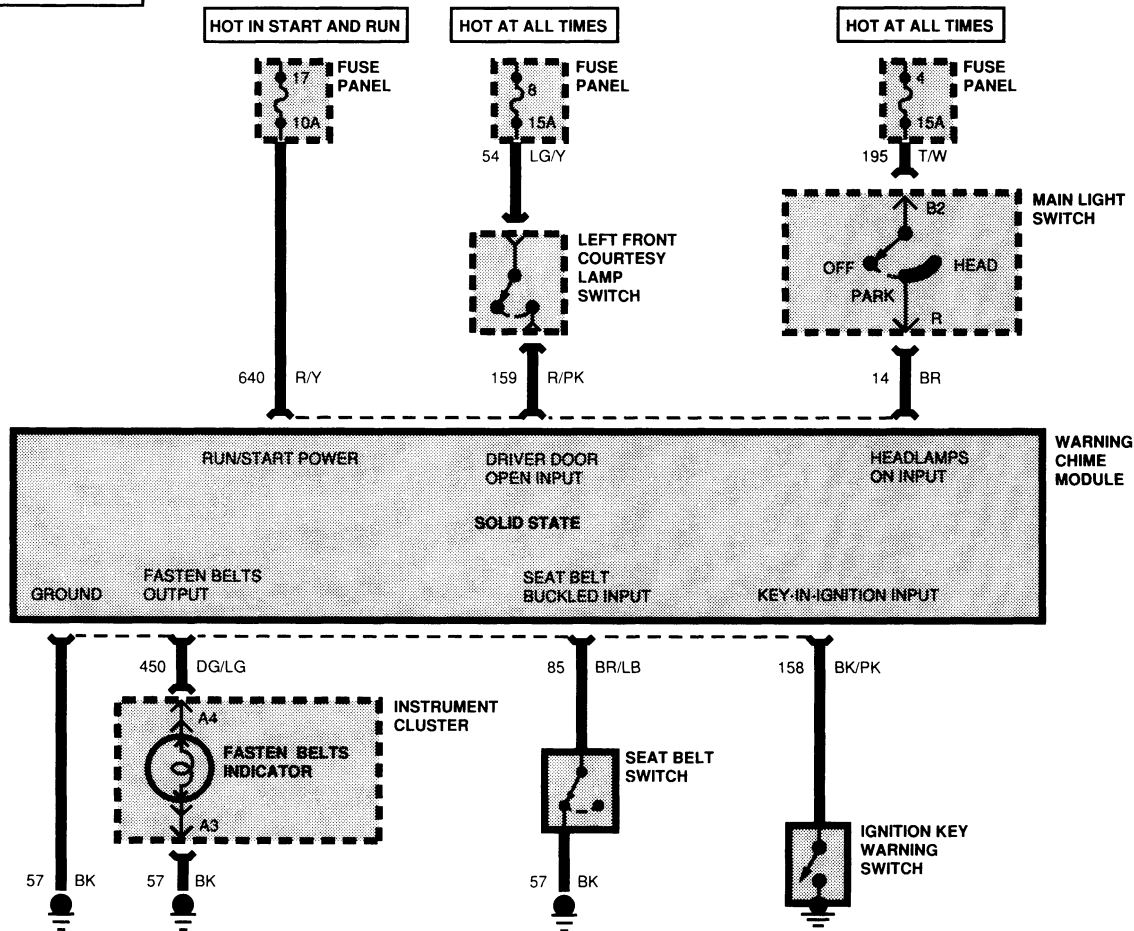
Check system fuse before proceeding.

- Equipment: 12-volt test lamp or ohmmeter.
- When necessary to trace and/or service the various circuits, refer to the vehicle wiring diagram and diagnostic chart.

DIAGNOSIS AND TESTING (Continued)

Wiring Diagrams

See EVTM for more details of this circuit

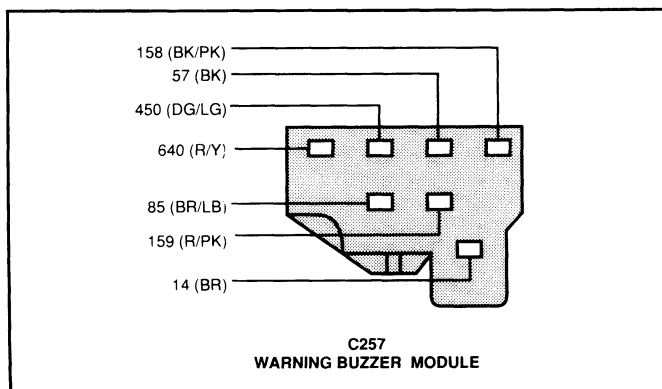
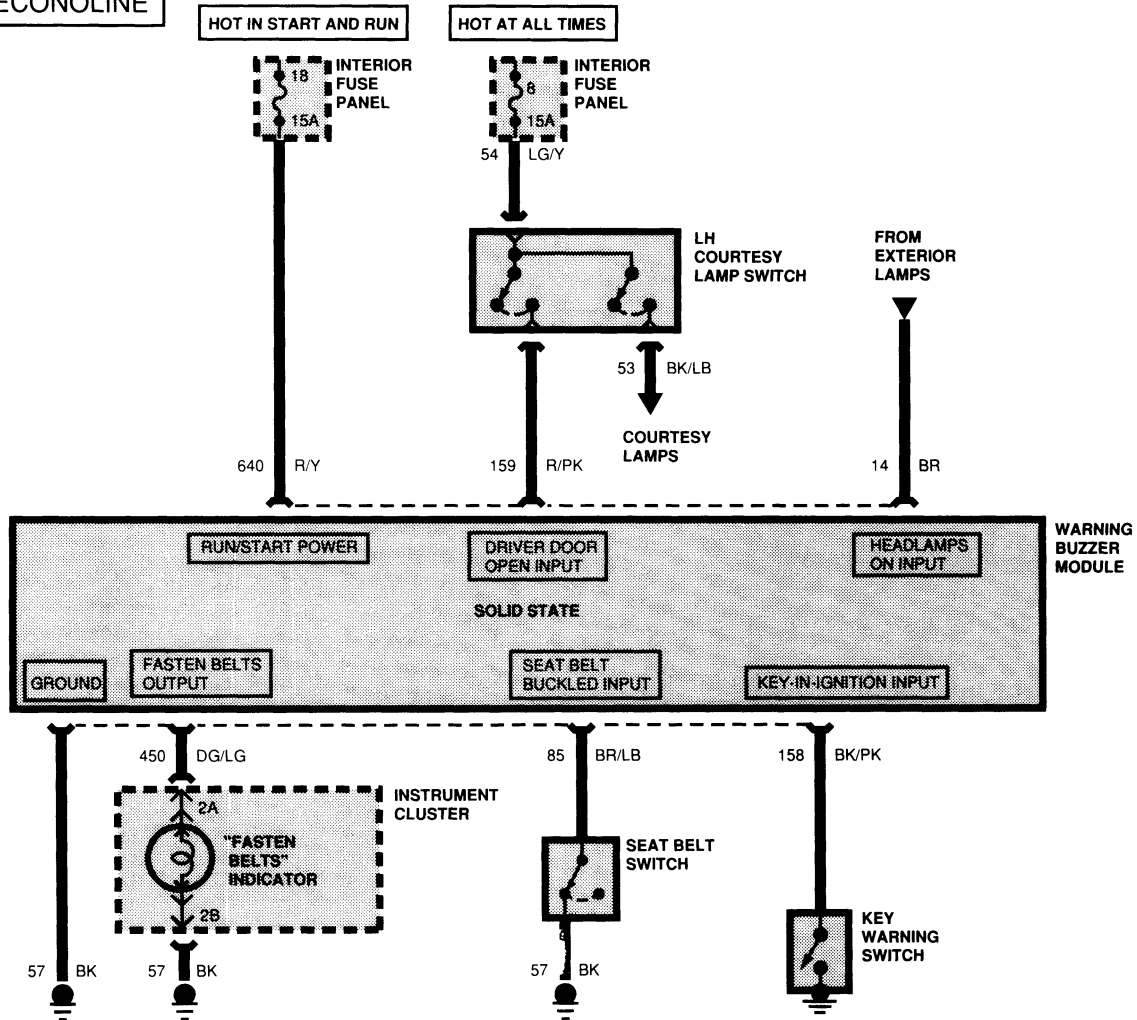
F-SERIES
AND
BRONCO

K18718-A

DIAGNOSIS AND TESTING (Continued)

See EVTM for more details of this circuit

ECONOLINE



K18719-A

DIAGNOSIS AND TESTING (Continued)

NOTE: The following is a step-by-step process of elimination procedure that must be performed in sequence in its entirety in order to obtain reliable results. If a specific failure condition is known, you may refer instead to the Electrical Vacuum Troubleshooting Manual to perform a quick check to determine cause and corrective action.

WARNING CHIME / BUZZER SYSTEM DIAGNOSTIC PROCEDURE — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK WARNING CHIME / BUZZER SYSTEM FUSE		
	<ul style="list-style-type: none"> If warning chime / buzzer is properly connected, check the warning chime / buzzer system fuse. 	Fuse not blown Fuse blown	GO to A2 . REPLACE fuse.
A2	CHECK FOR VOLTAGE AT CIRCUIT 640 (R-Y)		
	<ul style="list-style-type: none"> Disconnect warning chime / buzzer module. Connect a 12-volt test lamp between Circuit 640 (R-Y) in warning chime / buzzer connector and ground. Turn ignition switch to the run position. 	Test lamp lights Test lamp does not light	GO to A3 . CHECK Circuit 640 (R-Y) back to ignition switch. SERVICE as required. REPEAT A2 .
A3	CHECK FOR GROUND AT CIRCUIT 57 (BK)		
	<ul style="list-style-type: none"> Connect a 12-volt test lamp between Circuit 640 (R-Y) and 57 (BK) in warning chime / buzzer connector. Turn ignition switch to the run position. 	Test lamp lights Test lamp does not light	GO to A4 . CHECK Circuit 57 (BK) back to body ground. SERVICE as required. REPEAT A3 .
A4	CHECK CIRCUIT 450 (DG-LG) AND SAFETY BELT WARNING LAMP BULB		
	<ul style="list-style-type: none"> Connect jumper between Circuit 450 (DG-LG) and Circuit 640 (R-Y) in warning chime / buzzer module connector. Turn ignition switch to the run position. 	Safety belt warning lamp illuminates Lamp does not light	GO to A5 . CHECK Circuit 450 (DG-LB) back to safety belt warning lamp bulb. CHECK bulb. SERVICE as required. REPEAT A4 .
A5	CHECK FOR GROUND AT CIRCUIT 85 (BR-LB)		
	<ul style="list-style-type: none"> Retract safety belts. Connect a 12-volt test lamp between Circuit 85 (BR-LB) and Circuit 640 (R-Y) in warning chime / buzzer connector. Turn ignition switch to the run position. 	Test lamp lights Test lamp does not light	GO to A6 . CHECK Circuit 85 (BR-LB) back to safety belt switch. SERVICE as required. REPEAT A5 .
A6	CHECK FOR GROUND AT CIRCUIT 158 (BK-PK)		
	<ul style="list-style-type: none"> Turn ignition switch to the run position. Connect a 12-volt test lamp between Circuit 158 (BK-PK) and Circuit 640 (R-Y) in warning chime / buzzer connector. 	Test lamp lights Test lamp does not light	GO to A7 . CHECK Circuit 158 (BK-PK) back to lock cylinder switch. SERVICE as required. REPEAT A6 .
A7	CHECK FOR VOLTAGE AT CIRCUIT 159 (R-PK)		
	<ul style="list-style-type: none"> Connect a 12-volt test lamp between Circuit 159 (R-PK) in warning chime / buzzer connector and ground. Open door. 	Test lamp lights Test lamp does not light	GO to A8 OR GO to A9 , as appropriate. CHECK Circuit 159 (R-PK) back to courtesy lamp switch. SERVICE as required. REPEAT A7 .

DIAGNOSIS AND TESTING (Continued)**WARNING CHIME / BUZZER SYSTEM DIAGNOSTIC PROCEDURE — TEST A (Continued)**

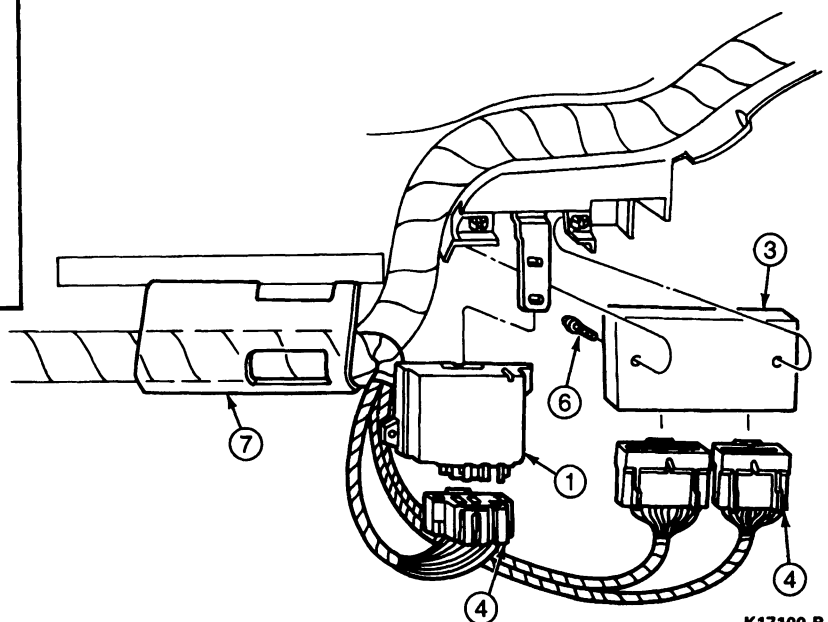
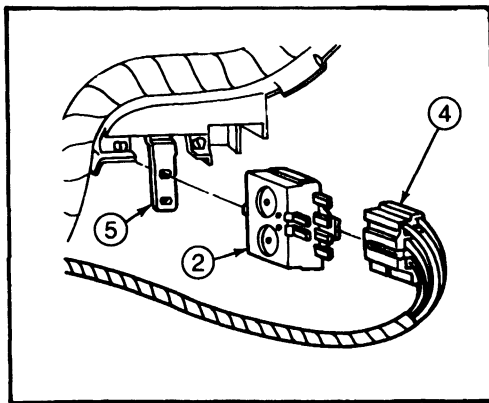
TEST STEP	RESULT	ACTION TO TAKE
A8 CHECK FOR VOLTAGE AT CIRCUIT 14 (BR) (ONLY FOR VEHICLES WITH HEADLAMPS-ON WARNING FEATURE) <ul style="list-style-type: none"> Connect a 12-volt test lamp between Circuit 14 and a known ground. Pull headlamp switch on. 	Test lamp lights Test lamp does not light	GO to A9. CHECK Circuit 14 back to headlamp switch. SERVICE as required. REPEAT A8.
A9 CHECK WARNING CHIME / BUZZER MODULE OPERATION <ul style="list-style-type: none"> Connect warning chime / buzzer module. Check for proper operation of: <ul style="list-style-type: none"> Safety belt warning. Key in ignition warning. Headlamp switch on warning (for vehicles equipped). 	All warnings operate properly One, two or three warnings inoperative All warnings not operating	System operating properly. CHECK back through appropriate circuit(s). SERVICE as necessary. REPEAT A9. REPLACE warning chime / buzzer module. REPEAT A9.

TK17099B

REMOVAL AND INSTALLATION**Warning Chime****Removal and Installation**

- Depress plastic tab on chime module case to release the chime module from the metal bracket.
- Slide the chime module off the metal bracket.
- Disconnect wiring connector from chime module.

For chime installation, follow removal procedures in reverse order. Check operation of chime.

Warning Chime / Buzzer Module Installation, F-150-250-350, F-Super Duty Chassis Cab and Bronco

K17100-B

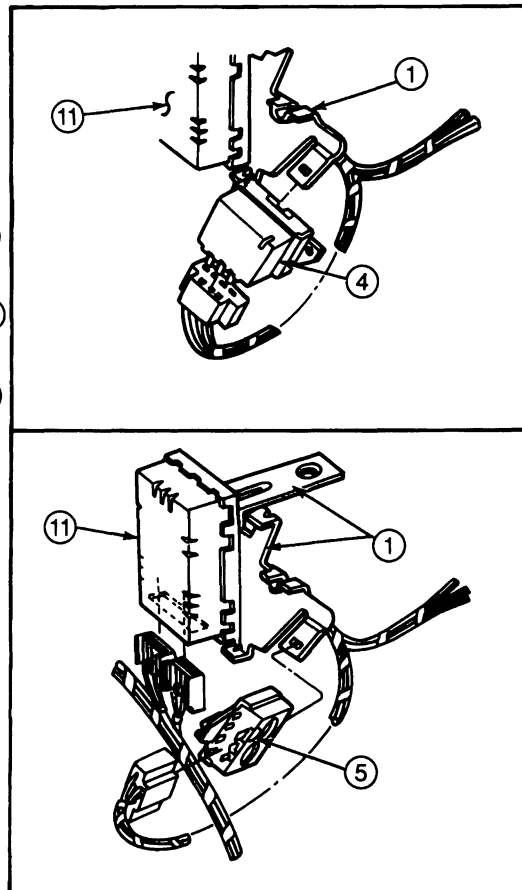
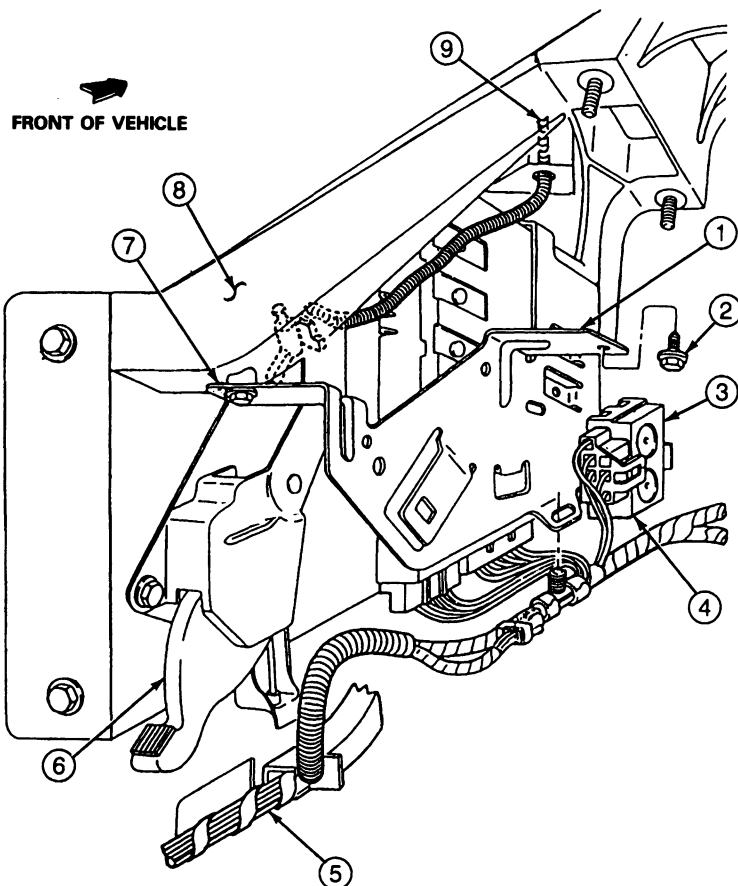
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	10D840	Chime Assembly
2	10B924	Warning Buzzer
3	9D844	Speed Control Amplifier
4	14401	Wiring Assembly

(Continued)

Item	Part Number	Description
5	—	Part of Instrument Panel
6	N807010-S36	Screw (2 Req'd)
7	14A099	Shield

TK17100A

Warning Chime / Buzzer Module Installation, E-150-250-350

K17102-B

Item	Part Number	Description
1	14B058	Air Bag Monitor Bracket
2	N806339-S2	Screw(s) (2 Req'd)
3	10B924	Buzzer Assembly
4	10D840	Chime Assembly
5	14A200	Wiring Assembly

(Continued)

Item	Part Number	Description
6	—	Parking Brake Assembly
7	N611174-S36	Fastener Screw(s) (2 Req'd)
8	313139	Steering Column Support
9	14401	Wiring Assembly
10	14B056	Air Bag Diagnostic Monitor

TK17102A

Buzzer Module**Removal and Installation**

1. Rotate buzzer 90 degrees.
2. Remove buzzer from bracket.

3. Disconnect wiring connector from buzzer module.
For buzzer installation, follow removal procedures in reverse order. Check buzzer operation.

SECTION 13-11 Theft Warning

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Activating the PANIC Alarm	13-11-5	Ignition Key Lock Cylinder Sensor	13-11-8
Arming the System	13-11-4	REMOVAL AND INSTALLATION	
Components	13-11-4	Control Module	13-11-5
Disarming a Triggered System	13-11-5	Door Disarm Switches, Anti-Theft	13-11-7
Disarming an Untriggered System	13-11-4	Hood Switch	13-11-6
Triggering the System	13-11-5	Ignition Key Lock Cylinder Sensor	13-11-7
DIAGNOSIS AND TESTING		Indicator Lamp, Anti-Theft	13-11-7
Diagnosis Guides	13-11-8	SPECIAL SERVICE TOOLS/EQUIPMENT	13-11-16
Door	13-11-7	SPECIFICATIONS	13-11-16
Hood Switch	13-11-8	VEHICLE APPLICATION	13-11-1

VEHICLE APPLICATION

E-150-250-350 Vehicles

DESCRIPTION AND OPERATION

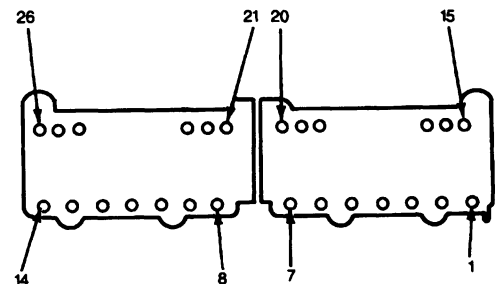
The anti-theft protection system provides two types of vehicle protection. The first is designed to provide the vehicle with protection from unauthorized entry into the passenger compartment and engine compartment (hood opening). The second monitors the status of the ignition key lock cylinder. If triggered, the system provides both audio and visual alarm signals and disables the starter circuit.

The system is controlled by an electronic module. When armed, unauthorized entry into the vehicle is detected by courtesy lamp switches (located in the passenger compartment door jambs), and a hood switch (located on the right cowl surface). In addition, the system triggers an alarm if the ignition lock cylinder is forcibly removed from the steering column.

NOTE: The system immediately monitors the ignition key lock cylinder upon removal of the key from the ignition.

Once triggered, the system flashes the low beam headlamps, the parking lamps, the alarm indicator, and sounds the horn. In addition, the starter circuit is interrupted until the system is disarmed.

Anti-Theft Connector Pinout



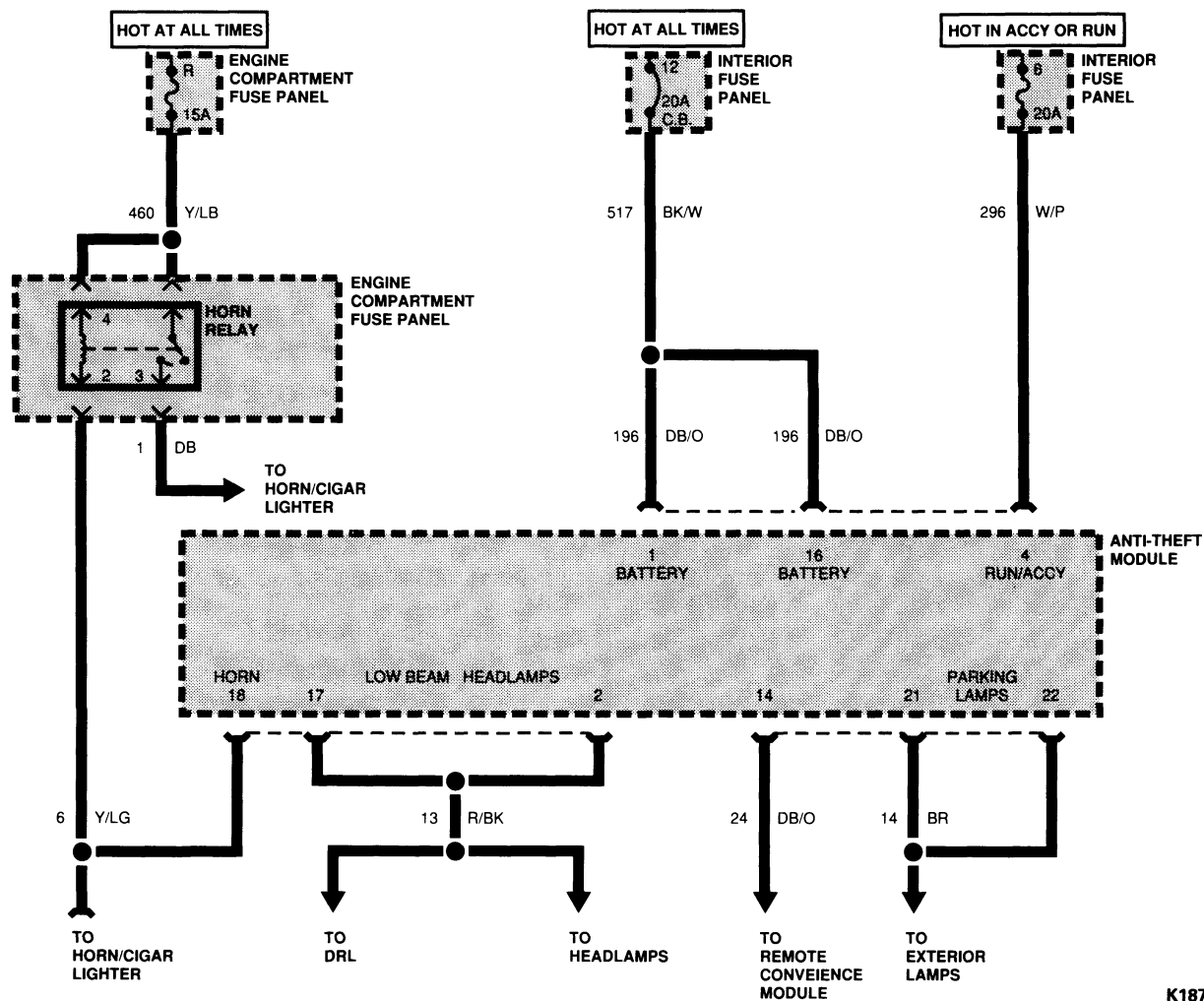
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DESCRIPTION AND OPERATION (Continued)

Wiring Schematics

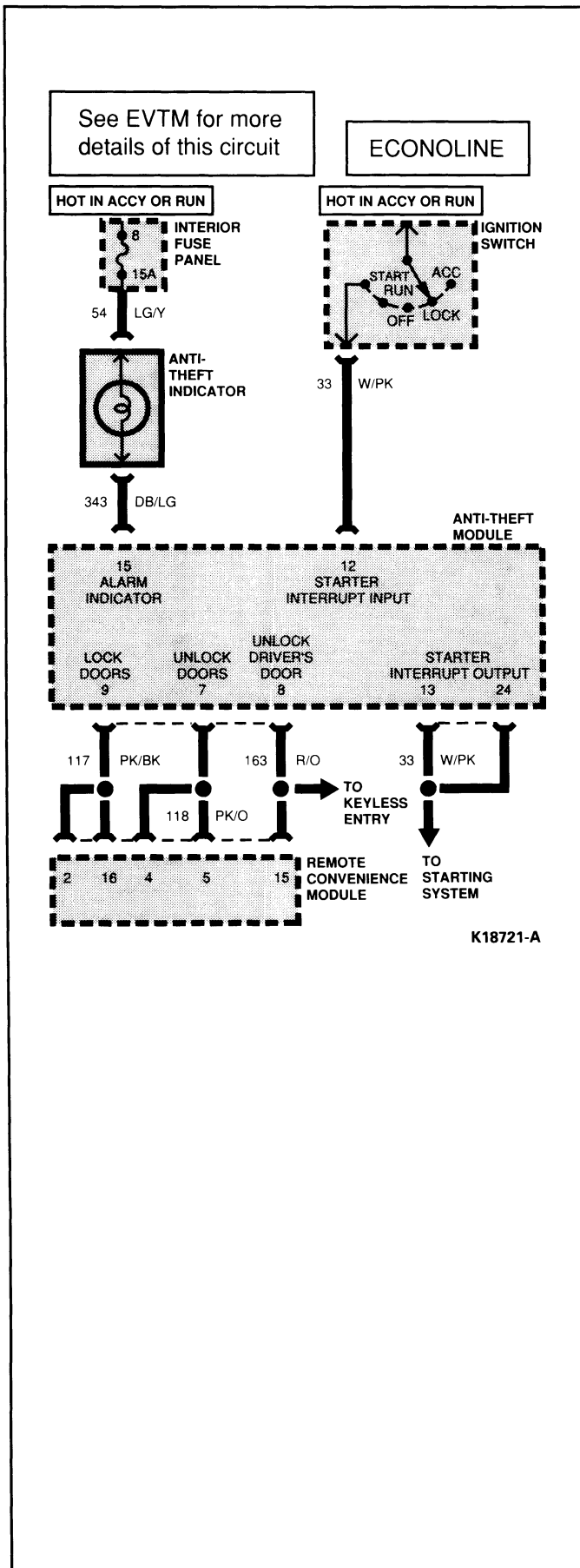
See EVTm for more details of this circuit

ECONOLINE

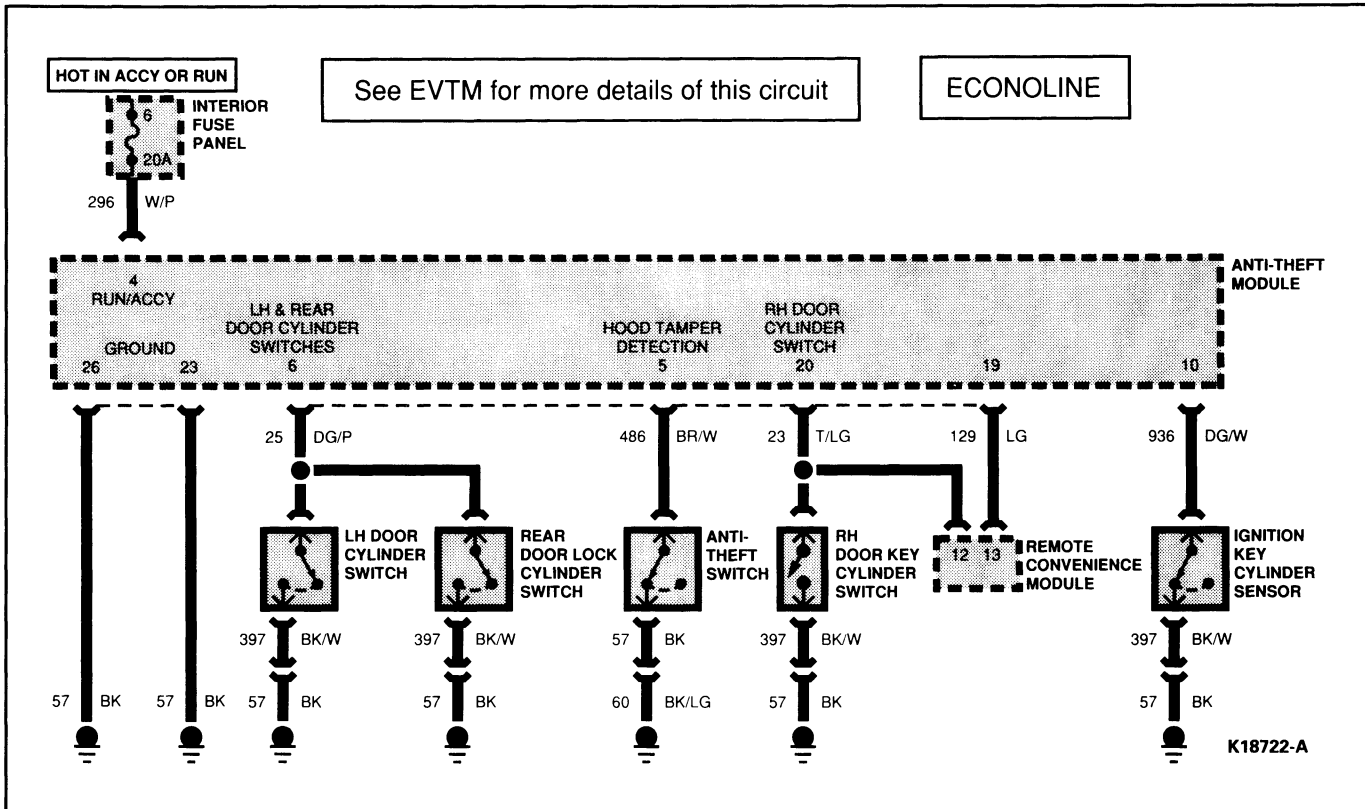


K18720-A

DESCRIPTION AND OPERATION (Continued)



DESCRIPTION AND OPERATION (Continued)

**Components**

The system is composed of the following components:

- Anti-theft control module
- Anti-theft warning lamp
- Door key unlock switches
- Hood switch
- Remote convenience module and transmitters
- Ignition key lock cylinder sensor

The following components already exist on the vehicle and are also used in the Anti-theft system:

- Electric door lock switches
- Courtesy lamp switches
- Horn relay
- Low beam headlamps
- Parking lamps
- Starter relay

The alarm system operating sequences are designed to be passive; therefore, the system can be armed or disarmed when following normal vehicle exit and entry procedures. Following is a detailed description of the system operation.

Arming the System

The system will be armed by the remote convenience transmitter when the following input sequence is followed:

1. Turn off ignition.
2. Close all doors (door unlocked).
3. Press the LOCK button on a transmitter to lock doors.
4. Wait approximately 30 seconds for the anti-theft indicator lamp to turn off.

The system will also be armed when the following input sequence is followed:

5. Turn off ignition.
6. Open a door.
7. Lock doors with power door locks.
8. Close all doors.
9. Wait approximately 30 seconds for the anti-theft indicator lamp to turn off.

NOTE: Opening the passenger compartment doors or opening the hood will activate the alarm after the alarm is armed.

Disarming an Untriggered System

The system can be disarmed by performing one of the following procedures.

DESCRIPTION AND OPERATION (Continued)

- Unlock driver's door or passenger's door with a key.
- Unlock driver's door by pressing the UNLOCK button of a remote convenience transmitter.
- If remaining in the vehicle, turn ignition switch to ON or ACC.

Triggering the System

The alarm system will be triggered if either of the following steps is taken.

- Door is opened without using a key or a remote convenience transmitter to unlock the door first.
- Hood is opened.

Disarming a Triggered System

Performing either of the following steps will disarm the triggered alarm system.

- Driver's door or passenger's door is unlocked with a key.
- Driver's door is unlocked by pressing the UNLOCK button of a remote convenience transmitter.

NOTE: Within two to four minutes after the system has been triggered, the horns and exterior lamps will shut off automatically. The system will then reset to an armed state and will trigger again if another intrusion occurs. The vehicle's starter circuit will remain disabled until the system is disarmed.

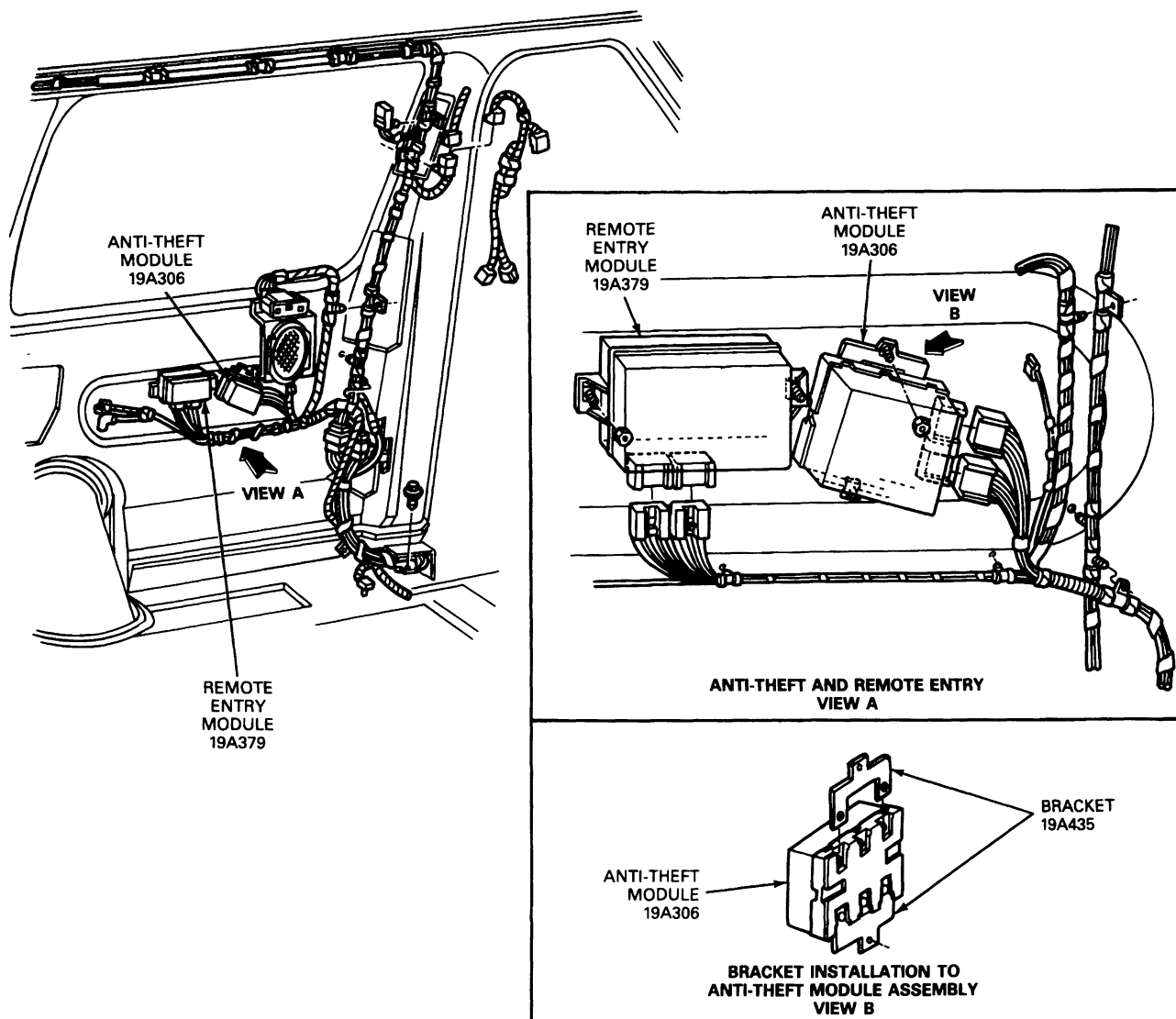
Activating the PANIC Alarm

1. Press the PANIC button of a remote convenience transmitter. The exterior lights and horn will flash for approximately four minutes or until:
 - a. the PANIC button is pressed again, or
 - b. the ignition is turned on.

REMOVAL AND INSTALLATION**Control Module****Removal and Installation**

1. Disconnect battery ground cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
2. Remove the left side interior mouldings and trim.
3. Disconnect white wiring harness electrical connectors to control module. (Module can be identified by a tan color).
4. Remove two screws securing control module.

REMOVAL AND INSTALLATION (Continued)**Control Module**

N9619-A

For installation, follow removal procedures in reverse order.

Hood Switch**Removal and Installation**

1. Disconnect battery ground cable.

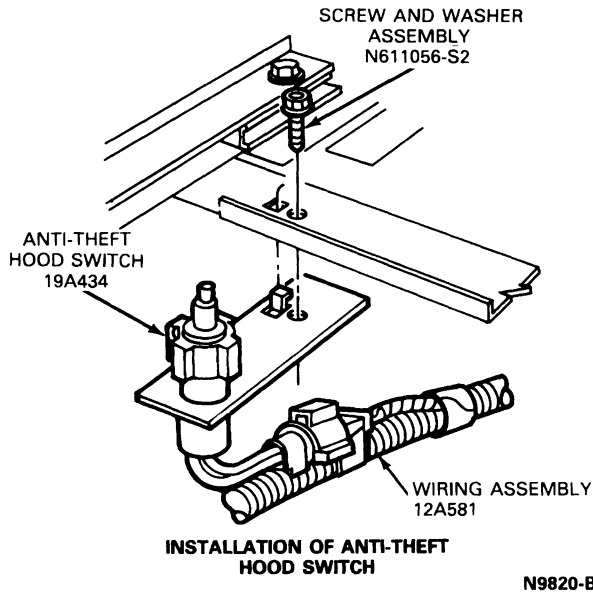
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

2. Locate hood switch on right side of cowl surface.
3. Disconnect electrical connector from hood switch.

REMOVAL AND INSTALLATION (Continued)

4. Remove two screws retaining hood switch assembly. Remove hood switch.

For installation, follow removal procedures in reverse order.

**Indicator Lamp, Anti-Theft**

To replace the indicator lamp, refer to Section 13-01.

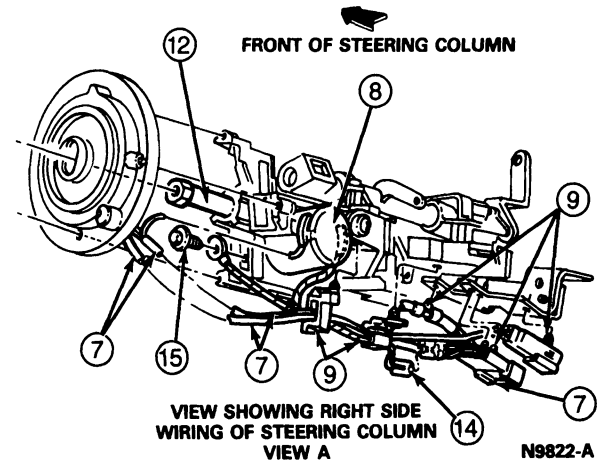
Door Disarm Switches, Anti-Theft

To replace the door disarm switches, refer to Section 01-14A.

Ignition Key Lock Cylinder Sensor**Removal**

1. Disconnect battery ground cable.
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
2. Remove the ignition key lock cylinder from steering column housing. Refer to Section 11-04.
3. Locate ignition key lock cylinder sensor attaching to steering column housing next to key warning buzzer switch.
4. Slide the sensor off steering column casting.
5. Remove the clock spring assembly to access the ground location of the ignition key lock cylinder sensor.

6. Disconnect ground terminal.
7. Disconnect the ignition key lock cylinder sensor from wiring harness.



Item	Part Number	Description
7	14A664	Wiring Assembly
8	—	To Ignition Switch Assembly
9	—	Locator
12	—	Steering Column Assembly
14	19A438	Switch Assembly, Ignition Lock Anti-theft
15	390345-S36	Screw

TN9822A

Installation

1. Attach ground terminal to steering column.
2. Install the clock spring assembly.
3. Slide ignition key lock cylinder sensor onto steering column housing and snap into position.
4. Attach connector to the wiring harness.
5. Install the ignition key lock cylinder into housing.
6. Install steering column housing.
7. Connect battery ground cable.

DIAGNOSIS AND TESTING**Door**

Measure switch resistance using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, with key removed from the door lock. The resistance should be more than 25,000 ohms. If not, refer to Test B, Verification of Unactivated Alarm Disarming Sequence.

DIAGNOSIS AND TESTING (Continued)

Measure the switch resistance with the key rotated 45 degrees from center of travel in the unlock direction in the driver's door. The resistance should be less than 200 ohms, and should remain less than 200 ohms when the key is fully rotated to the end of travel in the unlock direction. If not, refer to Test B, Verification of Unactivated Alarm Disarming Sequence.

Repeat test for unlocked position for passenger's and rear door.

Ignition Key Lock Cylinder Sensor

Disconnect anti-theft control module and measure the resistance between pin 10 and pin 26 at the wiring harness connectors. Resistance should be between 145 and 175 ohms. If not, replace the ignition key lock cylinder sensor or service Circuit 936.

Hood Switch

Disconnect anti-theft control module and measure the resistance between pin 5 and pin 26. The resistance should be more than 25,000 ohms when the hood is closed. The resistance should be less than 200 ohms when the hood is unlatched or open. If not, service Circuit 486 BR-W or replace the hood switch.

Diagnosis Guides

Refer to the following chart to perform individual tests on the anti-theft protection system.

Test	Symptom
A	Verification of Alarm Arming Sequence
B	Verification of Unactivated Alarm Disarming Sequence
C	Verification of Alarm Activation
D	Verification of Activated Alarm Disarming Modes

(Continued)

Test	Symptom
E	Vehicle Will Not Crank
F	Alarm Lamp is On All the Time
G	Alarm Lamp Does Not Work
H	Horn, Headlamps, Exterior Lamps Are On All the Time
J	System Activates Falsely
K	Verification of Door Disarm Switch, Ignition Key Lock Cylinder Sensor, and Hood Switch Inputs

TN9824A

VERIFICATION OF ALARM ARMING SEQUENCE — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	START VEHICLE THEN TURN IGNITION SWITCH OFF	Make sure alarm system is reset	GO to A2.
A2	ALARM INDICATOR CHECK		
	<ul style="list-style-type: none"> Close all vehicle doors. Verify indicator lamp is off. 	Off	GO to A3.
		Blinking	GO to A6.
		On steady	GO to A11.
A3	WARNING LAMP CHECK		
	<ul style="list-style-type: none"> Open a vehicle door. Verify warning lamp blinks. 	Blinks	GO to A4.
		No blinking	GO to A7.
A4	WARNING LAMP VERIFICATION		
	<ul style="list-style-type: none"> Activate the electric door lock switch. 	Lamp continuous	GO to A5.
		Lamp blinking	GO to A9.

DIAGNOSIS AND TESTING (Continued)**VERIFICATION OF ALARM ARMING SEQUENCE — TEST A (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
A5	WARNING LAMP TURNS OFF		
	<ul style="list-style-type: none"> Close the vehicle door completely. Verify the warning lamp turns off after 32 seconds. 	Lamp out Lamp remains on Alarm triggers	Manual arming sequence verified. GO to A14 . REPLACE control module. RETEST system. GO to TEST J .
A6	TERMINAL 14 VERIFICATION		
	<ul style="list-style-type: none"> Verify voltage on terminal 14 of module is less than 2 volts. 	Less than 2 volts More than 2 volts	Damaged module. REPLACE. RETEST system. Verify doors are completely closed. Courtesy lamp door switch contacts may be shorted to B+. Check Circuit 346 (BK-W). RETEST system.
A7	COURTESY LAMP OPERATION		
	<ul style="list-style-type: none"> Are the interior courtesy lamps on? 	Yes No	GO to A8 . SERVICE door courtesy lamp switches or Circuit 346 (BK-W). RETEST system.
A8	TERMINAL 14 VERIFICATION		
	<ul style="list-style-type: none"> Measure the voltage at terminal 14 of the control module. Check if it is greater than 7 volts. 	More than 7 volts Less than 7 volts	GO to TEST G . SERVICE Circuit 346 (BK-W). RETEST system.
A9	DOOR LOCK OPERATION		
	<ul style="list-style-type: none"> Did the doors lock? 	Doors locked Doors did not lock	GO to A10 . REFER to Remote Door Entry, Section 01-14B. SERVICE as required. RETEST system.
A10	TERMINAL 7 VERIFICATION		
	<ul style="list-style-type: none"> Verify door unlock terminal 7 (Circuit 118 PK-O) of the module is less than 2 volts and a momentary B+ signal is applied to terminal 9 (Circuit 117 PK-BK) when the door lock switch or keyless entry is activated. 	Momentary B+ on terminal 9 during power lock operation and terminal 7 less than 2 volts Voltage on terminal 9 remained less than 2 volts during power lock operation or terminal 7 greater than 2 volts	GO to A12 . SERVICE Circuit 117 (PK-BK) or Circuit 118 (PK-O). (Note Circuit 117 (PK-BK) should be at B+ voltage level only momentarily when the lock switch is activated.) RETEST system.
A11	LAMP OPERATION		
	<ul style="list-style-type: none"> Disconnect the harness connectors from the control module. 	Lamp still on Lamp goes off	SERVICE Circuit 343 (DB-LG) for short. RETEST system. REPLACE control module. RETEST system.

DIAGNOSIS AND TESTING (Continued)

VERIFICATION OF ALARM ARMING SEQUENCE — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A12	TERMINAL 20 VERIFICATION		
	<ul style="list-style-type: none"> Verify that the resistance between terminal 20 (T-LG) and terminal 26 (BK), ground, is greater than 25,000 ohms. 	Greater than 25,000 ohms Less than 25,000 ohms	GO to A13 . SERVICE passenger's door disarm switch or shorted Circuit 23 (T-L). REPEAT test.
A13	TERMINAL 6 VERIFICATION		
	<ul style="list-style-type: none"> Verify that the resistance between terminal 6 and terminal 26 (BK), ground, is greater than 25,000 ohms. 	Greater than 25,000 ohms Less than 25,000 ohms	REPLACE damaged module. RETEST system. SERVICE driver's and/or rear door disarm switch or shorted Circuit 25 (DG-P). REPEAT test.
A14	ARM ANTI-THEFT SYSTEM WITH TRANSMITTER		
	NOTE: Perform this step only for vehicles equipped with the FORD factory installed remote/keyless entry system. <ul style="list-style-type: none"> Ignition switch ON — reset alarm. Ignition switch OFF. Close all doors. — Doors unlocked Press the LOCK button on a transmitter to lock doors. 	Lamp OFF when doors closed; lamp ON for 30 seconds after doors lock Any problems	STOP. All arming sequences verified. SERVICE Remote Convenience System as required. REPLACE Module. REPEAT Quick Test.

TN9796B

VERIFICATION OF UNACTIVATED ALARM DISARMING SEQUENCE — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	DRIVER AND REAR DOOR KEY DISARM CHECK		
	<ul style="list-style-type: none"> Arm the alarm system by performing TEST A. Insert door key into driver's door and turn to the unlock position. Open vehicle door. Repeat Step B1 for rear door. 	Lamp blinks and alarm does not trigger Alarm triggers	System OK. GO to B3 . Try key in other door or unlock with remote transmitter or DISCONNECT battery to stop alarm. GO to B2 .
B2	TERMINAL 6 VERIFICATION		
	<ul style="list-style-type: none"> Verify terminal 6 (Circuit 25 BG-P) of the control module is less than 1 Volt when the driver's door key is in the unlocked position. Repeat Step B2 unlocking the rear door. 	Less than 1 Volt Greater than 1 Volt	Damaged module. REPLACE, RETEST system. SERVICE door disarm switch or Circuit 25 (DG-P) for open circuit. RETEST system.
B3	PASSENGER DOOR KEY DISARM CHECK		
	<ul style="list-style-type: none"> Arm the alarm system. Insert door key into passenger's door and turn to the unlock position. Open vehicle door. 	Lamp blinks and alarm does not trigger Alarm triggers	System OK. GO to B5 . Try key in other door, unlock with remote transmitter or DISCONNECT battery to stop alarm. GO to B4 .

DIAGNOSIS AND TESTING (Continued)**VERIFICATION OF UNACTIVATED ALARM DISARMING SEQUENCE — TEST B (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
B4	TERMINAL 20 VERIFICATION		
	<ul style="list-style-type: none"> Verify terminal 20 (Circuit 23 T-LG) of the control module is less than 1 Volt when the passenger's door key is in the unlocked position. 	Less than 1 Volt Greater than 1 Volt	REPLACE damaged module. RETEST system. SERVICE door disarm switch or Circuit 23 (T-LG). RETEST system.
B5	REMOTE ENTRY DISARM CHECK		
	<ul style="list-style-type: none"> Arm the alarm system. Press the UNLOCK button of a remote transmitter to unlock doors. Open a vehicle door from the outside of the vehicle. 	Lamp blinks and alarm remains off Alarm triggers	System OK. GO to B6. Use door key to stop alarm. GO to B10.
B6	ELECTRIC DOOR UNLOCK CHECK		
	<ul style="list-style-type: none"> Open vehicle door and activate electric lock switch. Activate electric door unlock switch. 	Lamp blinks Lamp glows steady	GO to B8. Insert door key and unlock door to disarm system. GO to B7.
B7	TERMINAL 7 AND 9 VERIFICATION		
	<ul style="list-style-type: none"> Press unlock switch for the power door locks. Verify a momentary B+ signal is at terminal 7 (Circuit 118 PK-O) and terminal 9 (Circuit 117 PK-BK) is less than 2 Volts when unlock switch is activated. 	B+ present momentarily on terminal 7 and terminal 9 is less than 2 Volts during power unlock No Voltage present during power unlock actuation or Voltage on terminal 7 remains less than 2 Volts or terminal 9 is greater than 2 Volts.	Damaged module. REPLACE, RETEST system. SERVICE Circuit 118 (PK-O) or Circuit 117 (PK-BK). RETEST system.
B8	IGNITION KEY DISARM		
	<ul style="list-style-type: none"> Open any vehicle door. Observe blinking alarm lamp. Insert ignition key and turn to ACC or RUN. 	Alarm indicator turns off Alarm indicator continues to blink	Ignition input OK. System OK. STOP test. GO to B9.
B9	TERMINAL 4 VERIFICATION		
	<ul style="list-style-type: none"> Verify terminal 4 (Circuit 296 W-P) of control module is greater than 9 Volts with ignition key in RUN, ACC. 	Greater than 9 Volts Less than 2 Volts	DAMAGED module. REPLACE, RETEST system. SERVICE ignition switch or Circuit 296 (W-P) for open circuit. RETEST system.
B10	TERMINAL 8 VERIFICATION		
	<ul style="list-style-type: none"> Verify a momentary B+ signal is present at terminal 8 (Circuit 163 R-O). Remote entry transmitter unlock button is pressed and is less than 2 Volts on terminal 7 at all times. 	B+ present during keyless entry unlock No Voltage present during keyless entry unlock activation	REPLACE damaged module. RETEST system. SERVICE Circuit 163 (R-O). RETEST system. REFER to Remote Door Entry, Section 01-14B.

TN9797B

DIAGNOSIS AND TESTING (Continued)**VERIFICATION OF ALARM ACTIVATION — TEST C**

TEST STEP		RESULT	ACTION TO TAKE
C1	CHECK ALARM		
	<ul style="list-style-type: none"> Verify alarm system passes TEST A. Ensure hood is closed. Roll down driver's window. Perform TEST A to arm system. (Remain inside the vehicle.) Open driver's door from inside handle. Repeat TEST C1 opening the rear door from the inside handle. 	Alarm turns on and off at approximately 1 hertz rate Alarm does not turn on Alarm triggers before opening a door Alarm turns on continuously	Unlock the door with a key to disarm the system. GO to C2. SERVICE courtesy lamp switches and/or open Circuit 346 (BK-W). GO to TEST H. REPLACE damaged module. RETEST system.
C2	CHECK ALARM WITH PASSENGER DOOR		
	<ul style="list-style-type: none"> Perform TEST A to arm the system. (Remain inside the vehicle.) Open the passenger's door from the inside handle. 	Alarm triggers Alarm does not trigger	Unlock the door with a key to disarm the system. GO to C3. SERVICE right door courtesy lamp disarm switch and/or open Circuit 346 (BK-W).
C3	CHECK ALARM WITH THE HOOD		
	<ul style="list-style-type: none"> Perform TEST A to arm the system. (Remain inside the vehicle.) Open the hood with the hood release inside the vehicle. 	Alarm triggers Alarm does not trigger	GO to C4. SERVICE the hood switch and/or open Circuit 486 (BR-W).
C4	ALARM VERIFICATION — HORN		
	<ul style="list-style-type: none"> Horns should turn off and on at approximately 1 hertz rate. 	Horns sound Horns silent	GO to C5. SERVICE horn relay and/or Circuit 1 (DB) or SERVICE horns. RETEST
C5	ALARM VERIFICATION — TAIL / PARKING LAMP		
	<ul style="list-style-type: none"> Tail and parking lamps should turn off and on. 	Lamps flash Lamps remain off	GO to C6. SERVICE Circuit 14 BR. RETEST system.
C6	ALARM VERIFICATION — LOW BEAM		
	<ul style="list-style-type: none"> Low beam headlamps should turn off and on. 	Headlamps flash Headlamps remain off	GO to C7. SERVICE Circuit 13 R/BK. RETEST system.
C7	CHECK ALARM		
	<ul style="list-style-type: none"> Attempt to start the vehicle. 	Will not start Vehicle starts	System OK. Unlock door with a key to disarm the system. STOP test. GO to C8.
C8	RE-CHECK ALARM		
	<ul style="list-style-type: none"> Disconnect alarm module from wiring harness. Attempt to start vehicle. 	Vehicle starts Will not start	GO to C9. REPLACE damaged module. RETEST system.
C9	OPEN CIRCUIT CHECK		
	<ul style="list-style-type: none"> Verify open circuit (greater than 1000 ohms) between Pins 12 and 13 of anti-theft module harness connector. 	Greater than 1000 ohms Less than 50 ohms	REPLACE damaged module. RECONNECT module. RETEST system. SERVICE Circuits 32 (R-LB) and 33 (W-PK) RECONNECT module. RETEST system.

TN8510D

DIAGNOSIS AND TESTING (Continued)**VERIFICATION OF TRIGGERED ALARM DISARMING MODES — TEST D**

TEST STEP		RESULT	ACTION TO TAKE
D1	DRIVER AND REAR DOOR KEY DISARM CHECK		
	<ul style="list-style-type: none"> Arm the alarm system with a window down. Open a door from the inside door handle. Unlock driver's door with key. Repeat Step D1 for rear door. 	Alarm triggers then turns off, alarm lamp blinks Alarm does not turn off	GO to D3 . GO to D2 .
D2	TERMINAL 6 VERIFICATION		
	<ul style="list-style-type: none"> Verify terminal 6 (Circuit 25 DG-P) of the control module reads less than 1 volt when the door key is in the unlock position of the driver's or rear door. 	Less than 1 volt Greater than 1 volt	REPLACE damaged module. RETEST system. SERVICE door disarm switch or Circuit 25 (DG-P) for open circuit. RETEST system.
D3	PASSENGER DOOR DISARM CHECK		
	<ul style="list-style-type: none"> Arm the alarm system with a window down. Open a door from the inside door handle. Unlock the passenger's door with a key. 	Alarm triggers then turns off, alarm lamp blinks Alarm does not turn off	GO to D5 . GO to D4 .
D4	TERMINAL 20 VERIFICATION		
	<ul style="list-style-type: none"> Verify terminal 20 (Circuit 23 T-LG) of the control module reads less than 2 volts when the door key is in the unlock position of the passenger's door. 	Less than 2 volt Greater than 2 volt	REPLACE damaged module. RETEST system. SERVICE door disarm switch and/or open Circuit 23 (T-LG).
D5	REMOTE ENTRY CHECK		
	<ul style="list-style-type: none"> Arm and trigger alarm as in Step D1. Press the UNLOCK button of a remote entry transmitter after triggering the alarm. 	Alarm triggers then alarm turns off, alarm lamp blinks Alarm does not turn off	GO to D7 . GO to D6 .
D6	SIGNAL VERIFICATION		
	<ul style="list-style-type: none"> Verify a momentary B+ signal is present at terminal 8 when the UNLOCK button of a remote entry transmitter has been pressed and less than 2 volts on Terminal 7 at all times. 	B+ present during remote entry unlock Less than 1 volt	REPLACE damaged module. RETEST system. SERVICE Circuit 163 R/O. RETEST.
D7	ALARM RESET VERIFICATION		
	<ul style="list-style-type: none"> Arm the alarm system with a window down. Open the door from the inside door handle. Wait 4 minutes. 	Alarm triggers, then shuts off after 3-4 minutes. Vehicle will not start. Alarm does not shut off, or vehicle starts.	System OK. STOP. REPLACE damaged module. RETEST system.

TN9798B

DIAGNOSIS AND TESTING (Continued)**VEHICLE WILL NOT CRANK — TEST E**

TEST STEP		RESULT	ACTION TO TAKE
E1	MAKE SURE ALARM SYSTEM IS RESET		
	<ul style="list-style-type: none"> Insert door key and turn to the unlock position. 	System disarmed	GO to E2.
E2	CHECK BATTERY VOLTAGE		
	<ul style="list-style-type: none"> Measure battery voltage. Verify voltage is greater than 9 volts. 	Greater than 9 volts	GO to E3.
		Less than 9 volts	SERVICE battery. RETEST system.
E3	CHECK RESISTANCE		
	<ul style="list-style-type: none"> Measure resistance between terminals 12 and 13 of the control module. 	Greater than 1000 ohms	REPLACE damaged module. RETEST system.
		Less than 100 ohms	System OK. SERVICE starting system. Refer to Section 03-06B.

TCN9799A

ALARM LAMP IS ON ALL THE TIME — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	MAKE SURE ALARM SYSTEM IS RESET		
	<ul style="list-style-type: none"> Close all vehicle doors. Within 30 seconds, insert door key and turn to unlock position. 	Lamp turns off	System OK. STOP.
		Lamp is still on	GO to F2.
F2			
	<ul style="list-style-type: none"> Disconnect module connectors. 	Lamp turns off	REPLACE damaged module. RETEST system.
		Lamp remains on	SERVICE Circuit 343 (DB-LG) for short circuit. RETEST system.

TCN9800A

ALARM LAMP DOES NOT WORK — TEST G

TEST STEP		RESULT	ACTION TO TAKE
G1	TURN SIGNAL SWITCH TO OFF		
G2	CHECK LAMP AND CIRCUIT 343 DB / LG		
	<ul style="list-style-type: none"> With a jumper wire, short terminal 15 (Circuit 343 DB-LG) of the control module to ground. 	Lamp turns On	GO to G3.
		Lamp remains Off	SERVICE indicator lamp or Circuit 343 (DB-LG) for open circuit. RETEST system.
G3	CHECK MODULE B+		
	<ul style="list-style-type: none"> Measure terminal 1 (Circuit 196 DB-O) of the module for greater than 9 volts. 	Greater than 9 volts	GO to G4.
		Less than 9 volts	SERVICE fuse and / or Circuit 196 (DB-O).
G4	CHECK MODULE IGNITION INPUT		
	<ul style="list-style-type: none"> Measure terminal 4 (Circuit 296 W-P) of the module for less than 9 volts. 	Less than 9 volts	GO to G5.
		Greater than 9 volts	SERVICE Circuit 296 (W-P) for short. RETEST.
G5	CHECK MODULE OPERATION		
	<ul style="list-style-type: none"> Open a vehicle door. Activate the electric door lock switch. 	Lamp blinks then glows steadily	STOP, system OK.
		Lamp does not blink or glow steadily	REPLACE damaged module. RETEST system.

TCN9801A

DIAGNOSIS AND TESTING (Continued)**HORN, HEADLAMPS, AND /OR EXTERIOR LAMPS ALWAYS ON — TEST H**

TEST STEP		RESULT	ACTION TO TAKE
H1	HORN ALWAYS ON		
	<ul style="list-style-type: none"> Disconnect control module. 	Horn turns off Horn remains on	REPLACE damaged module. RETEST system. SERVICE horn system. RETEST system.
H2	HEADLAMPS ALWAYS ON		
	<ul style="list-style-type: none"> Disconnect control module. 	Headlamps turn off Headlamps remain on	REPLACE damaged module. RETEST system. SERVICE Circuit 13 (R-BK). RETEST system.
H3	PARKING LAMPS ALWAYS ON		
	<ul style="list-style-type: none"> Disconnect control module. 	Parking lamps turn off Parking lamps remain on	REPLACE damaged module. RETEST system. SERVICE Circuit 14 (BR). RETEST system.

TCN9802A

FALSE ACTIVATION — TEST J

TEST STEP		RESULT	ACTION TO TAKE
J1	TURN KEY FROM OFF TO RUN		
		Alarm indicator extinguishes immediately Alarm indicator light extinguishes after approximately 10 seconds	System OK. GO to J2. GO to J7.
J2	ARM ALARM		
	<ul style="list-style-type: none"> Close all doors and hood. Arm alarm system. 	System activates at any time System arms and does not activate System activates after alarm indicator turns off	GO to J4. GO to J3. GO to J6.
J3	HOOD CHECK		
	<ul style="list-style-type: none"> Apply movement to hood. 	System activates System does not activate	ADJUST hood height for flush fit. RETEST system. REPLACE module. RETEST system.
J4	REMOTE ENTRY PANIC CHECK		
	<ul style="list-style-type: none"> Measure voltage at pin 19, Circuit 129 (LG), to see if the remote convenience module is sending a high voltage to enable the panic alarm through the anti-theft control. 	Less than 3 volts More than 3 volts	GO to J5. SERVICE the remote convenience module. Refer to Section 01-14B.
J5	PIN 14 MODULE CHECK		
	<ul style="list-style-type: none"> Measure voltage at pin 14 of anti-theft module harness connector. 	Greater than 7V Less than 2V	GO to J6. SERVICE Circuit 346 (BK-W) and/or courtesy lamp switches. RETEST system.

DIAGNOSIS AND TESTING (Continued)**FALSE ACTIVATION — TEST J (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
J6	PIN 5 MODULE CHECK		
	<ul style="list-style-type: none"> Measure voltage at pin 5 of anti-theft module harness connector. 	Greater than 2V Less than 2V	GO to J7. SERVICE Circuit 486 (BR-W) for a short to ground, or replace shorted hood switch, or ADJUST hood switch so plunger is depressed when the hood is closed.
J7	WIRING HARNESS RESISTANCE		
	<ul style="list-style-type: none"> Disconnect module from wiring harness and measure the resistance between pin 10 to pin 26 (wiring harness side) 	Resistance measures between 145 ohms and 175 ohms Resistance measures less than 145 ohms OR greater than 175 ohms	REPLACE module. REPLACE ignition keylock cylinder sensor or SERVICE Circuit 936 (DG-W).

TN9825B

DIAGNOSTICS FOR DOOR DISARM, IGNITION KEYLOCK CYLINDER, HOOD SWITCH INPUTS — TEST K

TEST STEP		RESULT	ACTION TO TAKE
K1	IGNITION KEYLOCK CYLINDER SWITCH OPERATION		
	NOTE: This diagnostic mode quickly provides the capability to identify a shorted-to-ground condition for the door disarm and / or luggage compartment circuit. <ul style="list-style-type: none"> Rotate ignition key to RUN. Observe anti-theft alarm indicator light. 	Light off Light on continuously for 10 seconds	Ignition keylock cylinder sensor OK. GO to K2. Ignition keylock cylinder sensor input shorted. GO to J1.
K2	DOOR DISARM, HOOD SWITCH AND LUGGAGE COMPARTMENT SWITCH OPERATION		
	<ul style="list-style-type: none"> Actuate power door (unlock and lock) five times in 10 seconds. Observe anti-theft alarm indicator light, count flashes (repeats every 10 seconds). NOTE: Diagnostic mode will automatically cancel after two minutes or rotate key from RUN to OFF to cancel.	Flashes one time Flashes two times Flashes three times Flashes four times	Door disarm and hood switch inputs not shorted. Door disarm input shorted, SERVICE door disarm switches Circuit 25 (DG-P) or Circuit 23 (T-LG). Hood switch shorted. SERVICE hood switch or Circuit 26 (W-P). Both inputs shorted, SERVICE door disarm switches or Circuit 25 (DG-P) or Circuit 23 (T-LG) and SERVICE hood switch or Circuit 26 (W-P).

TCN9826A

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N-m	Lb-Ft
Contact Brush Assembly Screw	2-3	18-26
Cylinder Sensor Screw	2-3	18-26

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
007-00001	Digital Volt-Ohmmeter

GENERATOR (ALTERNATOR), BATTERY AND CHARGING

GROUP
14
(10000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
GENERATOR (ALTERNATOR), INTEGRAL REAR MOUNT REGULATOR, INTERNAL FAN TYPE	14-02C-1	GENERATOR (ALTERNATOR), 165 AMPERE, LEECE-NEVILLE	14-02B-1
GENERATOR (ALTERNATOR), INTEGRAL REGULATOR, EXTERNAL FAN TYPE	14-02A-1	BATTERIES	14-01-1
		CHARGING GENERAL SERVICE	14-00-1

SECTION 14-00 Charging General Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		DIAGNOSIS AND TESTING (Cont'd.)	
Charging System	14-00-2	Generator (Alternator) Indicator Lamp Test	14-00-6
Fuse Link	14-00-2	Isolating the Concern	14-00-2
Indicator Lamp	14-00-2	Over Voltage Test	14-00-6
Voltmeter	14-00-2	Regulator S and I Circuit Test	14-00-8
DIAGNOSIS AND TESTING		Under Voltage Test	14-00-7
Battery Check	14-00-2	SPECIAL SERVICE TOOLS/EQUIPMENT	14-00-11
Charging System Test, Performance	14-00-6	SPECIFICATIONS	14-00-11
Diagnosis Guides	14-00-3	VEHICLE APPLICATION	14-00-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and Bronco

DESCRIPTION AND OPERATION

Charging System

The generator (alternator) charging system is a negative ground system and consists of a generator (alternator), regulator, charge indicator, storage battery, fuse link and associated wiring. Refer to the Electrical and Vacuum Troubleshooting Manual ¹ for schematics and locations of wiring harnesses.

Indicator Lamp

With the ignition key in the RUN position, voltage is applied through the charge lamp I circuit to the voltage regulator. This turns the regulator on, allowing current to flow from the battery sense A circuit to the generator (alternator) field coil. When the engine is started, the generator (alternator) begins to generate alternating (AC) current which is converted to direct (DC) current by the rectifier assembly internal to the generator (alternator). This current is then supplied to the vehicle's electrical system through the output located on the rear of the generator (alternator).

Once the generator (alternator) begins generating current, a voltage signal is taken from the generator (alternator) stator and fed back to the regulator S circuit, turning off the charge indicator (battery symbol).

With the system functioning normally, the generator (alternator) output current is determined by the voltage of the A circuit (battery sense voltage). The A circuit voltage is compared to a voltage internal to the regulator, and the regulator controls the generator (alternator) field current. The reference voltage will vary with temperature. The voltage is higher in the winter for increased battery recharging, and lower in the summer to reduce the chance of battery overcharging.

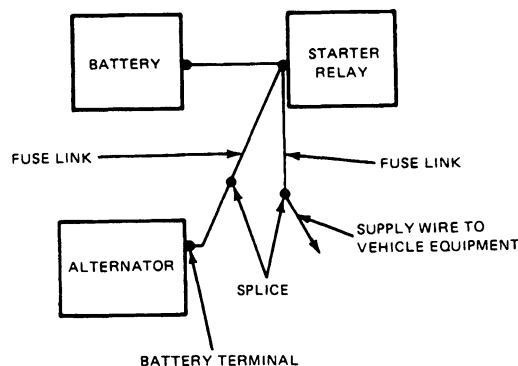
Voltmeter

The voltmeter is a gauge which measures the voltage potential at the battery to indicate the battery state of charge. The voltmeter is not adjustable and should be replaced if inoperative.

Fuse Link

The fuse link is a short length of insulated wire integral with the engine compartment wiring harness. It is several wire gauges smaller than the circuit that it protects.

Service fuse links are green or black depending on usage. All fuse links have a flag molded on the wire or on the terminal insulator. Color identification of the flag or connector is red 18-gauge wire, orange 16-gauge wire or green 14-gauge wire. The illustration shows a typical fuse link installation.



J2171-1A

The fuse link is designed to burn out, thus protecting the generator (alternator) and wiring when heavy reverse current flows, such as when a booster battery is connected incorrectly, or a short to ground occurs in the wiring harness.

A burned-out link may have bare wire ends protruding from the insulation, or bubbled insulation with illegible identification. If it is hard to determine if the link is burned out, perform a continuity test.

Refer to Section 18-01 for testing procedures for fuse links used in the charging system.

NOTE: There is no fuse link provided on vehicles with the ambulance prep package (F- and E-Series). A properly sized fuse link would severely restrict output and result in continual nuisance failures.

DIAGNOSIS AND TESTING

Isolating the Concern

Battery and starting system concerns can be caused by poor charging system performance. The charging system can also cause an overload in other electrical systems.

It is necessary to isolate the battery, the charging system, and the electrical circuits to correctly identify the area where the difficulty lies. Check the battery before performing any electrical system diagnosis. The battery must be in the proper state of charge and operation before other areas of the electrical system can perform normally.

Battery Check

Check battery to see if it can accept and hold a charge. Refer to Section 14-01. If the battery is good, then the charging system should be checked to see that it can keep the battery charged.

¹ Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

The battery capacity, specific gravity and cell comparison test (low-maintenance batteries only) will determine the ability of a battery to accept and hold a charge. If the battery cannot meet the specifications, replace it with a new fully charged battery before further diagnosis of other areas of the electrical system.

If the battery meets the required specifications, it should be fully charged before proceeding with the diagnosis of other electrical system components.

Diagnosis Guides**CHARGING SYSTEM DIAGNOSIS**

CONDITION	POSSIBLE SOURCE	ACTION
Battery does not stay charged — engine starts OK.	<ul style="list-style-type: none"> ● Battery. ● Loose or worn generator (alternator) belt. ● Damaged or worn wiring or cables. ● Generator (alternator). ● Regulator. ● Other vehicle electrical systems. 	<ul style="list-style-type: none"> ● Test battery; replace if necessary. Refer to Section 14-01. ● Adjust or replace belt. ● Service as required. ● Test and/or replace components as required. Refer to the appropriate Generator (Alternator) Section in Group 14. ● Test; replace if necessary. Refer to Section 14-02C. ● Check other systems for current draw. Service as required.
Generator (alternator) noisy.	<ul style="list-style-type: none"> ● Loose or worn generator (alternator) belt. ● Bent pulley flanges. ● Generator (alternator). 	<ul style="list-style-type: none"> ● Adjust tension or replace belt. ● Replace pulley. Refer to the appropriate Generator (Alternator) Section in Group 14. ● Service or replace generator (alternator). Refer to the appropriate Generator (Alternator) Section in Group 14.
Lamps and/or fuses burn out frequently.	<ul style="list-style-type: none"> ● Damaged or worn wiring. ● Generator (alternator) regulator. ● Battery. 	<ul style="list-style-type: none"> ● Service as required. ● Test, service, replace if necessary. Refer to Section 14-02C. ● Test, replace if necessary.
Charge indicator lamp flickers after engine starts or comes on while vehicle is being driven.	<ul style="list-style-type: none"> ● Loose or worn generator (alternator) belt. ● Generator (alternator). ● Field circuit ground. ● Regulator. ● Lamp circuit wiring and connector. 	<ul style="list-style-type: none"> ● Adjust tension or replace. ● Service or replace. Refer to the appropriate Generator (Alternator) Section in Group 14. ● Repair or replace wiring. ● Test, replace if necessary. Refer to Section 14-02C. ● Service as required.
Charge indicator lamp flickers while vehicle is being driven.	<ul style="list-style-type: none"> ● Loose or worn generator (alternator) belt. ● Loose or improper wiring connections or wiring welds. ● Generator (alternator). ● Regulator. 	<ul style="list-style-type: none"> ● Adjust tension, replace belt. ● Service as required. ● Service or replace. Refer to the appropriate Generator (Alternator) Section in Group 14. ● Test, replace if necessary.

DIAGNOSIS AND TESTING (Continued)

CHARGING SYSTEM DIAGNOSIS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
Charge indicator gauge shows discharge (Ammeter E-Series only) Voltmeter in the red area on F-Series and Bronco.	<ul style="list-style-type: none"> Loose or worn generator (alternator) belt. Damaged or worn wiring (battery to generator [alternator]). Field circuit ground. Generator (alternator). Regulator. Charge indicator gauge wiring and connections. Damaged or worn gauge. Other vehicle electrical system malfunction. 	<ul style="list-style-type: none"> Adjust tension or replace belt. Service or replace wiring. Repair or replace wiring. Service or replace. Refer to the appropriate Generator (Alternator) Section in Group 14. Test, replace if necessary. Refer to Section 14-02C. Service as required. Replace gauge. Service as required.

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CHARGING SYSTEM TEST — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	PRELIMINARY CHECKS		
	<ul style="list-style-type: none"> Check battery posts and cables for good connections. Check wiring connections at generator (alternator) and engine. Check fuse link between starter solenoid and generator (alternator). Check generator (alternator) belt tension. Check for secure ground connections at engine and body. Do all components check OK? 	Yes No	GO to A2. SERVICE or REPLACE as required. REFER to Section 14-01 for battery connections, Section 18-01 for generator (alternator) connections, and the Electrical & Vacuum Troubleshooting Manual for engine wiring connections. GO to A2.
A2	BATTERY DRAIN TEST		
	<ul style="list-style-type: none"> KEY OFF Install test lamp in-series between negative battery cable and negative battery post. <p>NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.</p> <ul style="list-style-type: none"> Does the test lamp light? 	Yes No	REMOVE fuses one at a time to isolate damaged circuit. SERVICE as required. REFER to Section 18-01. GO to A3. GO to A3.
A3	ALTERNATOR INDICATOR LAMP CHECK		
	<ul style="list-style-type: none"> KEY OFF. Indicator lamp should be OFF. KEY ON, engine OFF. Indicator lamp should be ON. KEY ON, engine RUNNING. Indicator lamp should be OFF. Does the indicator lamp respond as outlined? 	Yes No	GO to A4. SERVICE charge indicator lamp circuit. REFER to Generator (Alternator) Indicator Lamp Test in this section. GO to A4.
A4	VOLTMETER TEST		
	<ul style="list-style-type: none"> KEY ON, engine OFF, no electrical load. Voltmeter should show approximately 12 volts. KEY ON, engine running and battery fully charged. Voltmeter should show voltage increase. KEY ON, engine OFF, headlights ON. Voltmeter should show lower voltage. Does voltmeter respond as outlined? 	Yes No	GO to A11. GO to A5.
A5	CONTINUITY CHECK, INSTRUMENT CLUSTER FUSE		
	<ul style="list-style-type: none"> Check fuse for continuity. Is the fuse good? 	Yes No	GO to A7. REPLACE fuse. GO to A6.

DIAGNOSIS AND TESTING (Continued)**CHARGING SYSTEM TEST — TEST A (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
A6	VOLTMETER TEST		
	<ul style="list-style-type: none"> KEY ON, engine OFF, no electrical load. Voltmeter should show approximately 12 volts. KEY ON, engine running and battery fully charged. Voltmeter should show voltage increase. KEY ON, engine OFF, headlamps ON. Voltmeter should show lower voltage. Does voltmeter respond as outlined? 	Yes No	GO to A11. GO to A7.
A7	VOLTAGE CHECK, INSTRUMENT CLUSTER		
	<ul style="list-style-type: none"> Check for battery voltage between ignition switch and instrument cluster. 	Less than battery voltage Battery voltage	REPAIR / REPLACE harness / ignition switch GO to A8. GO to A11.
A8	VOLTMETER TEST		
	<ul style="list-style-type: none"> KEY ON, engine OFF, no electrical load. Voltmeter should show approximately 12 volts. KEY ON, engine running and battery fully charged. Voltmeter should show voltage increase. KEY ON, engine OFF, headlamps ON. Voltmeter should show lower voltage. Does voltmeter respond as outlined? 	Yes No	GO to A11. GO to A9.
A9	GROUND CHECK, INSTRUMENT CLUSTER		
	<ul style="list-style-type: none"> Check ground at instrument cluster terminal clips (harness connected). Is ground OK? 	Yes No	REPLACE instrument cluster. REFER to Section 13-01A. GO to A11. REPAIR / REPLACE instrument panel harness or ground connection. GO to A10.
A10	VOLTMETER TEST		
	<ul style="list-style-type: none"> KEY ON, engine OFF, no electrical load. Voltmeter should show approximately 12 volts. KEY ON, engine running and battery fully charged. Voltmeter should show voltage increase. KEY ON, engine OFF, headlamps ON. Voltmeter should show lower voltage. Does voltmeter respond as outlined? 	Yes No	GO to A11. REPLACE instrument cluster. REFER to Section 13-01A. GO to A11.
A11	BASE VOLTAGE / NO LOAD TEST		
	<ul style="list-style-type: none"> KEY OFF, no electrical load. Place transmission in NEUTRAL and apply parking brake. Make sure battery is fully charged. Connect Rotunda Inductive Dwell-Tach-Volts Ohms Tester, 059-00010 or equivalent to battery posts. Record voltage. This is base voltage reading. KEY ON, engine running, no electrical loads. Increase engine speed to 1500 rpm. Check voltmeter reading. 	Voltmeter reading is 2.0 volts above base voltage Voltmeter reading continues to rise above base voltage Voltmeter reading is less than 2.0 volts above base voltage	GO to A12. PERFORM the Over Voltage Tests in this section. PERFORM the Under Voltage Tests in this Section.

DIAGNOSIS AND TESTING (Continued)

CHARGING SYSTEM TEST — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A12	LOAD TEST		
<ul style="list-style-type: none"> ● KEY ON, engine running, blower motor on high and headlamps on high beams. ● Increase engine speed to 2000 rpm and check voltage reading. 		Voltage reading is 0.5 volts above base voltage	▶ The charging system is operating normally.
		Voltmeter reading continues to rise above base voltage	▶ PERFORM the Over Voltage Tests in this section.
		Voltmeter reading is less than 0.5 volts above base voltage	▶ PERFORM the Under Voltage Tests in this section.

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Charging System Test, Performance

When measuring alternator output, connect the Rotunda Starting / Charging Tester 078-00005 VAT-40 or equivalent to the battery positive or negative cable. All electrical accessories must be turned off and 10-15 amps added to the reading on the VAT-40 or equivalent due to the engine operation. With the engine running at 2000 rpm, adjust the VAT-40 or equivalent load bank to determine the output of the alternator. The alternator output should be near to, or exceed the generator (alternator) rating at 27°C (80°F). Checkout the charging system as indicated and service if required.

NOTE: Refer to the test procedure manual for complete directions on examining the charging system.

Fuse Link Continuity Check

1. Make certain that the battery is OK, then turn on the headlamps or any other accessory. If the headlamps or accessory do not operate, the fuse link is probably burned out.
2. On some vehicles there are several fuse links. Use the same procedure as in Step 1 to test the fuse link that protects vehicle equipment.

To test the fuse link that protects the generator (alternator), make certain the battery is OK. Then check for voltage at the BAT terminal of the generator (alternator). Use Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent. No voltage indicates that the fuse link is probably burned out.

Generator (Alternator) Indicator Lamp Test

1. If the charge indicator lamp does not light with the ignition key in the RUN position (engine not running), check the I wiring circuit (ignition switch to regulator I terminal) for an open circuit or burned out charge indicator lamp.

2. If the charge indicator lamp does not light, disconnect the wiring plug connector at the regulator and connect a jumper wire to the negative battery post cable clamp.
3. The charge indicator lamp should light with the ignition key turned to the RUN position (engine not running).
4. If the charge indicator bulb does not light, check the bulb for continuity and replace if necessary.
5. If the bulb is not burned out, check to see if an open circuit exists between the ignition switch and the regulator.
6. Check the 500 ohm resistor across the charge indicator lamp for a short circuit. If the 500 ohm resistor is shorted, the lamp will not light

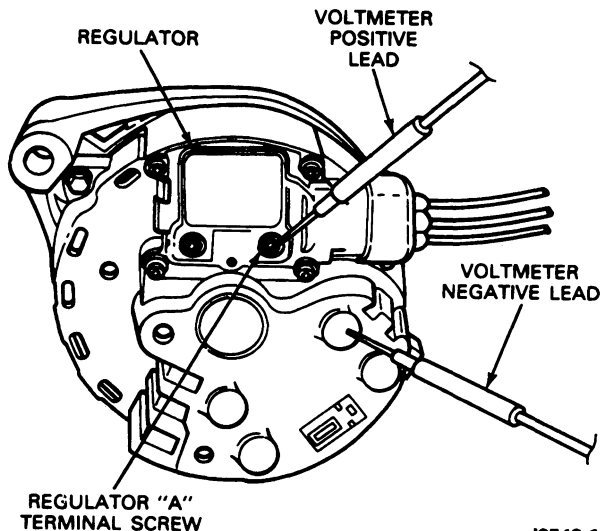
Over Voltage Test

If the voltmeter indicated more than 2.0 volts above base voltage in the No Load Test, follow these procedures:

1. With the ignition in the RUN position (engine not running), connect the voltmeter negative lead to the generator (alternator) rear housing. Contact the voltmeter positive lead first to the generator (alternator) output connection at the starter solenoid and then to the regulator A screw head.
2. If the voltage difference between the two locations is greater than 0.5 volts, service the A wiring circuit to eliminate the high resistance condition indicated by the excessive voltage drop.
3. If the over voltage condition still exists, check for loose regulator and generator (alternator) grounding screws. Tighten loose regulator grounding screws to 1.7-2.8 N·m (15-25 in-lb).

DIAGNOSIS AND TESTING (Continued)

4. If the over voltage condition still exists, connect the voltmeter negative lead to the generator (alternator) rear housing. With the ignition off, contact the voltmeter positive lead first to the regulator A screw head and then to the regulator F screw head. Different voltage readings at the two screw heads indicate a malfunctioning regulator, grounded brush lead or a grounded rotor coil. Service the entire integral generator (alternator) / regulator assembly. Refer to Section 14-02A.
5. If the same voltage reading (battery voltage) is obtained at both screw heads in Step 4 and there is no high resistance in the ground or A circuit, replace the regulator. Refer to Section 14-02A.



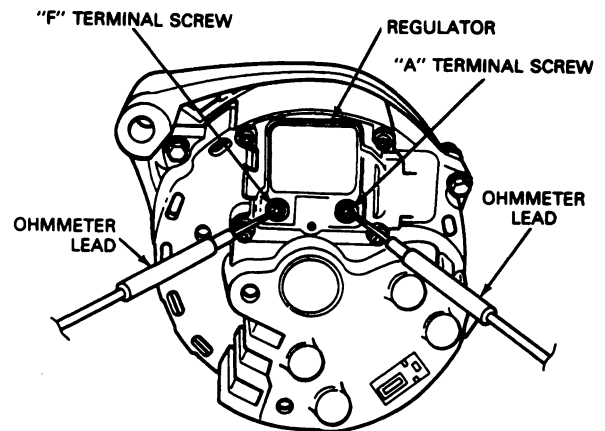
J3548-1A

Under Voltage Test

If the voltmeter did not indicate more than 0.5 volts above the base voltage:

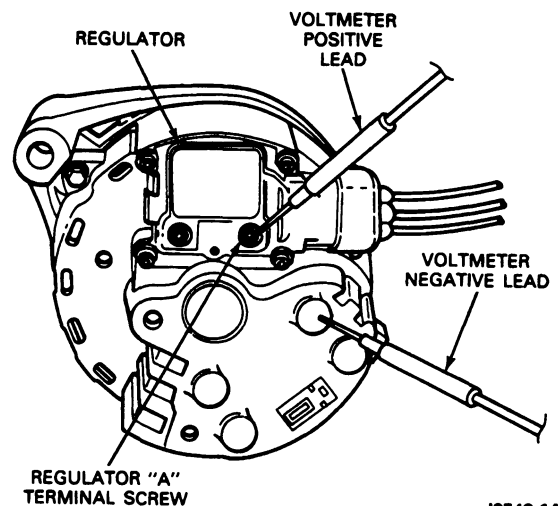
1. Disconnect the wiring plug from the regulator and connect an ohmmeter between the regulator A and F terminal screws. The meter should indicate more than 2.4 ohms. If less than 2.4 ohms is indicated, service the integral generator (alternator) / regulator unit for a failed regulator and check the generator (alternator) for a shorted rotor or field circuit. Refer to Section 14-02A. Perform the Load Test after servicing.

CAUTION: Do not replace the regulator before a shorted rotor coil or field circuit has been serviced. The result could be another damaged regulator.



J3549-1A

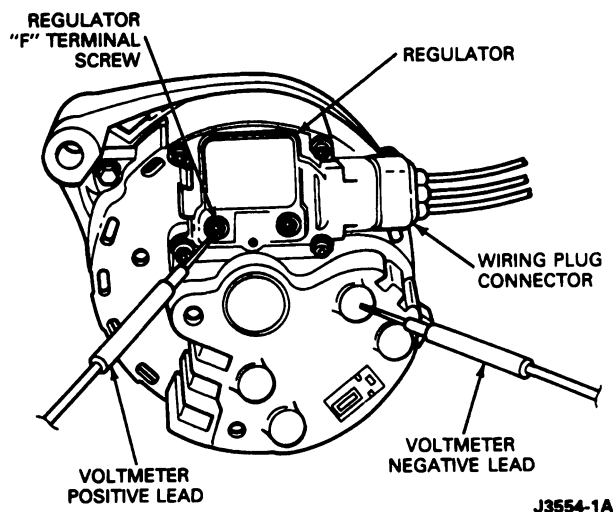
2. If the above ohmmeter reading is greater than 2.4 ohms, reconnect the regulator wiring plug and connect the voltmeter negative lead to the generator (alternator) rear housing. Contact the voltmeter positive lead to the regulator A terminal screw. The meter should indicate battery voltage. If there is no voltage, service the A wiring circuit. Perform the Load Test after servicing.



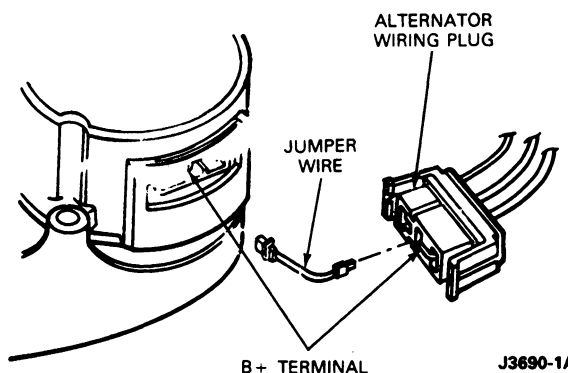
J3548-1A

DIAGNOSIS AND TESTING (Continued)

3. If the voltmeter indicates battery voltage, connect voltmeter ground lead to generator (alternator) rear housing. With the ignition switch off, contact voltmeter positive lead to regulator F terminal screw. The meter should indicate battery voltage. If there is no voltage, service integral generator (alternator) / regulator unit for an open field circuit. Refer to Section 14-02A. Perform Load Test after servicing.

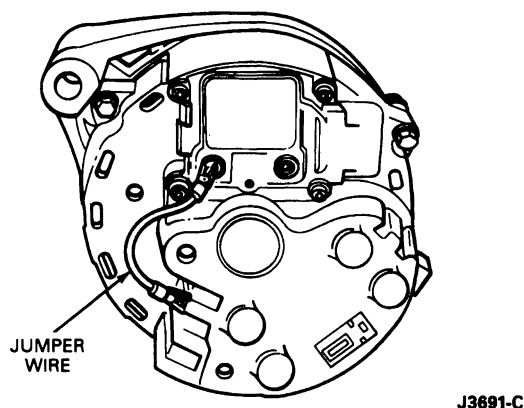


4. If voltmeter indicates battery voltage, connect voltmeter negative lead to generator (alternator) rear housing. Turn the ignition switch to RUN (engine off) and contact voltmeter positive lead to regulator F terminal screw. Refer to illustration under Step 3. The voltmeter should indicate 1.5 volts or less. If more than 1.5 volts is indicated, perform I circuit tests and service I circuit if needed. If I circuit tests normal, replace regulator. Refer to Section 14-02A. Perform Load Test after servicing.
5. If 1.5 volts or less is indicated, disconnect generator (alternator) wiring plug and connect a set of 12-gauge jumper wires between generator (alternator) Battery Positive Voltage (B+) terminal blades and mating wiring connector terminals. Perform Load Test, but connect voltmeter positive to one of B+ jumper wire terminals. If voltage rises more than 0.5 volt above base voltage, service the wiring from the generator (alternator) to the starter relay. Repeat Load Test, and measure voltage at battery cable clamps after servicing.



6. If voltage does not rise more than 0.5 volt above base voltage, connect a jumper wire from generator (alternator) rear housing to regulator F terminal. Repeat Load Test with voltmeter positive lead connected to one of Battery Positive Voltage (B+) jumper wire terminals. If voltage rises more than 0.5 volt, replace regulator. Refer to Section 14-02A.

INTEGRAL ALTERNATOR/REGULATOR



7. If voltage does not rise more than 0.5 volt, service the generator (alternator). Refer to Section 14-02A.

Regulator S and I Circuit Test

IGR System with Warning Lamp

The Integral Generator (Alternator) Regulator (IGR) has a circuit in the regulator that will indicate a high battery voltage condition. With the IGR system, two conditions can cause the charge indicator lamp to come on during vehicle operation:

- No generator (alternator) output — damaged generator (alternator), regulator or wiring.
- Over voltage correlation — shorted generator (alternator) rotor, regulator or wiring.

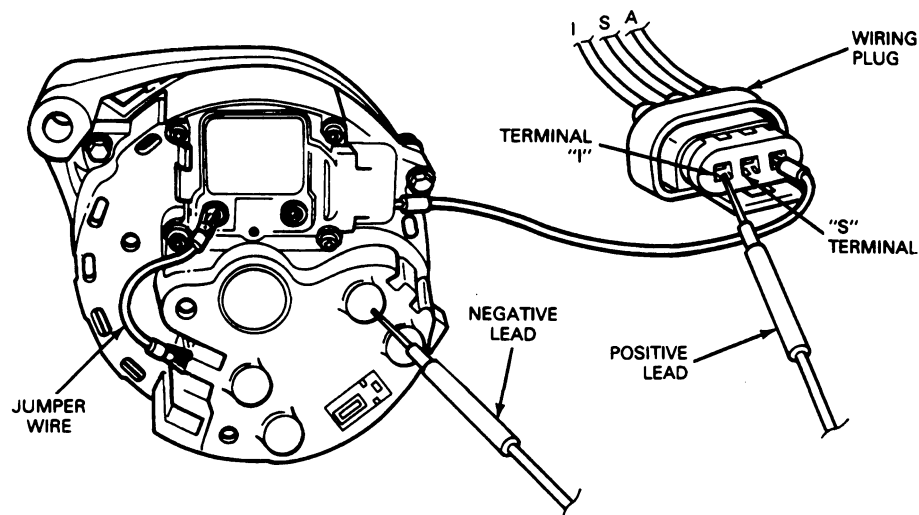
If the system is working normally, the following conditions will be present:

DIAGNOSIS AND TESTING (Continued)

- With ignition switch in OFF position — charge indicator (battery symbol) lamp is off.
- With ignition switch in RUN position (engine not running) — charge indicator (battery symbol) lamp is on.
- With ignition switch in RUN position (engine running) — charge indicator (battery symbol) lamp is off.

If these conditions are not met, use the following procedure to isolate the source of the concern.

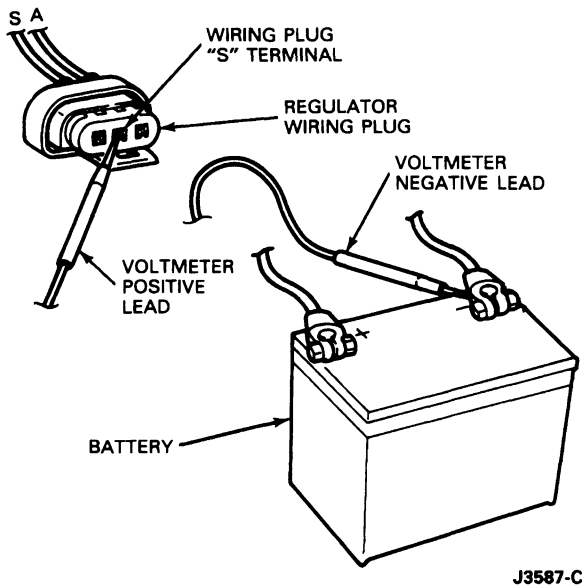
1. Disconnect the wiring plug from the regulator. Connect a jumper wire from the regulator A terminal to the wiring plug A lead. Add a jumper wire from the regulator F screw to the generator (alternator) rear housing.
2. With the engine idling and the voltmeter negative lead connected to the battery ground terminal, connect the voltmeter positive lead to the S terminal and then to the I terminal of the regulator wiring plug. The voltage at the S circuit should read approximately one-half that of the I circuit. If voltage readings are normal, remove the jumper wires. Replace the regulator and connect the wiring plug to the regulator. Refer to Section 14-02A. Repeat the load test.
3. If no voltage is present, remove the jumper wires and service the faulty wiring circuit or generator (alternator). Refer to Section 18-01 and Section 14-02A.
4. Connect the voltmeter positive lead to the positive battery terminal. Connect the wiring plug to the regulator. Repeat the load test.

Test Connections, IGR System with Warning Lamp**IGR System with Ammeter**

1. Disconnect the regulator wiring plug from the generator (alternator) regulator connector. Connect the positive lead of the voltmeter to the S terminal of the wiring plug and the negative lead to the battery ground terminal.
2. Turn the ignition switch to RUN positive (engine not running). The voltmeter should indicate battery voltage. If the voltage reading is normal, replace the regulator and repeat the Load Test.
3. If there is no voltage reading, service the S wire lead from the ignition switch to the regulator wiring plug.

DIAGNOSIS AND TESTING (Continued)

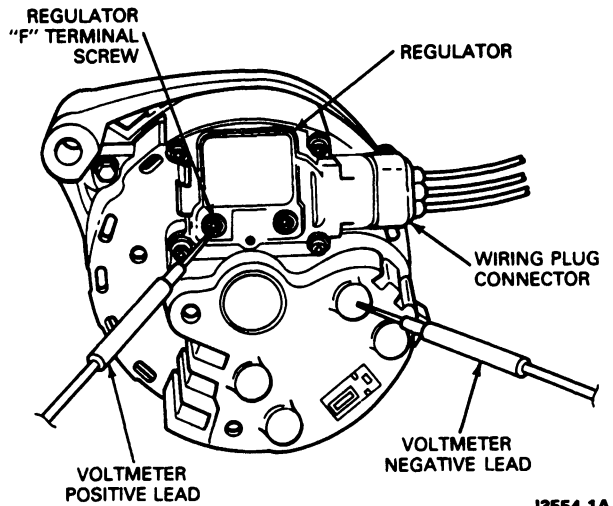
4. Connect the positive voltmeter lead to the positive battery cable terminal, connect regulator wiring plug to regulator and repeat the Load Test.



Field Circuit Drain

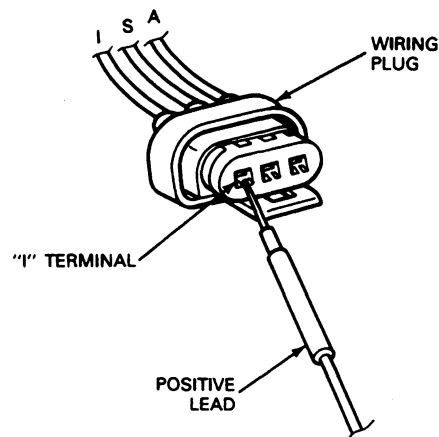
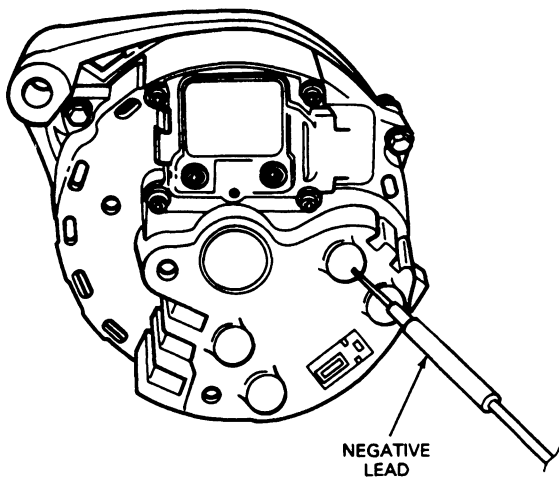
Connect the voltmeter negative lead to the generator (alternator) rear housing for all of the following voltage readings.

1. With the ignition switch turned off, contact the voltmeter positive lead to the regulator F terminal screw. The meter should indicate battery voltage if the system is operating normally. If less than battery voltage is indicated, proceed to Step 2 to find the cause of the current drain.



2. With the ignition switch off, disconnect the wiring plug from the regulator and contact the voltmeter positive lead to the wiring plug I terminal. No voltage should be indicated. If voltage is indicated, service the I lead from the ignition switch to identify and eliminate the voltage source.
3. If no voltage was indicated in Step 2, contact the voltmeter positive lead to the wiring plug S terminal. Voltage should be indicated. If no voltage is indicated, replace the regulator.
4. If voltage was indicated in Step 3, disconnect the wiring plug from the generator (alternator) rectifier connector. Again, contact the voltmeter positive lead to the regulator wiring plug S terminal. If voltage is indicated, service the S lead to the generator (alternator) plug to eliminate the voltage source. If no voltage is indicated, replace the generator (alternator) rectifier assembly.

Test Connections, Field Circuit Drain, IGR System



SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	Lb·Ft
Regulator Ground Screw	1.7-2.8	15-25

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA EQUIPMENT**

Tool Number	Description
007-00001	Digital Volt / Ohmmeter
059-00010	Inductive Dwell-Tach-Volts Ohms Tester
078-00005	VAT-40 Starting / Charging Tester

SECTION 14-01 Batteries

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING AND INSPECTION		DIAGNOSIS AND TESTING (Cont'd.)	
Adding Water.....	14-01-14	Battery State of Charge	14-01-1
Battery Cleaning.....	14-01-13	REMOVAL AND INSTALLATION	
Tools	14-01-13	Battery	14-01-5
DIAGNOSIS AND TESTING		Battery Tray.....	14-01-12
Battery Charging	14-01-4	SPECIAL SERVICE TOOLS	14-01-14
Battery Drain Test.....	14-01-3	VEHICLE APPLICATION	14-01-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and Bronco

DIAGNOSIS AND TESTING

Before attempting to test a battery, it is important to give it a thorough examination to determine if it has been damaged.

Batteries are tested to determine the state of charge and ability to crank an engine. The result of these tests is to show that the battery is either good, needs recharging, or must be replaced.

WARNING: BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERY. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.

WHEN LIFTING A PLASTIC-CASED BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY, DAMAGE TO THE VEHICLE OR BATTERY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.

WARNING: KEEP OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH SKIN OR EYES, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF 15 MINUTES AND GET PROMPT MEDICAL ATTENTION. IF ACID IS SWALLOWED, CALL A PHYSICIAN IMMEDIATELY.

Battery State of Charge

Maintenance-Free Batteries

Read the battery open circuit terminal voltage with a digital voltmeter, such as Digital Volt-Ohmmeter 007-00001 or equivalent, capable of reading 1 / 100 of a volt. If open circuit voltage is below 12.4 volts and the battery passed the capacity test, charge the battery.

Low-Maintenance Batteries

Use a hydrometer such as Rotunda Battery and Anti-Freeze Tester 021-00046 or equivalent to check the specific gravities of all cells.

To obtain an accurate specific gravity reading, it must be corrected to the standard temperature of 26°C (78°F). The correction factor of four points (0.004) is used for each 6°C (10°F) change in temperature. Four points (0.004) are added to the indicated reading for each 6°C (10°F) increment above 26°C (78°F) and four points (0.004) are subtracted for each 6°C (10°F) increment below 26°C (78°F).

If the difference between cells is 50 points (0.050) or more, the battery should be replaced.

If the difference between cells is less than 50 points (0.050) and one or more cells are less than 1.225, charge the battery for 20 minutes at 35 amps and conduct the capacity test. If the battery fails, replace the battery. If it passes, add water if necessary and charge the battery.

DIAGNOSIS AND TESTING (Continued)

If the difference between cells is less than 50 points (0.050) and all cells are above 1.225, conduct the capacity test. If the battery fails, replace the battery. If it passes, return to service.

BATTERY TESTING PROCEDURE

TEST STEP		RESULT	ACTION TO TAKE																				
A1	VISUAL INSPECTION																						
	<ul style="list-style-type: none">Remove negative cable, then positive cable.Check for dirty or corroded connections.Are connections OK?	No	CLEAN terminals and clamps. GO to A2.																				
		Yes	GO to A2.																				
A2	LOOSE BATTERY POST																						
	<ul style="list-style-type: none">Check for loose battery posts.Are posts OK?	No	REPLACE battery.																				
		Yes	GO to A3.																				
A3	BATTERY COVER INSPECTION																						
	<ul style="list-style-type: none">Remove holddowns and shields.Check for broken / cracked case or cover.Is cover OK?	No	REPLACE battery.																				
		Yes	GO to A4.																				
A4	BATTERY CAPACITY AND LOAD TEST																						
	<ul style="list-style-type: none">Use a high rate discharge tester with a variable rate control or a fused rate tester with meter compensation for different battery electrical sizes. Follow instructions supplied with tester for the battery capacity test.Recommended Discharge Rate for 15 seconds apply a load equal to one half of the cold cranking amps.Observe the battery voltage at 15 seconds with load on.	Passed the minimum load voltage and OCV above 12.40 volts	Battery OK.																				
		Passed the minimum load voltage and OCV below 12.40 volts	Battery OK but needs charging.																				
		Failed the minimum load voltage and OCV above 12.40 volts	Battery worn out. REPLACE battery.																				
		Failed the minimum load voltage and OCV below 12.40 volts	CHARGE battery for 20 minutes @ 35 amps. REPEAT Battery Capacity Test.																				
<table><tr><th>Approximate Electrolyte Temperature</th><th>Minimum Required Voltage @ 15 seconds with Load On</th></tr><tr><td>27°C(80°F) and above</td><td>9.6</td></tr><tr><td>21°C(70°F)</td><td>9.6</td></tr><tr><td>16°C(60°F)</td><td>9.5</td></tr><tr><td>10°C(50°F)</td><td>9.4</td></tr><tr><td>4°C(40°F)</td><td>9.3</td></tr><tr><td>-1°C(30°F)</td><td>9.1</td></tr><tr><td>-7°C(20°F)</td><td>8.9</td></tr><tr><td>-12°C(10°F)</td><td>8.7</td></tr><tr><td>-18°C(0°F)</td><td>8.5</td></tr></table>		Approximate Electrolyte Temperature	Minimum Required Voltage @ 15 seconds with Load On	27°C(80°F) and above	9.6	21°C(70°F)	9.6	16°C(60°F)	9.5	10°C(50°F)	9.4	4°C(40°F)	9.3	-1°C(30°F)	9.1	-7°C(20°F)	8.9	-12°C(10°F)	8.7	-18°C(0°F)	8.5		
Approximate Electrolyte Temperature	Minimum Required Voltage @ 15 seconds with Load On																						
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4°C(40°F)	9.3																						
-1°C(30°F)	9.1																						
-7°C(20°F)	8.9																						
-12°C(10°F)	8.7																						
-18°C(0°F)	8.5																						
NOTE: Use half of these values for 6 volt batteries.																							
<ul style="list-style-type: none">Wait 2 minutes and check the Open Circuit Voltage (OCV) with a digital voltmeter capable of reading 1 / 100 volt.																							

TJ2789A

DIAGNOSIS AND TESTING (Continued)

Battery Drain Test

With Clamp-On DC Ammeter

Test Procedure

1. Turn the ignition to the OFF position and make sure there are no electrical loads. After determining that the underhood lamp is turning off properly, disconnect the bulb.
2. Clamp the meter clip securely around positive or negative battery cable (all cables if two or more lead to post).

NOTE: Do not start vehicle with clip on cable.

Test Conclusion

The current reading (current drain) should be less than 0.05 amp. If it exceeds 0.05 it indicates a constant current drain which could cause a discharged battery. Possible sources of current drain are vehicle lamps (underhood, glove compartment, luggage compartment, etc.) that do not shut off properly.

If the drain is not caused by a vehicle lamp, remove the fuses one at a time until the cause of the drain is located. If drain is still undetermined, disconnect leads at starter relay one at a time to find the problem circuit.

With Voltmeter

This test requires a digital volt-ohmmeter with an appropriate low voltage scale such as Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent. The meter must read within 0.01 millivolt. Also required is a shunt assembly similar to that shown in the illustration.

Test Procedure

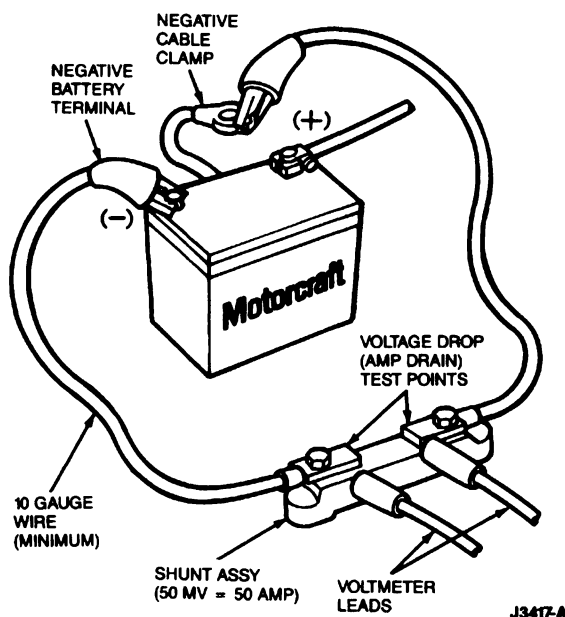
1. Turn ignition switch to the OFF position and make sure there are no electrical loads. After determining the underhood lamp is turning off properly, disconnect the bulb.
2. Check battery voltage. If voltage is under 11.5 volts, charge the battery to above 11.5.
3. Disconnect negative battery cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

4. Connect shunt assembly as shown.

CAUTION: Do not crank the engine; it could destroy the shunt. Also do not use the shunt to measure starting currents.

5. Set volt-ohmmeter to 200 or 300 mv scale for an accurate reading (must be within 0.01 millivolt).
6. Connect meter leads to shunt as shown. With this size shunt (50 mv = 50 amps) and meter, a direct current drain measurement can be made.



Test Conclusion

The current reading (current drain) should be less than 0.05 amps. If the reading is between 0.2 and 0.9, a possible drain may be a vehicle lamp (glove compartment, underhood, luggage compartment, etc.) that does not turn off. If the problem is not a lamp, remove the fuses one at a time until the cause of the drain is located. If still undetermined, disconnect leads at starter relay one at a time to find the problem circuit.

To Test Vehicles with Major Key-Off Loads such as Air Suspension or Load Leveling

Vehicles equipped with these features will have temporary current drains that may last up to 70 minutes after ignition is switched OFF. These drains can range from 0.1 to 20 amps if the compressor is cycling. This action can often mask a problem and must be considered when evaluating test results. To test for this kind of drain proceed as follows.

1. Repeat Steps 1 through 5 of the battery drain test.
2. Turn ignition to RUN for a moment and then OFF again.
3. Disconnect major key-off load circuits.
4. Make sure illuminated entry is off, if applicable.

Test Conclusion

The current reading (current drain) should be less than 0.05 amps. If it is higher, disconnect fuses and starter relay leads as in the previous test to locate the problem circuit.

If the drain is less than 0.05 amps, reconnect the major key-off load circuits, turn ignition to RUN and then OFF, and wait 70 minutes to make sure they shut off properly. If current drain is still greater than 0.05 amps after 70 minutes, disconnect each of the components one at a time, until the cause of the current drain is located.

DIAGNOSIS AND TESTING (Continued)

To Check for Electronic Drains Which Shut Off When the Battery Cable is Disconnected

1. Repeat Steps 1 through 5 of the Voltmeter Drain Test.
2. Without starting engine, turn ignition switch to the RUN position for a moment and then OFF. If applicable, wait one minute for the illuminated entry lamps to turn off.
3. Connect voltmeter and read voltage.

Test Conclusion

The current reading (current drain) should be less than 0.05 amps. If it exceeds 0.05 after a few minutes, and if this drain did not show in previous tests, the drain is most likely caused by a malfunctioning electronic component. As in previous tests, remove fuses and disconnect starter relay leads one at a time to locate the problem circuit.

Battery Charging

Before recharging a discharged battery, inspect and service the following conditions, if they exist:

1. Loose generator (alternator) belt.
2. Pinched or grounded generator (alternator) / voltage regulator wiring harness.
3. Loose harness connections at the generator (alternator) and / or voltage regulator.
4. Loose or corroded connections at battery, starter relay and / or engine ground.
5. Excessive battery drain due to:
 - a. Hood, deck lid, glove compartment and courtesy lamps remaining energized (damaged or misadjusted switch, glove compartment left open, etc).
 - b. Isolation relay concerns (if applicable).

Maintenance-Free and Low-Maintenance Batteries

Cold batteries will not readily accept a charge. Therefore, batteries should be allowed to warm up to approximately 5°C (41°F) before charging. This may require four to eight hours at room temperature depending on the initial temperature and battery size.

A battery which has been completely discharged may be slow to accept a charge initially, and in some cases may not accept a charge at the normal charger setting. When batteries are in this condition, charging can be started by use of the dead battery switch on chargers so equipped.

A rapid recharge procedure has been developed for recharging batteries that have passed the Load Test and only need a recharge. This can be due to: in-service no-start battery failures (vehicle will not crank due to low battery state of charge, or battery discharged in vehicle due to key-off loads. Refer to Section 14-00 for Load Test procedure.

The battery can be rapidly recharged by using either of the following methods:

- Perform a 2-hour charge using 20A constant current (manual setting on charger).
- Perform a 2-hour charge using a constant potential (automatic setting on charge).

NOTE: If excessive gassing or electrolyte spewing occurs during the charge, discontinue charging. The battery has reached serviceable charge. If the battery will not accept at least 5A after 20 minutes of charging, replace the battery.

WARNING: WEAR SAFETY GLASSES. BATTERY CHARGING CAN BE DANGEROUS. WHILE BEING CHARGED, THE BATTERY PRODUCES A POTENTIALLY EXPLOSIVE MIXTURE OF HYDROGEN AND OXYGEN GASSES. KEEP SPARKS, FLAMES AND LIGHTED CIGARETTES AWAY FROM BATTERIES. REMEMBER, IN CASE OF ACID CONTACT WITH SKIN, EYES OR CLOTHING, FLUSH IMMEDIATELY WITH LARGE AMOUNTS OF WATER. GET MEDICAL ATTENTION.

After releasing switch and with charger still on, measure battery voltage. If it shows 12 volts or higher, the battery is accepting a charge and is capable of being recharged. However, it may require up to two hours of charging with batteries colder than 5°C (41°F) before the charge rate is high enough to show on the charger ammeter. All non-damaged batteries can be charged by this procedure. If a battery cannot be charged by this procedure, replace it.

If battery is accepting charge, it can be charged by one of two methods:

1. Use the AUTOMATIC setting on chargers so equipped. Approximately two to four hours will be required to charge a completely discharged battery to a serviceable state.

NOTE: If a full state of charge is desired, the charge can be completed by a low current rate of 3-5 amps for several hours.

2. Use the MANUAL or constant current setting on the charger. Set the charging rate for 30-40 amps and maintain this setting for approximately 30 minutes. If gassing results, reduce charge rate until gassing stops.

REMOVAL AND INSTALLATION

Battery**Help Us Protect Our Environment**

Ford Motor Company strongly recommends that lead-acid batteries be returned to an authorized recycling facility for disposal.

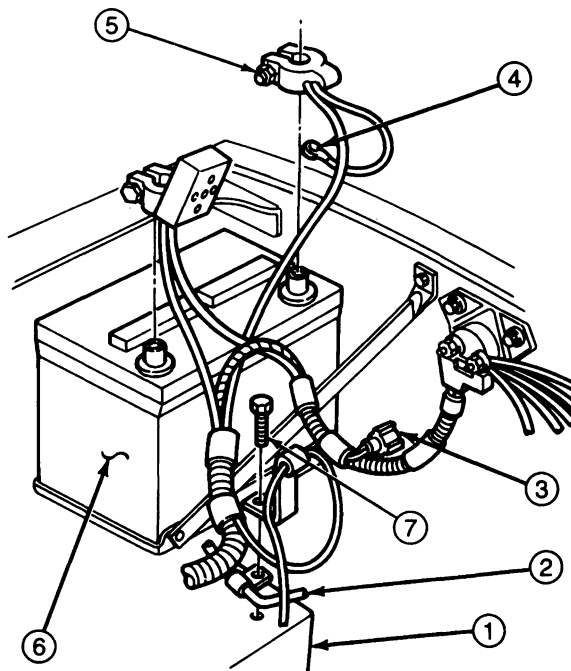


J4961-A

Removal

1. Remove battery cables from battery terminals (negative first).
2. Remove hold-down clamps.
3. Remove battery from vehicle.

CAUTION: When lifting a plastic-cased battery, excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury, damage to the vehicle or battery. Lift with a battery carrier or with your hands on opposite corners.

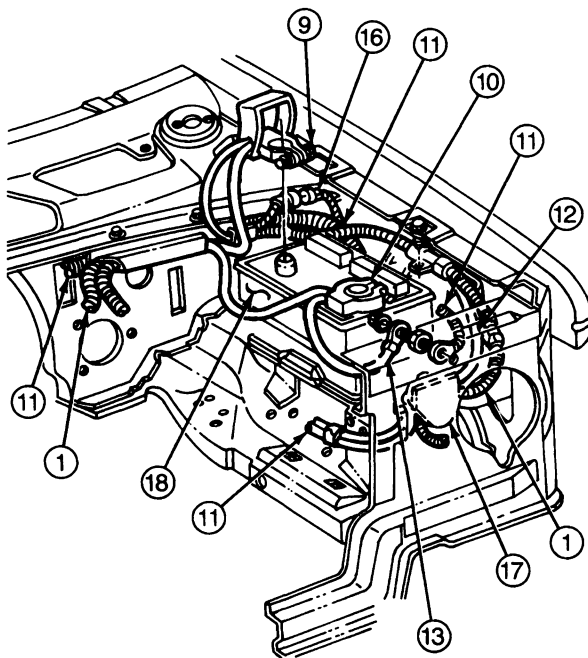
Battery Connections, Typical For F-150-250-350 and Bronco with 4.9L, 5.0L, 5.8L and 7.5L Gasoline Engines


J3895-B

Item	Part Number	Description
1	05019	Crossmember
2	09A228	Gas Evaporator Tube
3	12A690	HO2S Connection (4.9L, 5.0L and 5.8L Under 8550 lbs.)
4	14301	Body Ground
5	—	Dynamic Torque 13-17 N·m (10-13 Ft-Lb) Static Torque 11-16 N·m (8-12 Ft-Lb)
6	10655	Battery
7	14301	Frame Ground

REMOVAL AND INSTALLATION (Continued)

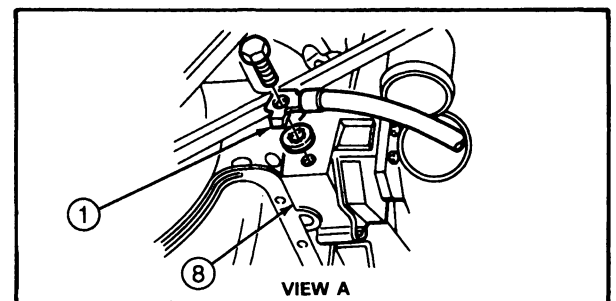
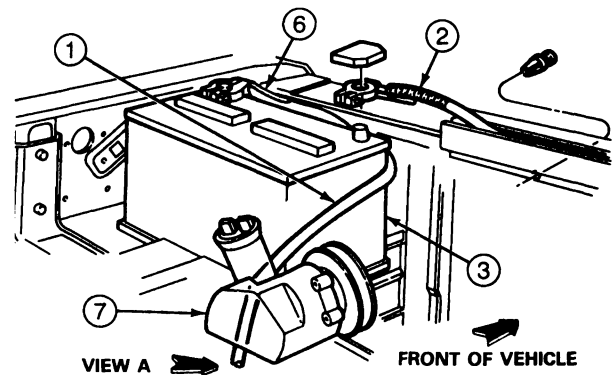
Battery Connections, Econoline with Gasoline Engines



J3896-B

Item	Part Number	Description
1	14B060	Battery Cable Assembly
9	14300	Positive Terminal
10	14301	Negative Terminal
11	12A581	Wiring Assembly
12	14305	Generator (Alternator) Wiring
13	14301	Body Ground
16	12A581	Wiring Assembly
17	11450	Starter Relay
18	10655	Battery

Battery Connections, All F-250-350 Vehicles with 7.3L Diesel Engine (Left Side)

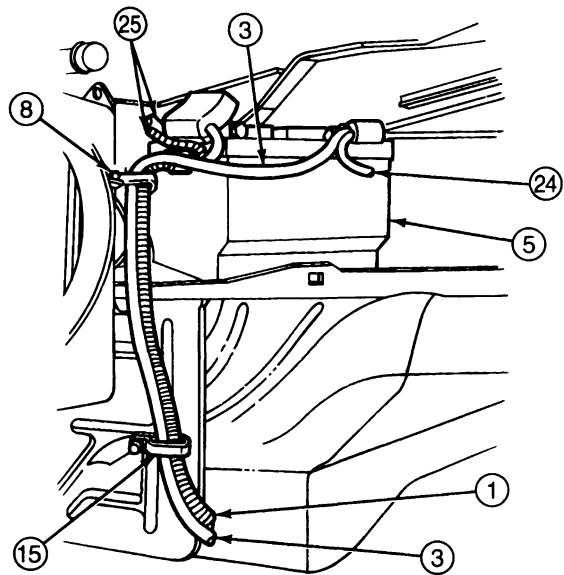


J3897-B

Item	Part Number	Description
1	14301	Engine Ground Cable
2	14300	Positive Cable
3	—	Battery
6	14301	Body Ground
7	03A674	Power Steering Pump
8	6007	Engine Block

REMOVAL AND INSTALLATION (Continued)

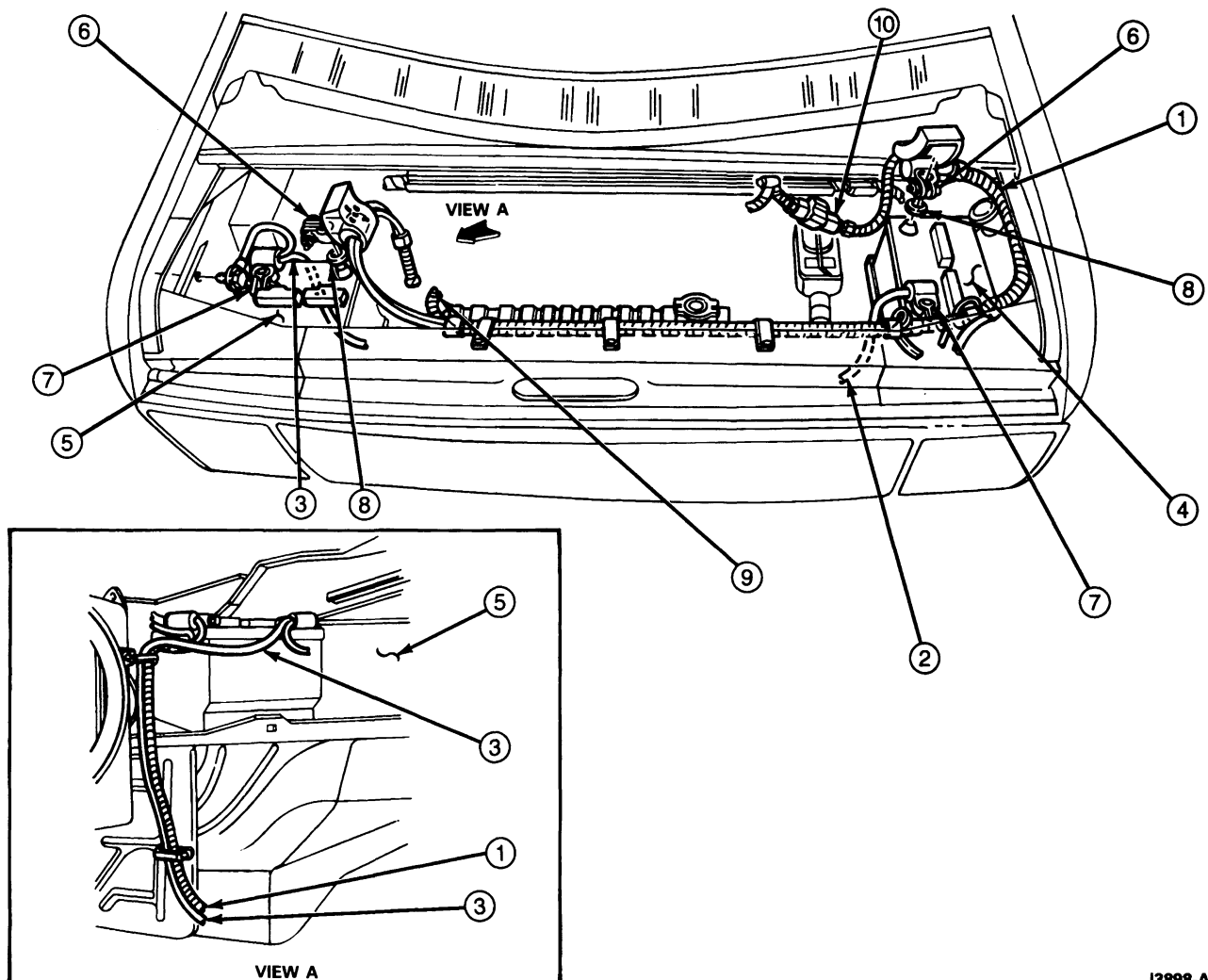
Battery Connections, All F-250-350 Vehicles with 7.3L Diesel Engine (Right Side)



Item	Part Number	Description
1	14300	Positive Battery Cable
3	14301	Negative Battery Cable
5	10655	Battery
8	—	Radiator Shroud
15	—	Retaining Bracket
24	14301	Body Ground
25	14B060	Battery Cable Assembly

REMOVAL AND INSTALLATION (Continued)

Battery Connections, Econoline Vehicles with 7.3L Diesel Engine (Right and Left Side)



J3898-A

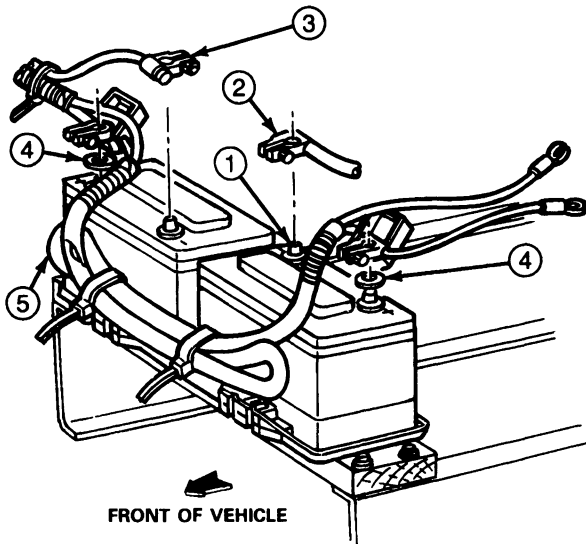
Item	Part Number	Description
1	14B060	Cable Assembly, Battery to Starter Relay
2	14301	Cable Assembly, Battery to Engine Ground (L.H.)
3	14301	Cable Assembly, Battery to Engine Ground (R.H.)
4	10655	Battery (L.H.)
5	10655	Battery (R.H.)

(Continued)

Item	Part Number	Description
6	14B060	Cable Assembly, to Positive Battery Terminal
7	14301	Cable Assembly, to Negative Battery Terminal
8	374043	Felt Washer
9	14B060	Wiring Assembly 14305 to Generator (Alternator)
10	14487	Connector, 14305 Wiring Assembly to 12A581 Wiring Assembly

TJ3898A

REMOVAL AND INSTALLATION (Continued)

Battery Connections, F-Super Duty Commercial Chassis with 7.3L Diesel Engine

J3899-A

Item	Part Number	Description
1	10655	Battery Assembly
2	14301	Ground Cable (L.H.)
3	14301	Ground Cable (R.H.)
4	374043	Felt Washer
5	14300	Starter Motor Relay Cable

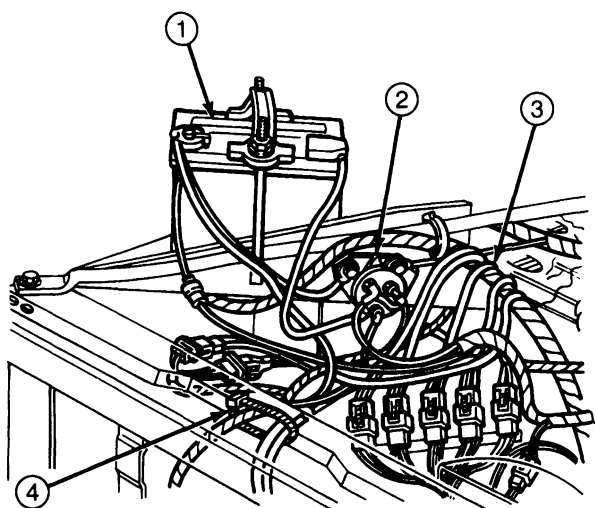
TJ3899A

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
20	383256-S36	Nut and Washer 1/4-20 9-12 N·m (7-9 Ft-Lb)
22	9F479	Map Sensor
23	9C392	Relay and Bracket Assembly
24	N800322-S36	Screw 3-4 N·m (27-35 In-Lb)
25	14K730	Junction Block Mounting Panel

(Continued)

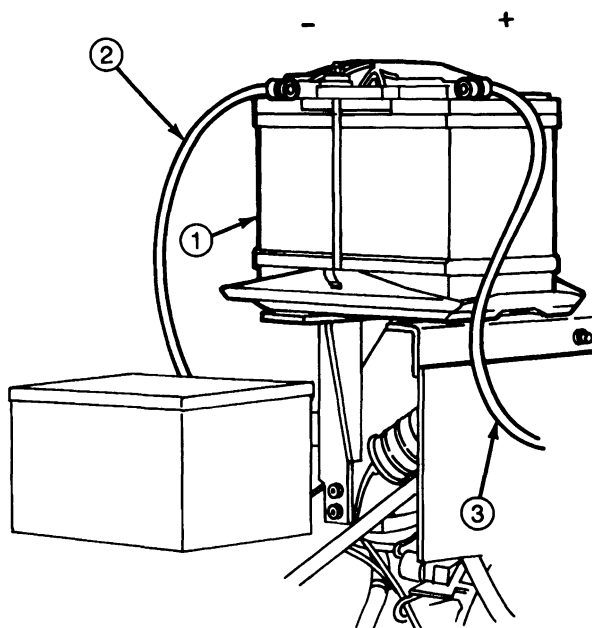
Item	Part Number	Description
26	N80032-S36	Screw 3-4 N·m (27-35 In-Lb)
47	N605786-S2	Bolt
48	N620481-S2	Nut 21-32 N·m (15-24 Ft-Lb)
52	95456	Map Sensor Insulator Cover Cap
54	14A396	Wire Connection Cover Assembly
56	14A593	

Battery Connections, E-350 Commercial Chassis with 4.9L, 5.8L and 7.5L Engines

J3901-A

Item	Part Number	Description
1	10655	Battery
2	11450	Starter Motor Relay Assembly
3	12A581	Wiring Assembly
4	95875	Strap

TJ3901A

Battery Connections, E-350 RV Chassis with Gasoline Engines

J3902-A

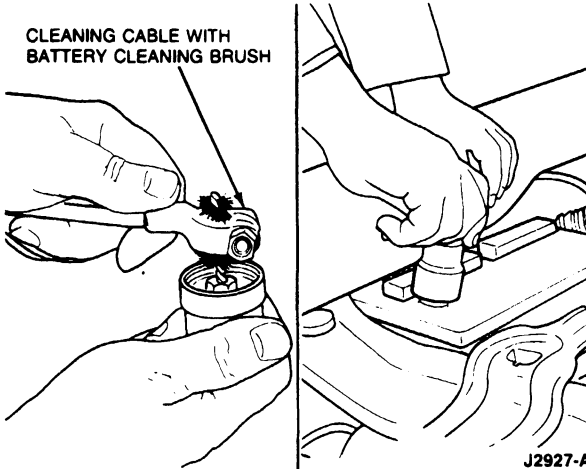
Item	Part Number	Description
1	10655	Battery
2	14301	Negative Ground Cable
3	14300	Positive Battery Cable

TJ3902A

REMOVAL AND INSTALLATION (Continued)

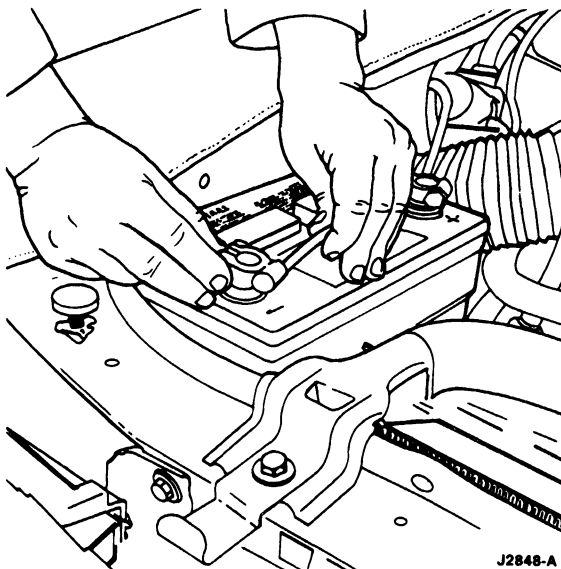
Installation

1. Clean cable terminals and hold down with a wire brush. Replace all cables or parts that are worn or frayed.



2. Clean battery tray with a wire brush and scraper.
3. Place battery in tray with positive and negative terminals in same position as previous battery. Assemble and tighten hold-down hardware so battery is secure. Do not over-tighten.
4. Secure cables (positive first) to proper terminals. **Do not over-tighten.** Apply petroleum jelly to terminals.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.



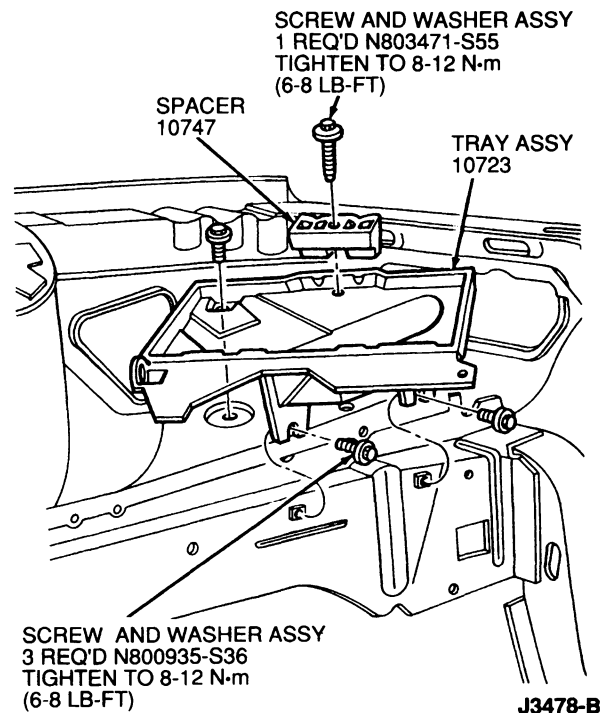
Battery Tray

Removal

1. Remove battery from vehicle.
2. Remove retaining bolts, screws and washers from battery tray.
3. Remove battery tray from vehicle.

Installation

1. Position battery tray to inside fender in engine compartment.
2. Install retaining bolts, screws and washers. Tighten each to 8-12 N·m (6-8 ft-lb).
3. Install battery.
4. Tighten hold-down bracket bolt to 7-10 N·m (6-7 ft-lb).



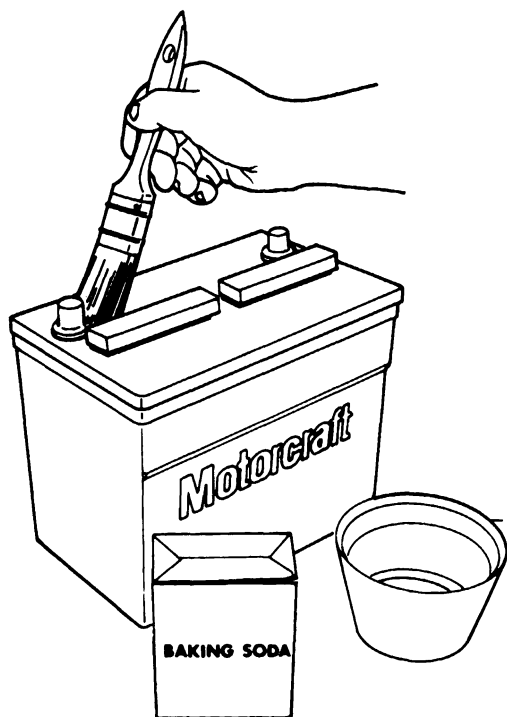
SCREW AND WASHER ASSY
3 REQ'D N800935-S36
TIGHTEN TO 8-12 N·m
(6-8 LB-FT)

J3478-B

CLEANING AND INSPECTION

Battery Cleaning

Keeping the battery top clean and dry reduces the need for service and extends battery life. Also, make certain the cable clamps are tightly fastened to the battery posts. If corrosion is found, disconnect the cables and clean clamps and posts with a wire brush. Neutralize the corrosion with a solution of baking soda and water. After installing cables, apply a small quantity of Premium Long-Life Grease XG-1-C or -K (ESA-M1C75-B) or equivalent to the base of each battery post to help prevent corrosion.



J2847-A

Tools

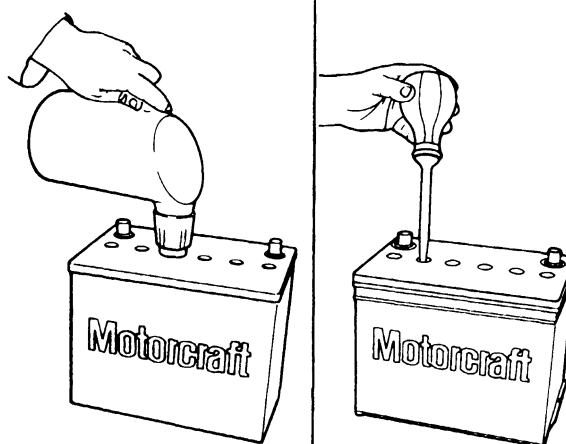
Anyone working with a battery needs the proper tools. Using the right tools will prevent damage to the battery, battery cables and hold-down bracketry.

Tools and equipment manufactured for servicing batteries have parts insulated to help prevent arcing should the tool be dropped or placed accidentally between a terminal and some other contact surface.

Battery Filling Devices

Batteries with Removable Vent Caps

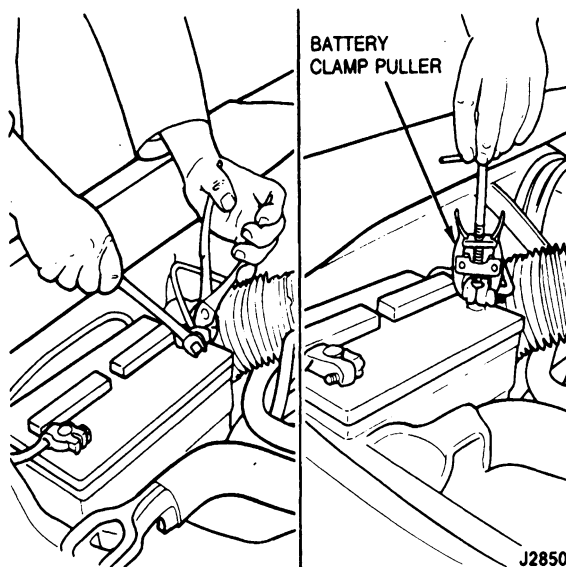
One of the most important on-vehicle services is to maintain the correct electrolyte level. Two devices are available for this purpose: a self-leveling filler which allows the battery to be filled to a predetermined level automatically, and a syringe-type filler.



J2849-A

Battery Pliers

Battery pliers have jaws specifically designed for gripping cable clamp bolts securely. Care should be taken when removing or replacing the cable clamp bolts so that the battery terminal is not subjected to any excessive lateral or twisting forces. Such forces could cause major damage to the internal components of the battery, and leakage at the terminals.



J2850-A

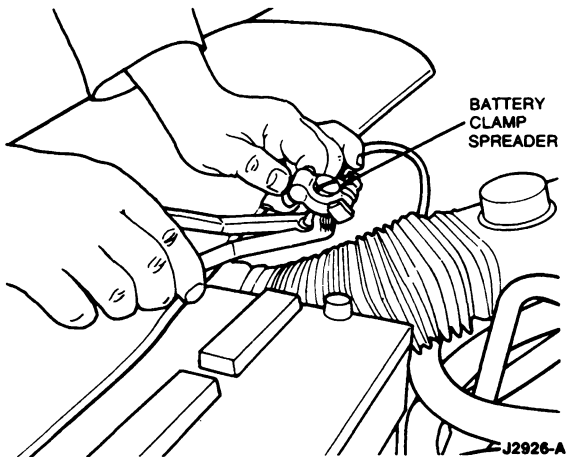
Battery Clamp Puller

Use a clamp puller to remove a cable clamp from the battery terminal. With the jaws gripping the underside of the cable clamp, pull the clamp up by means of pressure exerted against the top of the battery terminal. Proper use of this tool avoids the damaging lateral or twisting forces that result when using a pry bar or pliers.

CLEANING AND INSPECTION (Continued)

Battery Clamp Spreader

The spreader is used to expand the cable clamp after it has been removed from the terminal and the clamp bolt has been loosened. The cable clamp can then be easily placed in its correct position completely on the terminal.



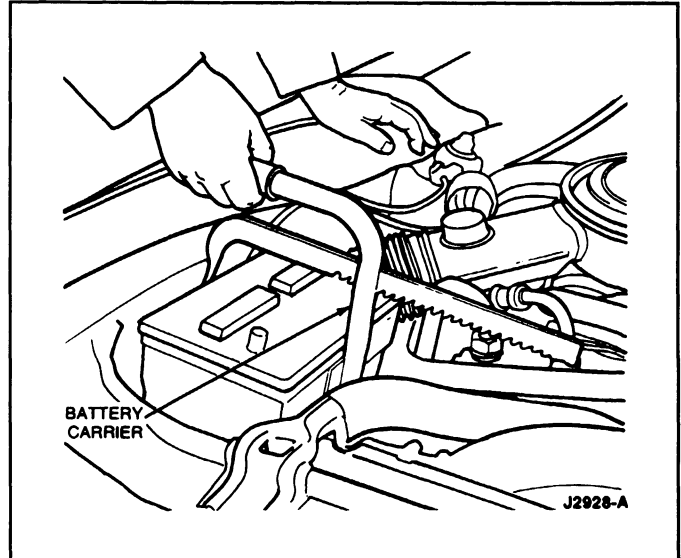
Terminal Cleaning Brush

The terminal cleaning brush is designed with units to clean both the tapered battery terminal and the mating surface of the cable clamp. Refer to illustration under Battery Installation, Step 1.

Battery Carrier

Use a suitable battery carrier for lifting and transporting the battery. The illustration shows a clamp-type carrier used to grip the sidewalls of the container just below the lip of the cover. The carrier is used on the sidewalls, rather than the endwalls, since the sidewalls have additional strength from the inner cell partitions. This is particularly important with the plastic-cased battery which has endwalls that are flexible.

CAUTION: Gripping the endwalls on the plastic-cased battery could cause electrolyte to spew from some of the cells, resulting in personal injury and possibly cause damage to some of the internal components.



Adding Water

Some batteries have removable vent caps and may occasionally require the addition of water. If the electrolyte level is below the level indicator in any cell, add enough pure water to bring the level up to the indicator. In batteries without a level indicator, maintain electrolyte level at 6.3 to 12.7mm (1/4 to 1/2 inch) above the plates. **Never add electrolyte ("battery acid") to the battery.** This could shorten the life of the battery.

SPECIAL SERVICE TOOLS

ROTUNDA EQUIPMENT

Model	Description
078-00160	VAT-60 Starting / Charging Tester
021-00046	Battery and Anti-Freeze Tester
007-00001	Digital Volt-Ohmmeter

SECTION 14-02A Generator (Alternator), Integral Regulator, External Fan Type

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS.....	14-02A-16	DISASSEMBLY AND ASSEMBLY	14-02A-10
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	14-02A-9
Charging System	14-02A-1	SPECIAL SERVICE TOOLS/EQUIPMENT	14-02A-17
Circuit Description	14-02A-2	SPECIFICATIONS.....	14-02A-17
DIAGNOSIS AND TESTING		VEHICLE APPLICATION	14-02A-1
Bench Tests	14-02A-4		

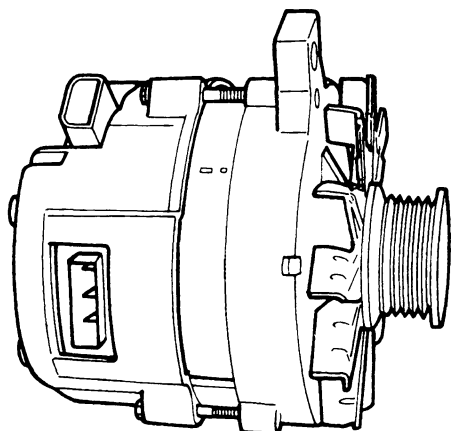
VEHICLE APPLICATION

F-150-250-350, F-Super Duty, Bronco with 4.9L and 7.5L Engines

DESCRIPTION AND OPERATION

Charging System

The electrical charging system is a negative ground system consisting of an integral generator (alternator) / voltage regulator (IGR), charge indicator, storage battery, and the necessary wiring and cables. Refer to the Electrical and Vacuum Troubleshooting manual for schematics and locations of components and wiring.



J2932-A

With the ignition key in the RUN position, voltage is applied through the charge indicator I circuit to the voltage regulator. This turns the regulator on allowing current to flow from the battery sense A circuit to the generator (alternator) field coil. When the engine is started, the generator (alternator) begins to generate alternating current (AC) which is converted to direct current (DC) by the rectifier assembly internal to the generator (alternator). This current is then supplied to the vehicle's electrical system through the output connector Battery Positive Voltage (B+) located on the rear of the generator (alternator).

Once the generator (alternator) begins generating current, a voltage signal is taken from the generator (alternator) stator and fed back to the regulator S circuit, turning off the charge indicator.

With the system functioning normally, the generator (alternator) output current is determined by the voltage of the A circuit (battery sense voltage). The A circuit voltage is compared to a set voltage internal to the regulator, and the regulator controls the generator (alternator) field current to maintain proper generator (alternator) output. The set voltage will vary with temperature and is typically higher in the winter than in the summer, allowing for better battery recharge in the winter and reducing the chance of overcharging the battery in the summer.

A fuse link is included in the charging system wiring on all models. The fuse link is used to prevent damage to the wiring harness and generator (alternator) if the wiring harness should become grounded, or if a booster battery with the wrong polarity is connected to the charging system.

DESCRIPTION AND OPERATION (Continued)

Circuit Description**Battery Positive Voltage (B+) Output**

The generator (alternator) output is supplied through the Battery Positive Voltage (B+) output connection to the battery and electrical system.

I Circuit

The I circuit, or ignition circuit, is used to turn on the voltage regulator. This circuit is powered up with the ignition key in the RUN position. This circuit is also used to turn the indicator on if there is a fault in the charging system operation or associated wiring circuits.

A Circuit

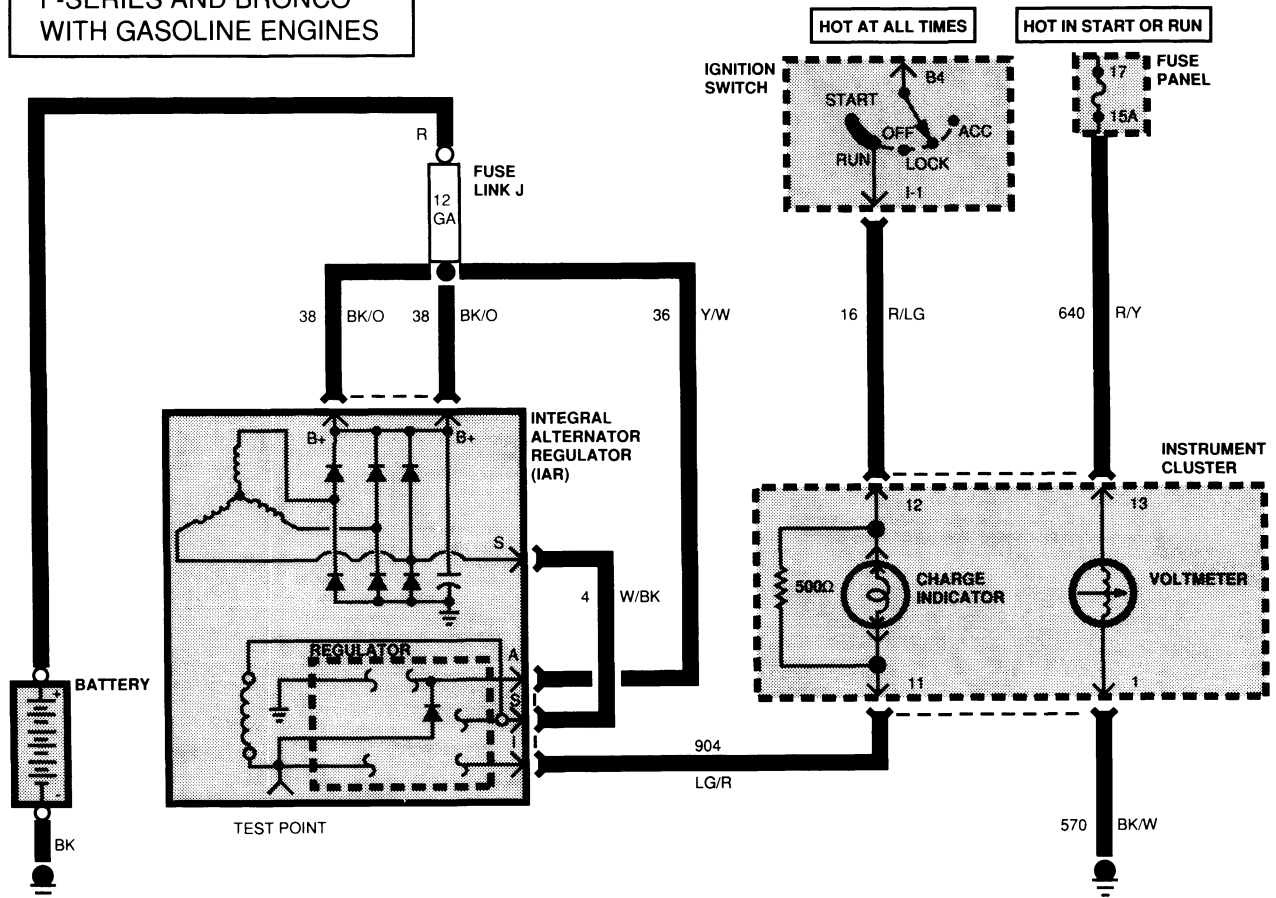
The A circuit, or battery sense circuit, is used to sense the battery voltage. This voltage is used by the regulator to determine the generator (alternator) output. This circuit is also used to supply power to the generator (alternator) field coil. This circuit is connected back to the load distribution point and is a protected circuit.

S Circuit

The S circuit, or stator circuit, is used to feed back a voltage signal from the generator (alternator) to the regulator. This voltage, typically half battery voltage, is used by the regulator to turn off the indicator.

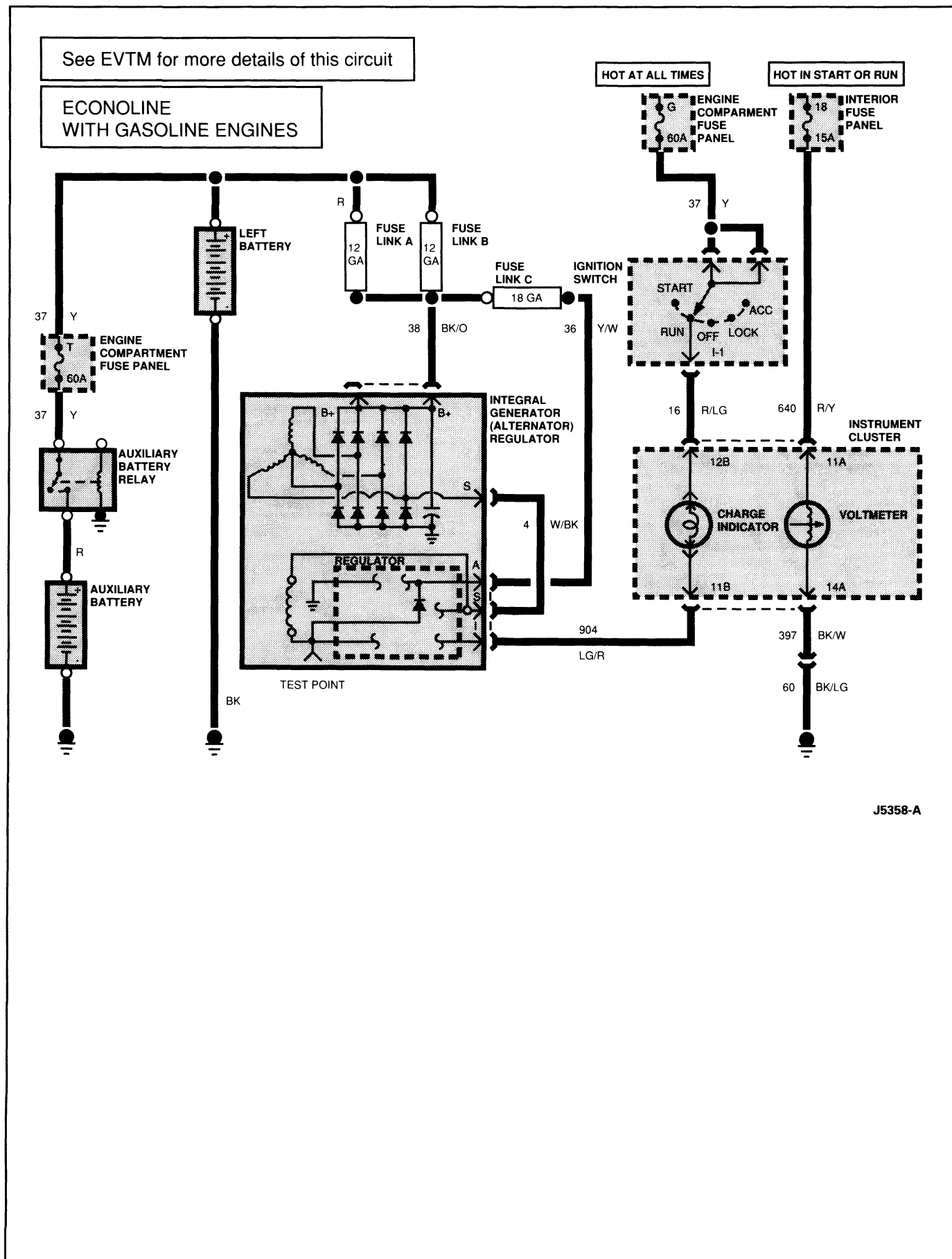
See EVTVM for more details of this circuit

F-SERIES AND BRONCO
WITH GASOLINE ENGINES

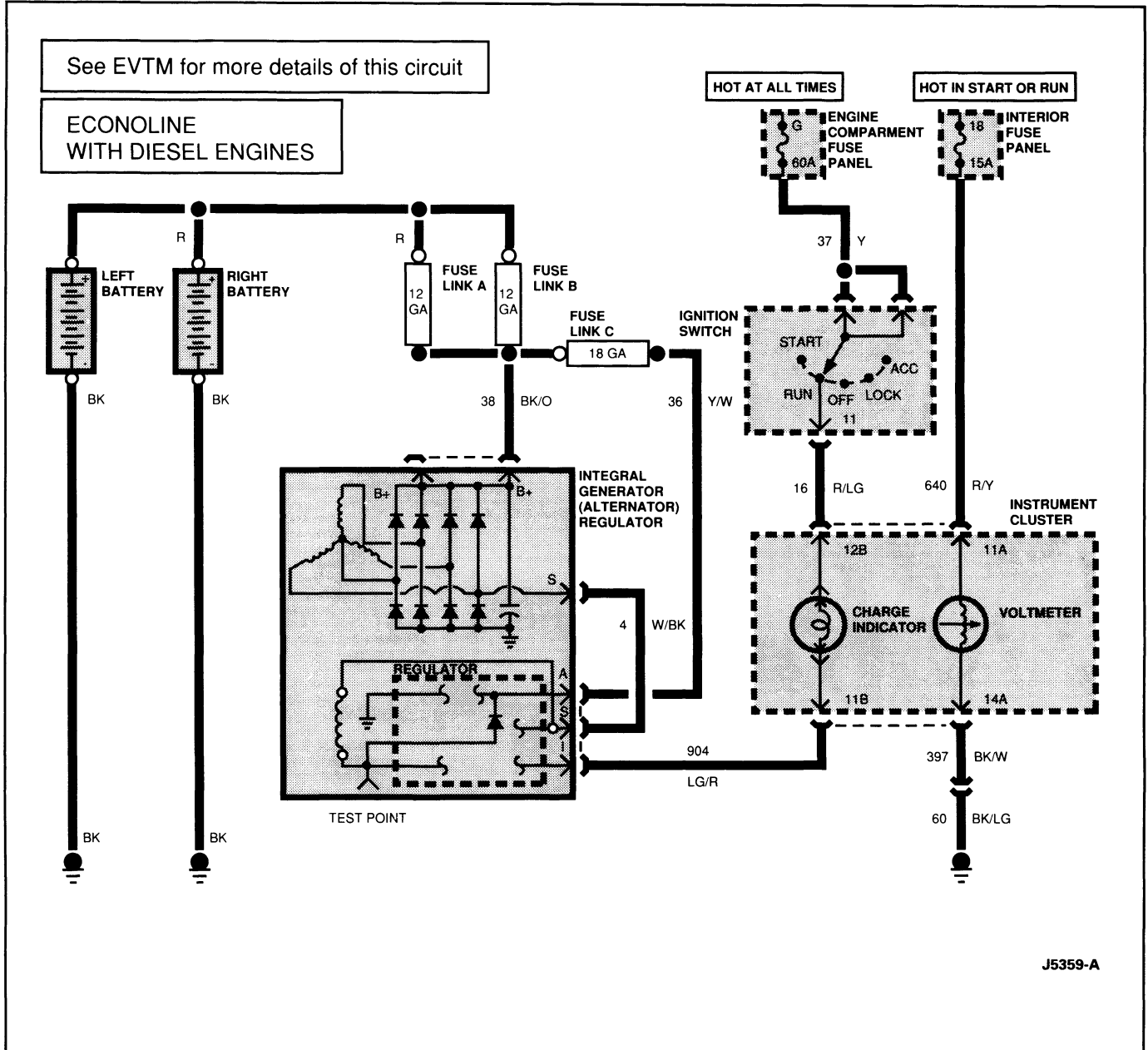


J5352-A

DESCRIPTION AND OPERATION (Continued)



DESCRIPTION AND OPERATION (Continued)



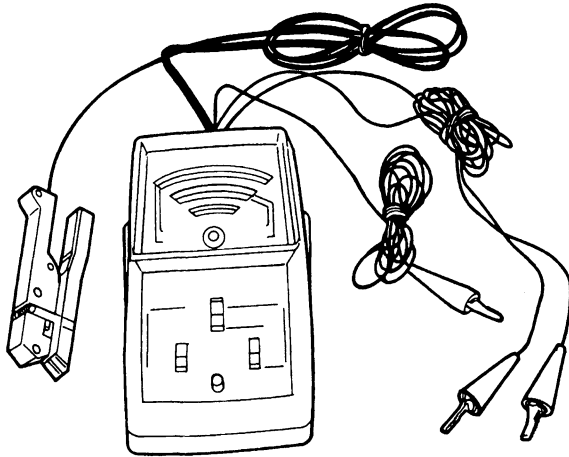
DIAGNOSIS AND TESTING

Bench Tests

If system diagnosis has isolated a concern in the integral generator (alternator)/regulator assembly, remove it from vehicle for bench testing and service or replace. Refer to Removal and Disassembly. In some cases, it may be possible to replace a damaged regulator or brushes without removing the IGR assembly.

DIAGNOSIS AND TESTING (Continued)

The following tests are performed with an analog (needle-type) ohmmeter. Test values shown are referenced to Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010 or equivalent. **THESE VALUES MAY BE DIFFERENT FOR OTHER OHMMETERS.** If a Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010 or equivalent is not available, use known good parts to establish reference values for your own meter. These values can be written into the spaces provided in the meter reading charts for future reference.



DWELL-TACH-VOLTS
OHMS TESTER 059-00010

J2934-C

Rectifier and Stator Grounded Tests

Tools Required:

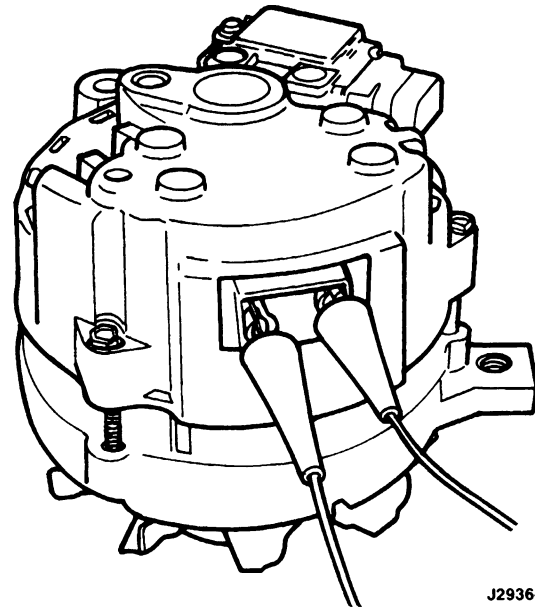
- Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010

Place the Multiply-By setting at 1 and calibrate the ohmmeter as directed.

NOTE: Test values shown in brackets [] ohms are referenced to Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010 and may be different if another tester is used.

CAUTION: Digital meters cannot be used to perform these rectifier tests.

1. Contact one ohmmeter probe of one of the generator (alternator) Battery Positive Voltage (B+) blade terminals and the other probe to the STA blade terminal. Then, reverse the ohmmeter probes and repeat the test. Normally, there will be no needle movement in one direction, indicating the rectifier diodes are being checked in the reverse current direction and are not shorted. A low reading of about [6.5] ohms with the probes reversed indicates that rectifier positive diodes are being checked in the forward current direction. A reading in both directions indicates a bad positive diode or shorted radio suppression capacitor. The radio suppression capacitor is built into the rectifier assembly and is not individually serviceable.



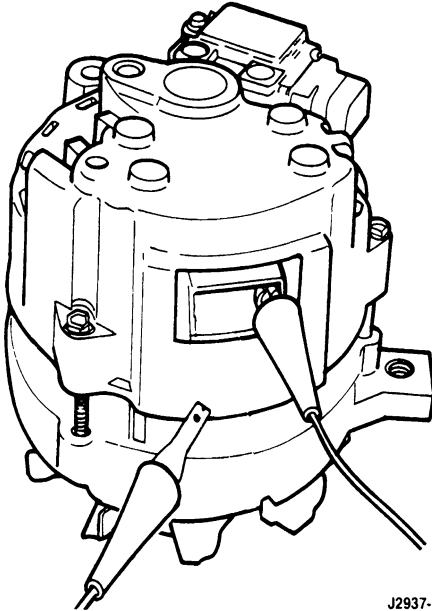
J2936-B

METER READING			
Set meter to Ohms x 1. Make reading in both directions.			
Resistance Measurement		Acceptable Reading	
BAT Terminal	to STA Terminal	Model 059-00010	Reference For Another Meter
One probe position		∞	∞
Other probe position		About [6.5] ohms	About ____ ohms

CJ3051-B

DIAGNOSIS AND TESTING (Continued)

2. Perform the same test using the STA blade terminal and generator (alternator) rear housing. A reading in both directions indicates either a grounded stator winding, a damaged negative diode, a grounded stator lead wire or a shorted radio suppression capacitor.



J2937-B

METER READING			
Set meter at Ohms x 1. Make reading in both directions.			
Resistance Measurement		Acceptable Reading	
GND	to STA Terminal	Model 059-00010	Reference For Another Meter
One probe position		∞	∞
Other probe position		About 6.5 ohms	About ____ ohms

CJ2673-A

3. If there is no needle movement with the probes in one direction and no needle movement or high resistance (significantly over [6.5] ohms) in the opposite direction for Tests 1 and 2, a bad connection exists in the rectifier assembly.

Field Open or Short Circuit Test

Tools Required:

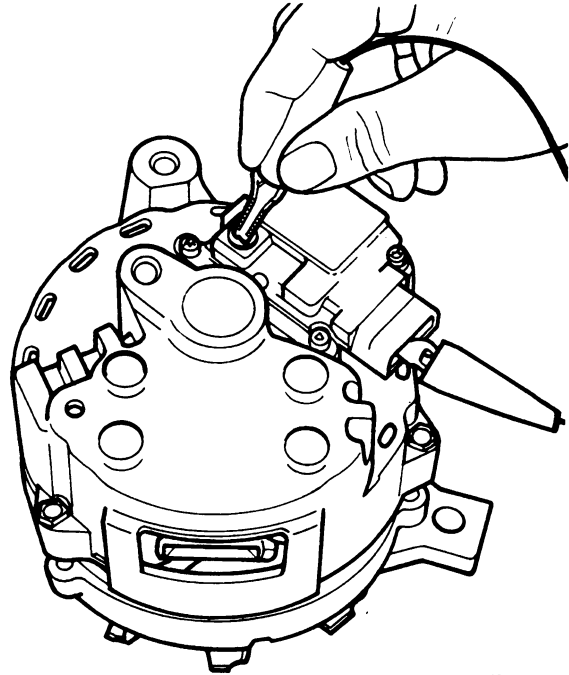
- Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010

Place the Multiply-By setting at 1 and calibrate the ohmmeter as directed.

NOTE: Test values shown in brackets [____] ohms are referenced to Rotunda Dwell-Tach-Volts Ohms Tester 059-00010, and may be different if another tester is used.

1. Contact the regulator A blade terminal with one probe and the regulator F screw head with the other probe. Spin the generator (alternator) pulley.

Reverse the ohmmeter probes and repeat the test. In one probe direction, the ohmmeter reading should be between 2.2 and 100 ohms (on Rotunda meter) and may fluctuate while the pulley is turning. In the other probe direction, the reading should fluctuate between 2.2 and about [9] ohms.



J2935-A

METER READING			
Set meter at Ohms x 1. Make readings in both directions. Spin pulley while taking reading.			
Resistance Measurement		Acceptable Reading	
Regulator A Blade Terminal	to Regulator F Screw Head	Model 059-00010	Reference For Another Meter
One probe position		2.2 to 100 ohms	2.2 to 100 ohms
Other probe position		2.2 to [9] ohms	2.2 to ____ ohms

CJ3053-C

2. An infinite reading (no meter movement) in one direction and approximately [9] ohms in the other, indicates an open brush lead, worn or stuck brushes, a damaged rotor or a loose regulator to brush holder retaining screw.
3. An ohmmeter reading less than [2.2] ohms in both directions indicates a shorted rotor or damaged regulator.
4. An ohmmeter reading significantly over [9] ohms in both directions indicates an inoperative regulator or loose F terminal screw.

DIAGNOSIS AND TESTING (Continued)

5. Contact the generator (alternator) rear housing with one ohmmeter probe and touch the other probe to the regulator F terminal. Reverse the probes and repeat the test. The ohmmeter reading should be infinite in one probe direction and approximately [9] ohms in the other. A reading less than infinite in both directions indicates a grounded brush lead or an inoperative regulator. A reading significantly over [9] ohms in both directions indicates an inoperative regulator or a damaged A terminal connection.

Rectifier Assembly Test**Tools Required:**

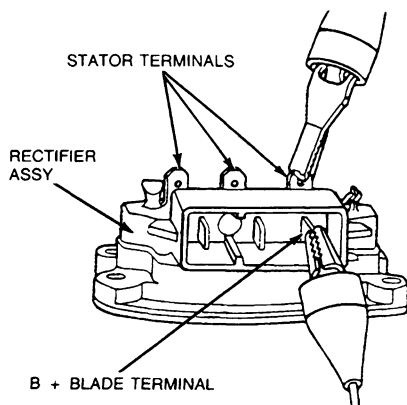
- Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010

Remove the rectifier assembly from the generator (alternator). Place the ohmmeter setting at 1 and calibrate the meter as directed.

NOTE: Test values shown in brackets [] ohms are referenced to Rotunda Dwell-Tach-Volts Ohms Tester 059-00010, and may be different if another tester is used.

CAUTION: Digital meters cannot be used to perform these rectifier tests.

1. To test the positive diodes, contact one probe to one of the rectifier assembly Battery Positive Voltage (B+) blade terminals and contact each of the three stator terminals with the other probe. Reverse the probes and repeat the test. All diodes should show a low reading of approximately [7] ohms in one direction and an infinite reading (no needle movement) with the probes reversed. This reading may be checked against a good rectifier if one is available.

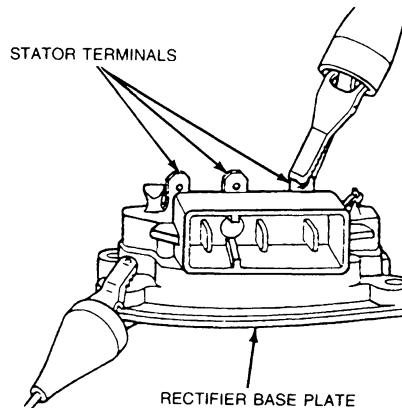


J2815-C

METER READING			
Set meter at Ohms x 1. Make readings in both probe directions to all three phase terminals.			
Resistance Measurement		Acceptable Reading	
B + Terminal	to Phase Terminal	Model 059-00010	Reference For Another Meter
One probe direction to each phase terminal		About 7.0 ohms	About ____ ohms
Other probe direction to each phase terminal		∞	∞

CJ2674-B

2. Perform the preceding tests for the negative diodes by contacting the rectifier assembly base plate and the three stator terminals.



J2816-C

METER READING			
Set meter at Ohms x 1. Make readings in both directions to all three phase terminals.			
Resistance Measurement		Acceptable Reading	
Base Plate	to Phase Terminal	Model 059-00010	Reference For Another Meter
One probe direction to each phase terminal		About 7.0 ohms	About ____ ohms
Other probe direction to each phase terminal		∞	∞

CJ2675-B

3. If the meter readings are not as specified, replace the rectifier assembly.

Radio Suppression Capacitor Open or Short Test

NOTE: This is an open or short circuit test only and does not measure capacitance value. Actual capacitance value should be measured on a capacitance bridge at 1 kHz at a maximum voltage of 350 mV rms.

DIAGNOSIS AND TESTING (Continued)

The radio noise suppression capacitor is built into the rectifier assembly and cannot be serviced by itself. To test the capacitor, place the ohmmeter. Multiply-By setting at 1000 and zero the meter.

NOTE: Test values shown in brackets [] ohms are referenced to Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010 and may be different if another tester is used.

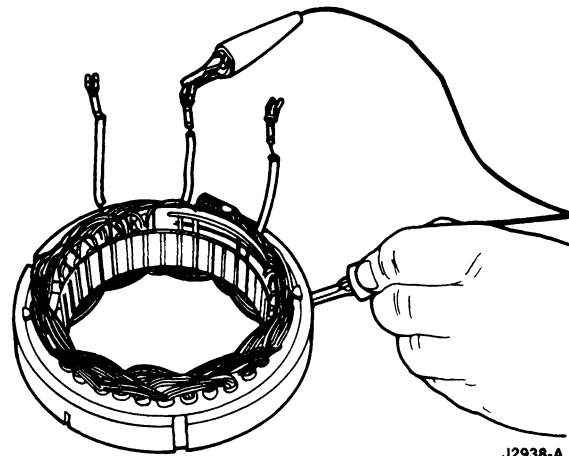
CAUTION: Digital meters cannot be used to perform this capacitor test. The rectifier assembly must be dry.

1. Contact one probe to one of the rectifier assembly Battery Positive Voltage (B+) blade terminals and contact the other probe to the rectifier assembly base plate. Reverse the probes and repeat the test. One position should give an infinite reading, indicating the reverse current direction through the diodes and the other position should give a reading of about [1000] ohms indicating the forward current direction. The same reading in both directions indicates an inoperative rectifier assembly.
2. To check the capacitor, contact the probes to the rectifier assembly Battery Positive Voltage (B+) terminal and base plate in the forward current [1000] ohms reading direction. While observing the meter indicator needle, reverse the probes and again contact them to the rectifier assembly Battery Positive Voltage (B+) terminal and base plate. The indicator needle should jump slightly (indicating that the ohmmeter batteries are charging the capacitor) and then return to its original position (infinite reading). If the needle does not jump, the capacitor is open. Replace the rectifier assembly.

Stator Coil Grounded Test

These tests are made to determine if the stator coil is shorted to ground. Remove the stator from the generator (alternator) and disconnect it from the rectifier assembly as outlined. Place the ohmmeter Multiply-By setting at 1000.

1. Connect the ohmmeter probes to one of the stator lead terminals and to the stator laminated core. Make sure the probe makes a good electrical connection with the stator core. The meter should show an infinite reading (no needle movement).
2. If the meter does not indicate an infinite reading (needle moves), the stator winding is grounded to the core and the stator must be replaced.



J2938-A

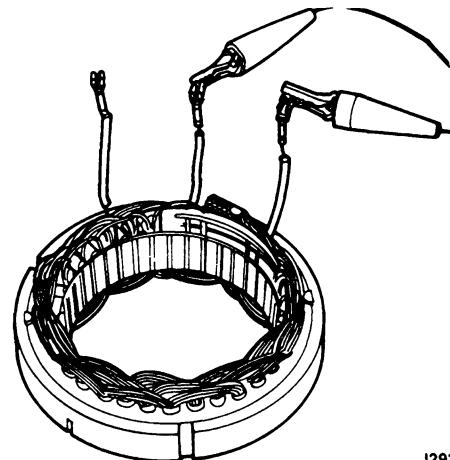
METER READING			
Set meter at Ohms x 1000. Make readings for all stator leads. DO NOT TOUCH LEADS WITH HANDS.			
Resistance Measurement		Acceptable Reading	
Stator Terminal	to Stator Core	Model 059-00010	Reference For Another Meter
All Stator lead combinations: Probe polarity optional		∞	∞

CJ2810-B

Stator Coil Open Test

This test determines if there is an open stator circuit. Disconnect the stator from the rectifier assembly. Place the ohmmeter Multiply-By setting at 1.

1. Connect one ohmmeter probe to a stator phase lead terminal and touch the other probe to another stator lead terminal. Check the meter reading.
2. Repeat this test with the other two stator lead combinations. If no meter movement occurs (infinite resistance) on a lead paired with either of the other phase leads, that phase is open and the stator must be replaced.



J2939-B

DIAGNOSIS AND TESTING (Continued)

METER READING			
Set meter at Ohms x 1. Make readings for all stator lead combinations.			
Resistance Measurement		Acceptable Reading	
Stator Terminal	to Stator Terminal	Model 059-00010	Reference For Another Meter
All lead combinations; Probe polarity optional		Less than 0.5 ohms	Less than 0.5 ohms

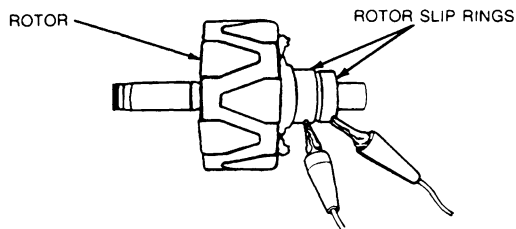
CJ2811-B

Rotor Open or Short Test

Remove the rotor from the generator (alternator). Place the ohmmeter Multiply-By setting at 1 and calibrate the meter as directed.

NOTE: Test values shown in brackets [] ohms are referenced to Rotunda Dwell-Tach-Volts-Ohms Tester 059-00010 and may be different if another tester is used.

1. Contact each ohmmeter probe to a rotor slip ring. The meter reading should be [2.0-3.9] ohms.
2. A higher reading indicates a damaged slip ring, welded connection or a broken wire. A lower reading indicates a shorted wire or slip ring. Replace the rotor if it is damaged and cannot be serviced.

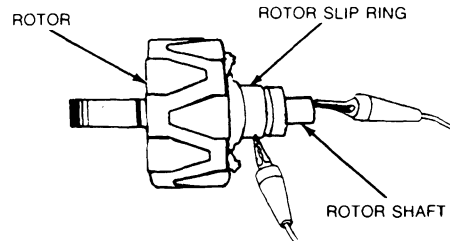


J2818-A

METER READING			
Set meter at Ohms x 1.			
Resistance Measurement		Acceptable Reading	
Slip Ring	to Slip Ring	Model 059-00010	Reference For Another Meter
Probe polarity optional		2.0 to 3.9 ohms	2.0 to 3.9 ohms

CJ2812-B

3. Contact one ohmmeter probe to a slip ring and the other probe to the rotor shaft. The meter reading should be infinite (no needle movement).
4. A reading other than infinite indicates the rotor coil is grounded to the shaft. Replace the rotor if it is grounded and cannot be serviced.



J2817-A

METER READING			
Set meter at Ohms x 1.			
Resistance Measurement		Acceptable Reading	
Slip Ring	to Rotor Shaft	Model 059-00010	Reference For Another Meter
Either slip ring; Probe polarity optional		∞	∞

CJ2813-B

REMOVAL AND INSTALLATION

WARNING: HYDROGEN AND OXYGEN GASES ARE PRODUCED DURING NORMAL BATTERY OPERATION. THIS GAS MIXTURE CAN EXPLODE IF FLAMES, SPARKS OR LIGHTED SUBSTANCES ARE BROUGHT NEAR THE BATTERY. WHEN CHARGING OR USING A BATTERY IN AN ENCLOSED SPACE, ALWAYS PROVIDE VENTILATION AND SHIELD YOUR EYES.

WARNING: KEEP BATTERIES OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH THE SKIN, EYES OR CLOTHING, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

Removal

1. Disconnect battery ground cable.
2. If required, remove the air cleaner assembly. Refer to Section 03-12.
3. Disconnect the wire harness attachments to the integral generator (alternator) / regulator assembly. Pull the two connectors straight out.
4. Remove the drive belt. Refer to Section 03-05 for procedure.
5. Remove the two generator (alternator) mounting bolts and remove the alternator from the mounting bracket.

REMOVAL AND INSTALLATION (Continued)

6. Remove the generator (alternator) fan shield, if so equipped.

Installation

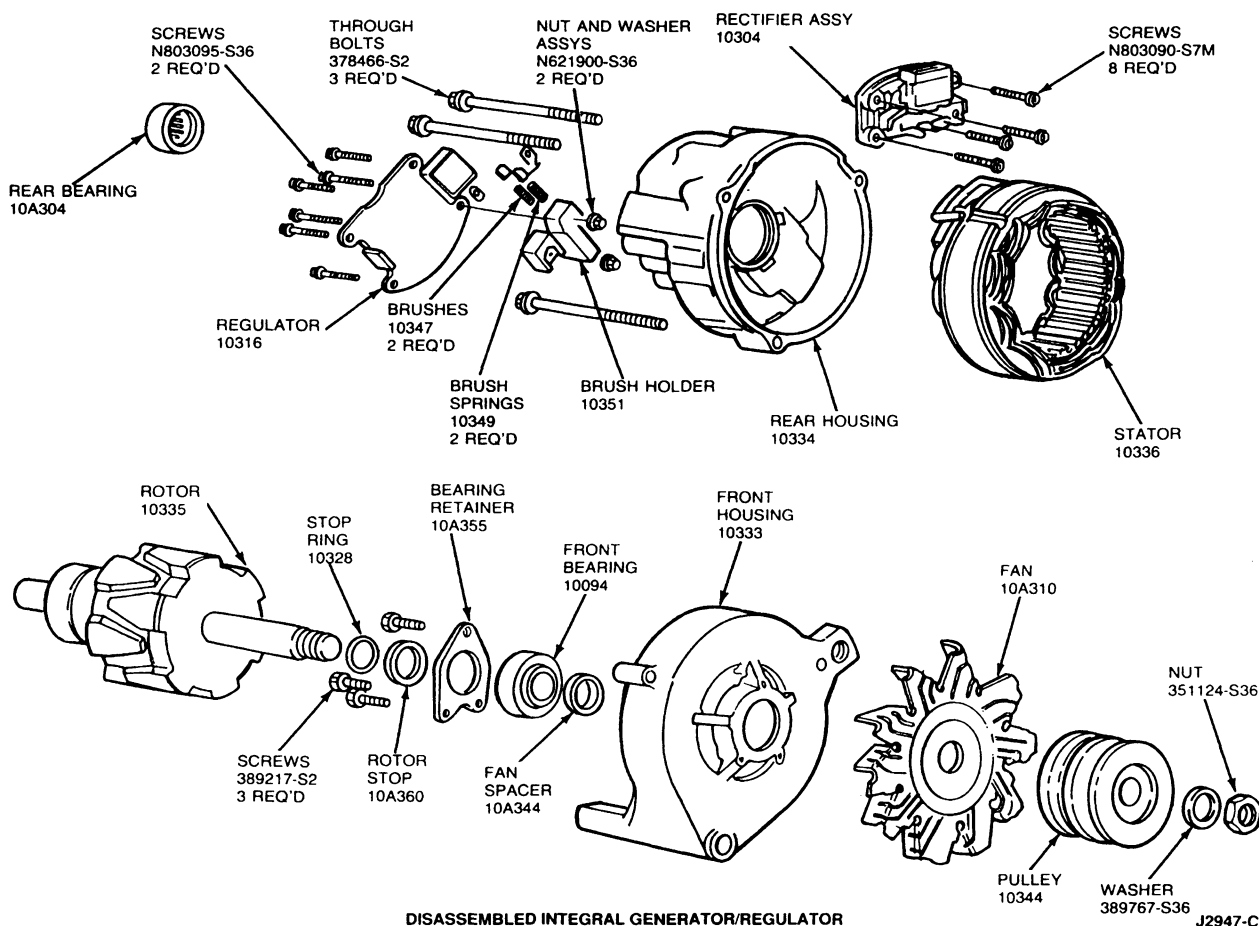
1. Position the integral generator (alternator) assembly on the engine.
2. Install the two generator (alternator) attaching bolts, but do not tighten the bolts until the belt is tensioned.
3. Install the drive belt. Refer to Section 03-05 for procedure.
4. Connect the wiring harness to the generator (alternator) assembly. Push the two connectors straight in.
5. Attach the generator (alternator) fan shield to the generator (alternator), if so equipped.
6. If required, install the air cleaner assembly. Refer to Section 03-12.

7. Connect battery ground cable.

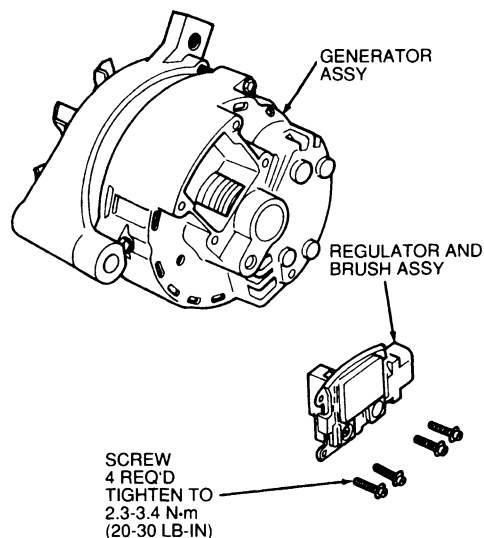
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

DISASSEMBLY AND ASSEMBLY

NOTE: All of the following Disassembly steps may not be necessary to perform a particular test or service. Perform only those steps that apply. The following illustration is a disassembled view of the integral generator (alternator) / regulator assembly. On generators (alternators) with fan shield, remove retaining clip and then remove fan shield.

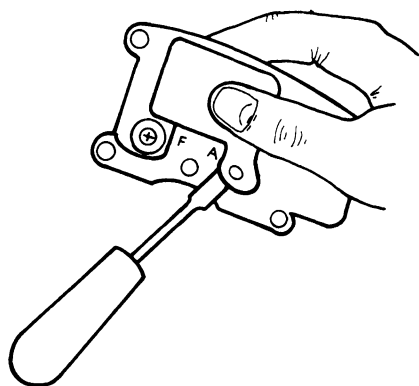
DISASSEMBLY AND ASSEMBLY (Continued)**Integral Generator (Alternator) Regulator, Disassembled View****Disassembly**

1. Remove the four screws (T20 Torx®-type head) retaining the regulator to the generator (alternator) rear housing. Remove the regulator, with brush holder attached, from the generator (alternator).



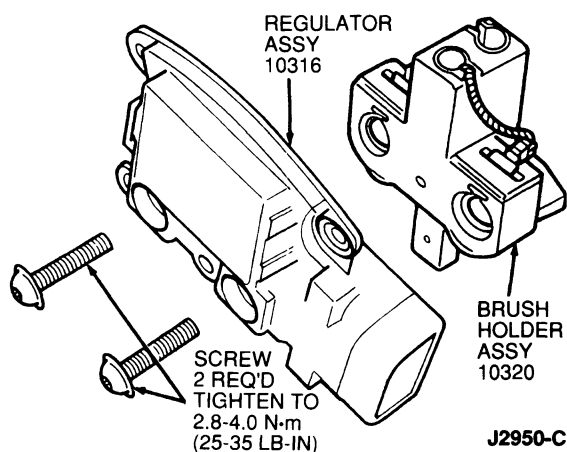
DISASSEMBLY AND ASSEMBLY (Continued)

2. Hold the regulator in one hand and break off the tab covering the A screw head with a screwdriver.



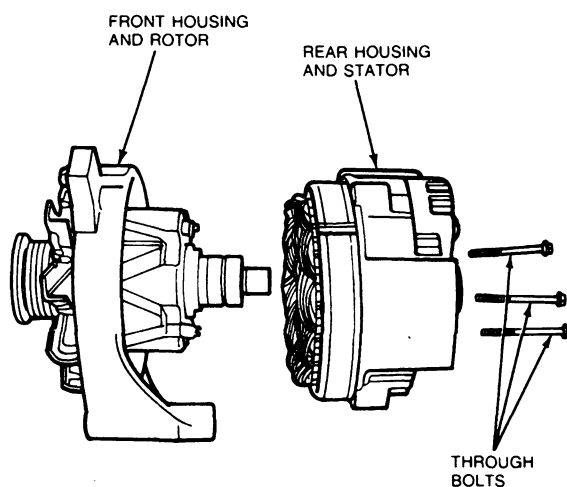
J3491-A

3. Remove two screws (T20 Torx®-type head) retaining the regulator to the brush holder. Separate the regulator, retaining nuts, brushes and brush springs from the brush holder.



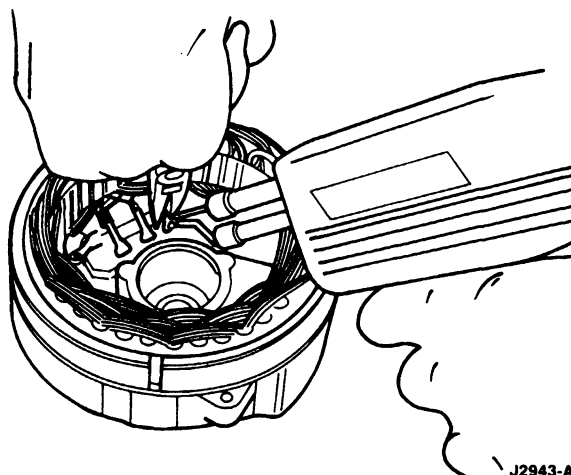
J2950-C

4. Scribe a line across the end housings and stator laminated core for reference during generator (alternator) assembly.
5. Remove the three through-bolts.
6. Separate the front housing and rotor assembly from the stator and rear housing. It may be necessary to tap the front housing with a plastic tipped hammer to loosen the front housing from the stator core.



J2942-A

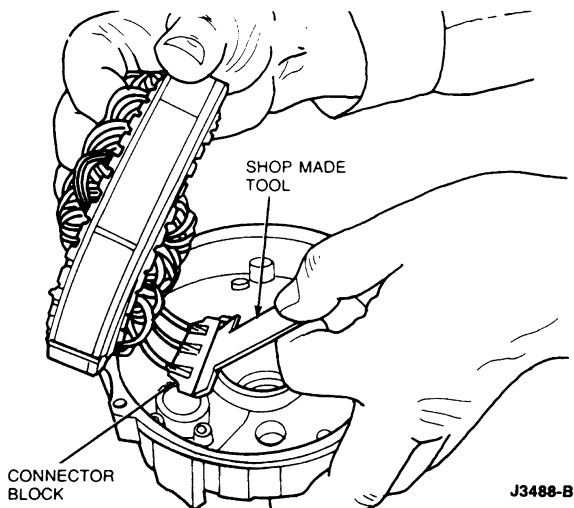
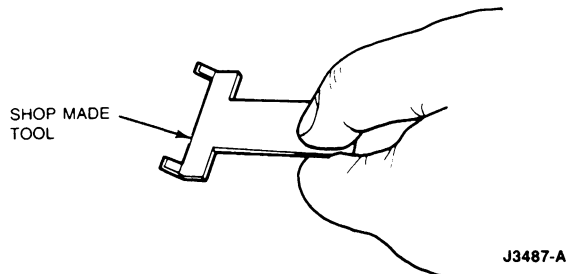
7. Remove the three stator lead terminals from the rectifier. If the terminals are soldered in place, unsolder the connections using a 100-watt soldering iron. Do not allow the soldering iron to overheat the rectifier. Use needle-nose pliers to pull the stator lead terminals upward from the rectifier assembly. Separate the stator from the rear housing.



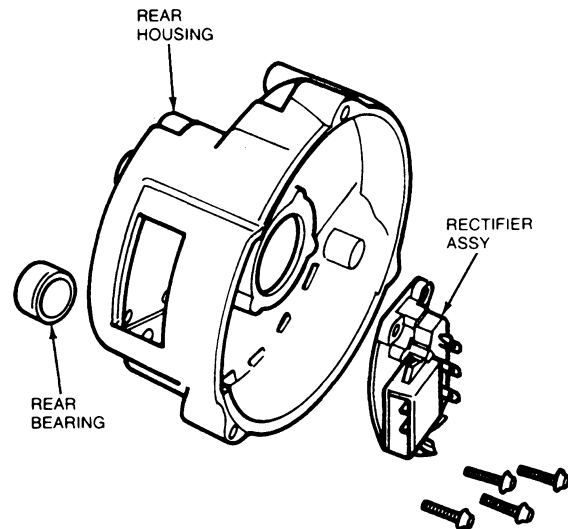
J2943-A

DISASSEMBLY AND ASSEMBLY (Continued)

8. Some generators (alternators) are designed with a connector block. In these designs, the terminals are not soldered to the rectifier. Using a shop made tool, carefully pry the connector block straight up to avoid bending the terminals.

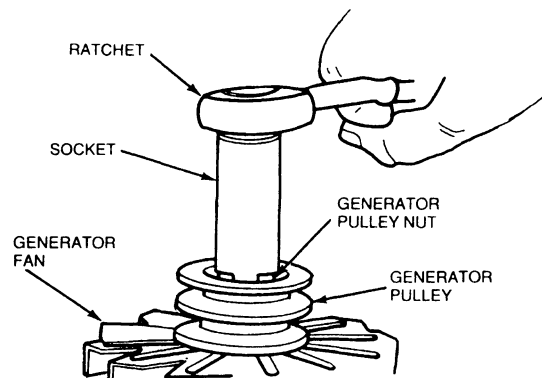


9. Remove the four rectifier assembly retaining screws (T20 Torx®-type head). Remove the rectifier assembly from the housing.
10. Using a suitable arbor press, remove the bearing from the rear housing. Support the housing close to the bearing boss to prevent housing damage.



J2940-A

11. Clamp the rotor in a soft-jaw vise.
12. Remove the pulley nut with a socket wrench.

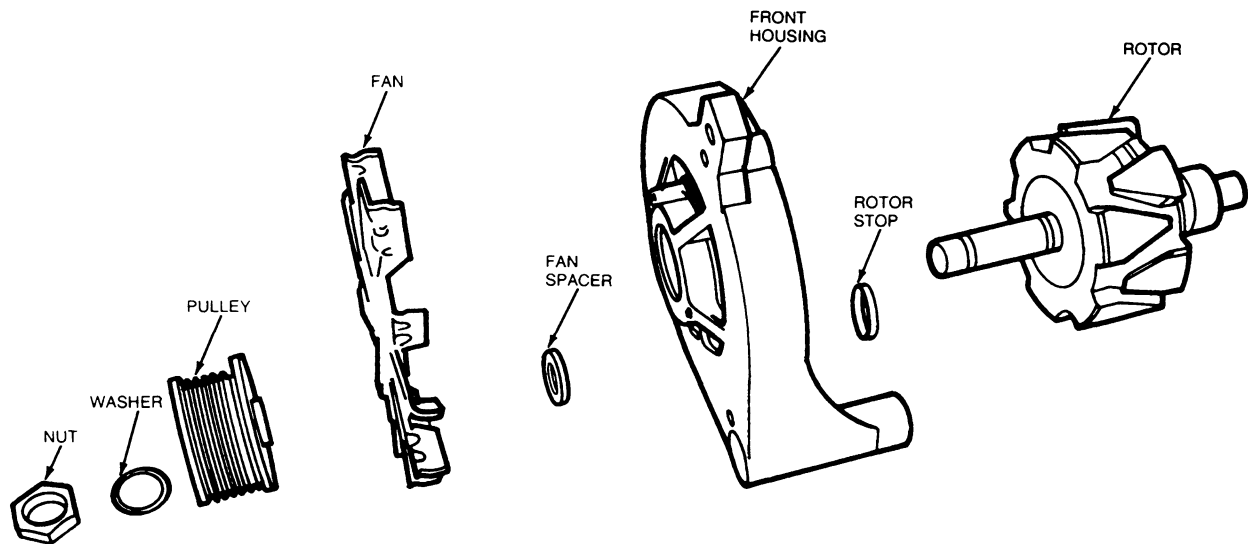


J3482-C

13. Remove the flatwasher, drive pulley, fan and fan spacer from the rotor shaft.
14. Remove the housing from the rotor and remove the rotor from the vise.
15. Remove the front rotor stop from the rotor shaft. Do not remove the stop ring from the rotor shaft unless it is damaged.
16. Remove the screws retaining the bearing retainer to the front housing and remove the retainer.
17. Remove the bearing from the front housing. If the bearing will not slide out, remove it using a suitable arbor press. Support the bearing close to the bearing boss to prevent damage to the housing.

DISASSEMBLY AND ASSEMBLY (Continued)

Generator (Alternator) Disassembly



J2946-B

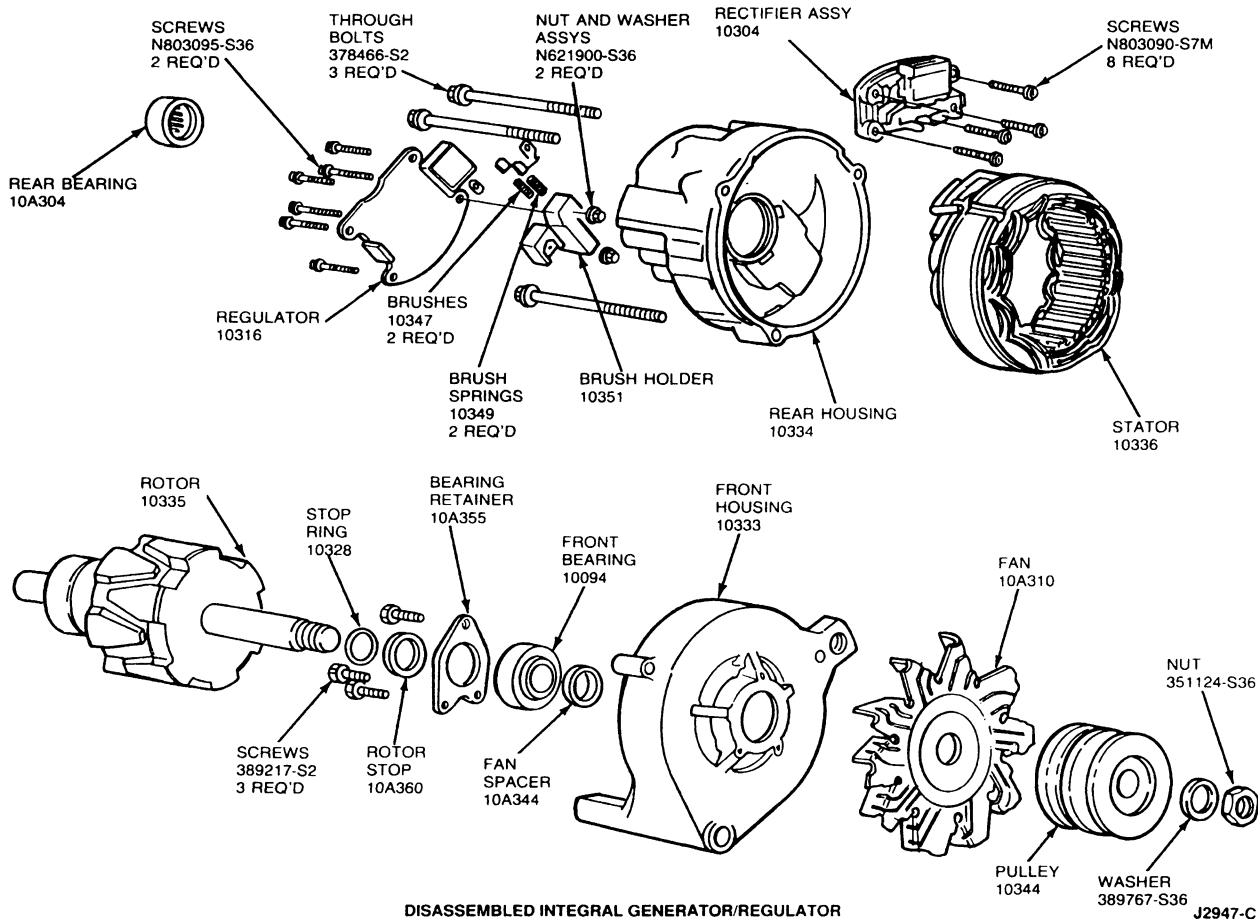
CAUTION: When rebuilding an integral generator (alternator), use only high-temperature bearings. Use of standard parts will result in generator (alternator) failure.

18. Wipe the stator, rotor and front bearing with a clean cloth. Do not clean these parts with solvent.
19. Rotate the front bearing on the drive end of the rotor shaft. Check for any scraping noise, looseness or roughness. Look for excessive lubricant leakage. If any of these conditions exist, replace the bearing.
20. Inspect the rotor shaft rear bearing surface for roughness or severe chatter marks. Replace the rotor assembly if the shaft is not smooth.
21. Place the rear bearing on the slip ring end of the rotor shaft and rotate the bearing. Make the same check for noise, looseness and roughness as was made for the front bearing. Inspect the rollers and cage for damage. Replace the rear bearing if these conditions exist or if the lubricant is lost or contaminated.
22. Check the slip rings for nicks and scratches. These may be removed by turning down the slip rings. Do not go beyond a minimum diameter of 31mm (1.22 inches). If the rings are badly damaged, replace the rotor assembly.
23. Check all wire leads on both the rotor and stator assemblies for loose or broken connections. Check the windings for burned insulation. Replace parts that show signs of burned insulation.
24. Check the pulley and fan for excessive looseness on the rotor shaft and for cracks or other damage. Replace any pulley or fan that is loose, cracked or bent out of shape.
25. Check both the front and rear housings for cracks, particularly in the webbed areas at the mounting ear. Replace a damaged or cracked housing.
26. Wipe the heat transfer grease from the rectifier assembly base and rectifier mounting area of the rear housing with a clean cloth.
27. Replace the brushes if they are worn shorter than 6.35mm (1 / 4 inch) from the shunt.

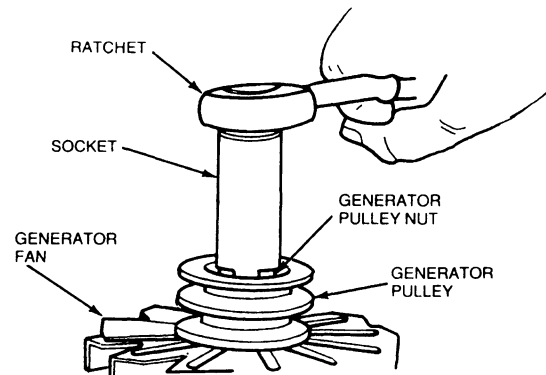
DISASSEMBLY AND ASSEMBLY (Continued)

Assembly

Refer to the following illustration for generator (alternator) / regulator assembly.



1. Install the bearing in the front housing. Press on the outer race only.
2. Position the bearing retainer on the front housing and install the retaining screws. Tighten the screws to 2.8-4.8 N·m (25-42 in-lb).
3. If the stop ring was removed from the rotor shaft, install a new ring by sliding it over the end of the shaft and into the groove furthest from the pole piece. Do not open the ring with snap ring pliers as permanent deformation of the ring will result.
4. Install the rotor stop on the rotor shaft with the recessed side against the stop ring.
5. Install the rotor in the front housing and clamp the rotor in a vise equipped with protective jaws.
6. Install the fan spacer, fan, drive pulley, flatwasher and nut on the rotor shaft. Tighten the nut to 82-135 N·m (61-99 ft-lb) with a socket wrench.



J3482-C

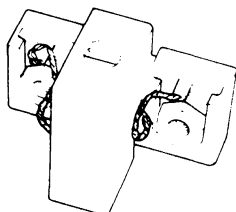
7. Remove the rotor and housing assembly from the vise and check for free rotation of the rotor in the housing.

DISASSEMBLY AND ASSEMBLY (Continued)

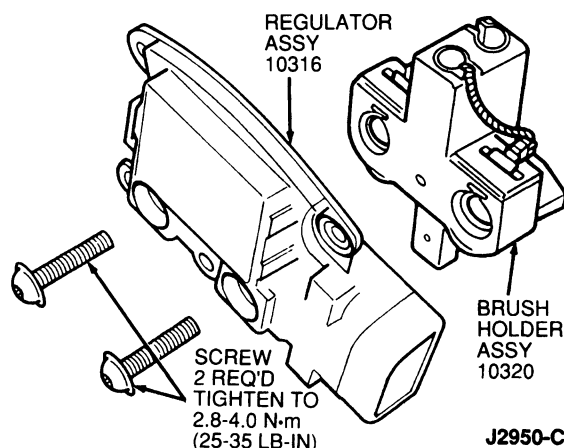
8. Support the rear housing close to the bearing boss to prevent damage to the housing and install the bearing using a suitable arbor press. Press the bearing into the bore until it is flush with the outside rear surface of the housing.
9. Wipe the rectifier assembly base plate with a clean cloth. Apply a 2.0mm (3/32 inch) wide by 20mm (3/4 inch) long strip of Ford Heat Transfer Compound E7AZ-19A426-A (ESF-M99G138-A) or equivalent lengthwise across the rectifier assembly base plate.
10. Wipe the rectifier mounting surface of the rear housing with a clean cloth and seat the rectifier into the recessed mounting area.

CAUTION: The rectifier assembly is cooled by conducting rectifier heat directly into the rear housing. Failure to remove foreign material from the mounting surfaces or failure to apply heat sink compound may cause rectifier overheating.

11. Install the four rectifier assembly retaining screws. Tighten the screws to 2.8-4.0 N·m (25-35 in-lb).
12. Position the stator assembly in the rear housing and align the scribe marks made during disassembly. Push the three stator terminals onto the rectifier blade terminals. Solder securely using resin core electrical solder if the terminals were previously soldered. Work quickly to prevent overheating the rectifier.
13. Wipe the rear end bearing surface of the rotor shaft with a clean, lint-free cloth.
14. Position the rear housing and stator assembly over the rotor and align the scribe marks made during disassembly.
15. Seat the machined portion of the stator core into the stop in both end housings and install the housing through-bolts. Tighten the bolts to 4.1-6.7 N·m (37-59 in-lb). Spin the rotor to check for free movement.
16. Position the two nut and washer assemblies into the retaining slots in the brush holder. Tip the holder back slightly so that the nut and washer assemblies fall to the nut side of the slots. Insert the brush terminals past the washers and into the slots.

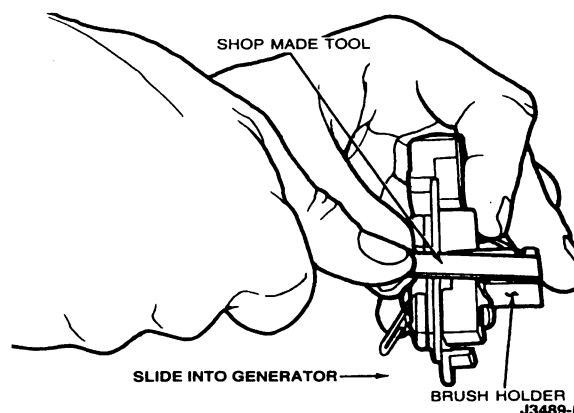


J2949-A



J2950-C

17. Wipe the regulator base plate with a clean cloth. Position the regulator against the brush holder and install the regulator to brush holder retaining screws. Tighten the screws to 2.3-3.4 N·m (21-30 in-lb).
18. Cover the head of the A terminal screw head with electrical tape.
19. Place brush springs in brush holder. Locate brushes in brush holder and hold in place with a thin, flat piece of steel (retaining tool). Loop the brush leads toward the brush end of the brush holder.



20. Wipe the regulator mounting surface of the generator (alternator) rear housing with a clean cloth. Position the regulator and brush holder assembly in the generator (alternator) rear housing and pull the retaining tool.
21. Install the regulator retaining screws. Tighten the screws to 2.8-4.0 N·m (25-35 in-lb).

ADJUSTMENTS

Refer to Section 03-05 for drive belt adjustments.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
Pulley Nut	81-135	60-100
Through-Bolt	4.1-6.7	36-60 (In-Lb)
Rectifier Assembly Mounting Screw	2.8-4	25-35 (In-Lb)


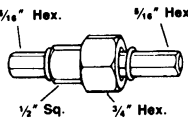
(Continued)

TORQUE SPECIFICATIONS (Cont'd)

Description	N-m	Lb-Ft
Brush Holder Mounting Screw	2.3-3.4	20-30 (In-Lb)
Regulator Mounting Screw	2.8-4	25-35 (In-Lb)
Bearing Retainer Screw	2.8-4.5	25-40 (In-Lb)

Supplier	Rating		Slip Ring Turning				Brush Length				Pulley Nut	
	Amperes @ 15V	Watts @ 15V	Min. Diameter		Max. Runout		New		Wear Limit		N-m	Ft-Lb
			MM	Inches	MM	Inches	MM	Inches	MM	Inches		
Ford	95A	1425W	26.4	1.04	.013	0.0005	18.00	.709	3.00	.17	82-135	60-100

SPECIAL SERVICE TOOLS / EQUIPMENT

Tool Number / Description	Illustration
T63L-8620-A Belt Tension Gauge	 T63L-8620-A
T65P-10300-B Generator (Alternator) Pulley Remover	 T65P-10300-B

ROTUNDA EQUIPMENT

Tool Number	Description
021-00019	Belt Tension Gauge
059-00010	Dwell-Tach-Volts-Ohms Tester

SECTION 14-02B Generator (Alternator), 165 Ampere, Leece-Neville

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS.....	14-02B-9	REMOVAL AND INSTALLATION	
DESCRIPTION AND OPERATION	14-02B-1	Generator (Alternator)	14-02B-5
DIAGNOSIS AND TESTING		Regulator	14-02B-5
Bench Tests	14-02B-3	SPECIAL SERVICE TOOLS/EQUIPMENT	14-02B-9
On Vehicle Tests	14-02B-2	SPECIFICATIONS.....	14-02B-9
DISASSEMBLY AND ASSEMBLY		VEHICLE APPLICATION	14-02B-1
Generator (Alternator).....	14-02B-6		

VEHICLE APPLICATION

Light Truck Vehicles with Ambulance Prep Package

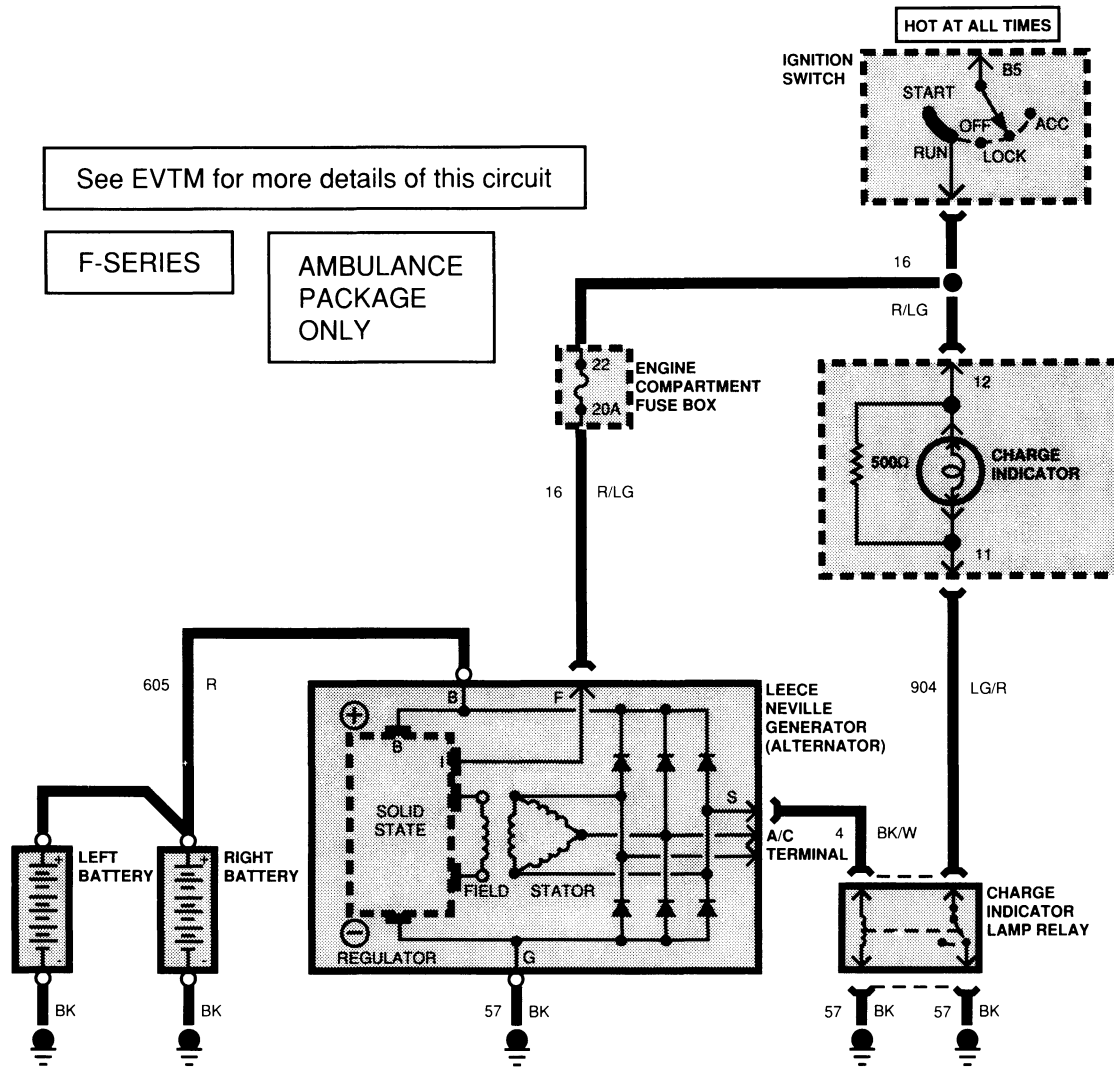
DESCRIPTION AND OPERATION

The Leece-Neville 165 ampere generator (alternator) is a self-current limiting unit with a fully adjustable solid state regulator.

The generator (alternator) features sealed ball bearings, with slip rings and brushes that are in a sealed housing mounted on the slip ring end housing. Six silicon diodes mounted in heat sinks convert alternating current from the delta wound stator into direct current. A capacitor connected between the heat sinks assists in suppressing transient voltage spikes which could possibly damage the diodes.

DESCRIPTION AND OPERATION (Continued)

The brushes and voltage regulator are located in a waterproof housing that may be removed for replacement or inspection without disassembling the generator (alternator).



J5371-A

DIAGNOSIS AND TESTING

On Vehicle Tests

NOTE: Before performing tests turn off all electrical accessories.

1. With the engine off, connect Rotunda Digital Volt-Ohmmeter 014-00407 or equivalent across the battery. Note reading on meter.

2. Start the engine and observe meter reading.

NOTE: If meter reading rises excessively, the charging system may be damaged or may require adjustment.

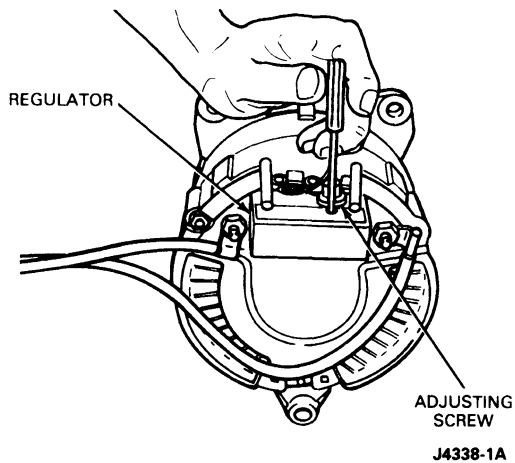
3. Remove the nylon screw from the voltage regulator.

DIAGNOSIS AND TESTING (Continued)

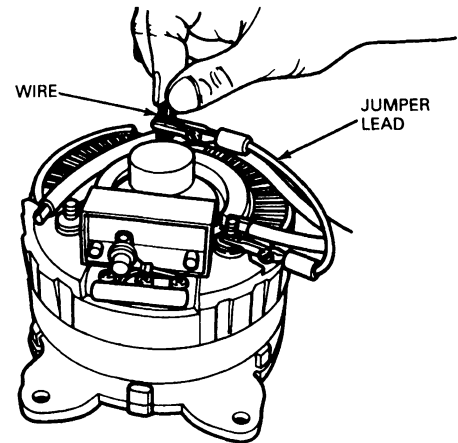
4. With the engine at approximately 1000 rpm, carefully turn the adjusting screw clockwise to raise, or counterclockwise to lower the voltage to 14.2-14.3 volts.

NOTE: When turning the adjustment screw, do not force the screw beyond its stop as damage will occur.

5. Replace the nylon screw in the regulator adjustment hole to prevent entry of foreign material into the regulator.



6. If the voltage is excessively high and cannot be lowered by adjustment, replace regulator.
7. If the output voltage cannot be raised, either the generator (alternator) or regulator may be at fault.
8. To determine if the cause is with the regulator or the generator (alternator), perform the following test.
 - a. Attach one end of the short jumper lead to the negative rectifier output terminal.
 - b. Connect the other end of the lead to a short stiff piece of wire at least 1-1/2 inches long.
 - c. Insert end, with wire into the small hole in the end of the brush holder so it firmly contacts the outer brush terminal.



9. If the voltmeter reading rises with the engine at a fast idle, the generator (alternator) is OK and a faulty regulator is indicated.

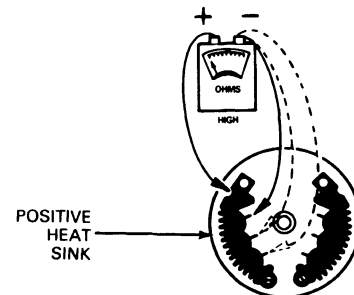
Bench Tests

Before performing these tests, carefully inspect all parts for wear, cracks, breakage, or other mechanical defects. Replace all damaged parts.

Diode Test, Positive Heat Sink

NOTE: The positive heat sink is connected to the positive output terminal. The square hole in the terminal end of the positive heat sink is larger than the terminal hole of the negative heat sink, approximately 11/32-inch square.

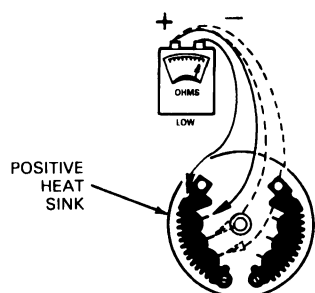
1. Connect the positive lead of the diode tester or ohmmeter to the positive heat sink.
2. Touch the negative test lead to each of the three diode terminals. A high resistance should be indicated.
3. If any of the three diodes shows a low resistance, the diode is shorted.



4. Reverse the test leads so that the negative test lead is connected to the positive heat sink.

DIAGNOSIS AND TESTING (Continued)

5. Touch positive test lead to each diode terminal; a low resistance reading should be obtained.
6. If a high resistance reading is obtained, an open diode is indicated.
7. If a shorted or open diode is detected, replace entire heat sink assembly.

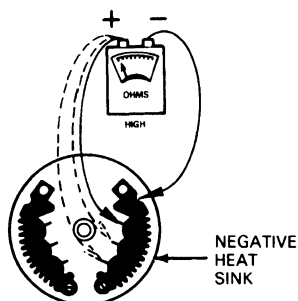


J4341-1A

Diode Test, Negative Heat Sink

NOTE: The negative heat sink terminal hole is approximately 9/32-inch square.

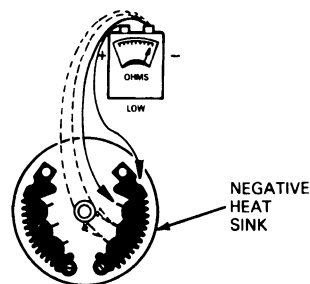
1. Connect the negative lead of the diode tester, ohmmeter, or test lamp to the negative heat sink.
2. Touch the positive test lead to each of the three diode terminals. A high resistance should be indicated.
3. If any of the three diodes shows a low resistance, the diode is shorted.



J4342-1A

4. Reverse the test leads so the positive test lead is connected to the negative heat sink. Touch the negative test lead to each diode terminal; a low resistance reading should be obtained.
5. If a high resistance reading is obtained, an open diode is indicated.

NOTE: If a shorted or open diode is detected in the preceding tests, the entire heat sink assembly should be replaced.

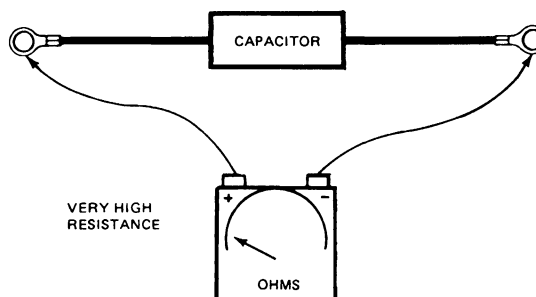


J4343-1A

Capacitor

The capacitor connected across the heat sinks may be tested on a capacitor tester if available. Its value is .158 MFD, and 100 working volts D.C.

In the absence of a capacitor tester, the unit may be checked for shorts by means of an ohmmeter connected across the terminals. A reading under 20 M ohms indicates a shorted or leaking capacitor which should be replaced.



J1949-1A

Rotor Test

1. Check rotor for grounds by connecting an ohmmeter to the shaft and to each of the two slip rings.
2. If a zero or close to zero reading is obtained, then the rotor assembly is grounded and must be replaced.
3. Check rotor coil resistance by connecting an ohmmeter to the two slip rings. Resistance readings should fall between 2.6-2.9 ohms.
4. If resistance falls outside values shown, then repeat this test by connecting the test leads to the rotor coil soldered connections to the slip rings.
5. If readings are now within 2.6 and 2.9 ohms, then the rotor coil soldered connections must be properly re-soldered.

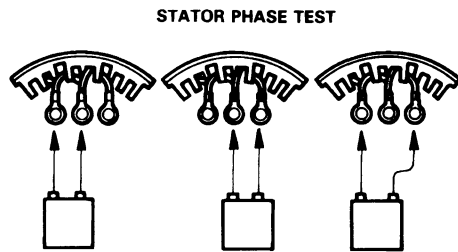
DIAGNOSIS AND TESTING (Continued)

6. If the resistance values are still outside figures shown when measured at the soldered connections, then the rotor assembly must be replaced.

Stator Test

1. Inspect the stator visually. If windings appear to be charred, burned, or if insulation is missing and bare copper is noticed, replace stator.
2. To test stator, remove from slip ring end housing and check with Rotunda Digital Volt-Ohmmeter 014-00407 or equivalent capable of reading 1 / 1000 of an ohm.
3. Check for grounds between stator lamination and each of the three stator terminals. If continuity is present, replace stator.
4. Check stator phase resistance across stator terminals. If resistance is about the same for each of three phases, stator phases are satisfactory.

NOTE: Reuse stator provided the windings appear undamaged and stator is not grounded.



DIGITAL VOLT-OHMMETER WITH 1/1000 OHM SCALE

J4345-1A

REMOVAL AND INSTALLATION

WARNING: HYDROGEN AND OXYGEN GASES ARE PRODUCED DURING NORMAL BATTERY OPERATION. THIS GAS MIXTURE CAN EXPLODE IF FLAMES, SPARKS OR LIGHTED SUBSTANCES ARE BROUGHT NEAR THE BATTERY. WHEN CHARGING OR USING A BATTERY IN AN ENCLOSED SPACE, ALWAYS PROVIDE VENTILATION AND SHIELD YOUR EYES.

WARNING: KEEP OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH SKIN, EYES OR CLOTHING, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

Generator (Alternator)**Removal**

1. Disconnect battery ground cable.
2. Disconnect the wire harness attachments to the generator (alternator) / regulator assembly.
3. Loosen the generator (alternator) pivot bolt.
4. Remove the adjustment bolt from the generator (alternator).
5. Disengage the generator (alternator) drive belt from the generator (alternator) pulley.
6. Remove the generator (alternator) pivot bolt and generator (alternator) / regulator assembly.
7. Remove the generator (alternator) fan shield, if equipped.

Installation

1. Position the generator (alternator) / regulator assembly on the engine.
2. Install the generator (alternator) pivot and adjuster arm bolts, but do not tighten either bolt until the belt is tensioned. Snug the pivot bolt still allowing movement of the generator (alternator).
3. Install the drive belt over the generator (alternator) pulley.
4. Adjust the belt tension and tighten the adjuster bolt.
5. Tighten pivot bolt to specification.
6. Check belt tension using Belt Tension Gauge T63L-8620-A or Rotunda Belt Tension Gauge 021-00019 or equivalent.

NOTE: Generator (alternator) has a built-in jack screw for tensioning the belt. Refer to Section 03-05.

CAUTION: Tighten the jackscrew by hand.

7. Connect the wiring harness to the generator (alternator) / regulator assembly.
 8. Reconnect battery ground cable.
- NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM)(12A650)relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
9. Attach the generator (alternator) fan shield to the generator (alternator), if so equipped.

Regulator**Removal**

1. Remove the lead from the regulator terminal.
2. Remove the two 6-32 nuts holding the regulator and the positive and negative jumpers.
3. Slowly pull the regulator from the holder and remove the regulator.

REMOVAL AND INSTALLATION (Continued)

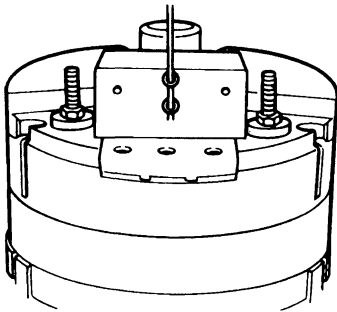
4. Check brushes. Replace brushes or regulator if necessary.
5. Replace brushes less than 4.76 mm (.188 inch) in length.



MINIMUM SERVICEABLE BRUSH LENGTH J4346-1A

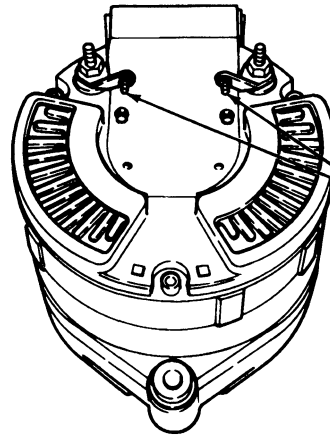
Installation

1. Before installing the regulator, insert the outer brush into the housing and compress the brush spring using a small screwdriver or similar tool.
2. While holding the spring compressed, insert a pin through the top hole in the rear of the housing so the spring is held in a compressed position.
NOTE: A suitable pin can be made using drill rod material or a 1/32-inch diameter drill.
3. Install and compress remaining brush in a similar manner.
4. Hold the springs in a compressed position by pushing the pin farther into the brush housing.



J4347-1A

5. Slowly push the regulator into the brush housing making sure the respective screws go through the positive and negative jumpers.
6. Install the lockwashers and 6-32 nuts and hand-tighten.
7. Remove brush pin; tighten the nuts to 113-135 N•cm (10-12 in-lb).
CAUTION: DO NOT TIGHTEN NUTS WITH BRUSH PIN IN PLACE AS DAMAGE TO THE REGULATOR WILL RESULT.
8. Install the lead to the regulator terminal.

NUTS
TIGHTEN TO
113-135 N•cm
(10-12 IN-LB)

J4348-1A

DISASSEMBLY AND ASSEMBLY

Generator (Alternator)

Disassembly

1. Hold pulley with a strap wrench and remove shaft nut with an impact gun. Remove pulley, fan, woodruff key, and fan spacer.
2. Remove the 5/16-18 and 1/4-20 nuts from the positive and negative generator (alternator) output terminals.
3. Remove the four 8-32 screws holding the regulator/brush holder assembly in place. Remove assembly.

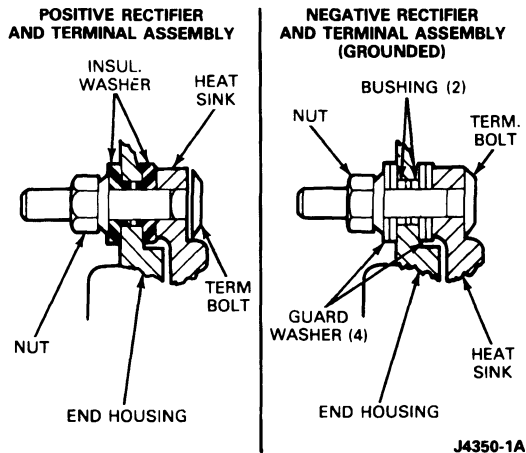
NOTE: Due to the application of Loctite® to the four brush housing screws, it may be necessary to apply heat to assist in removal of these screws. Use a large soldering iron or gun (300 to 500 watts). Hold the iron on each screw head for 40-50 seconds (a drop of solder on the iron's tip will help heat transfer). After applying heat to the screw head, remove immediately with a screwdriver.

4. Remove three self-locking nuts and through-bolts.
5. Remove rotor and drive end housing assembly from stator and slip ring end housing assembly.
NOTE: If drive end housing binds on stator, loosen by tapping gently on mounting ear with fiber hammer. Make sure drive end housing separates from stator and stator remains attached to slip ring end housing to avoid damage to stator leads.
6. Remove three nuts securing stator leads to terminals and remove stator.
7. Remove nuts from positive and negative output terminal bolts. Remove bolts.
8. Remove hex screws.
9. Remove capacitor connected between the heat sinks.

DISASSEMBLY AND ASSEMBLY (Continued)

10. Remove two screws, lockwashers, and insulating washers retaining lower end of heat sinks.
11. Remove heat sinks. Note location of insulating washers and bushings.
12. Remove terminal stud insulating washers from housing.

NOTE: There are two bushings in each terminal hole.



13. Using a puller or arbor press, remove the drive end housing bearing assembly from the rotor shaft.
14. Remove four screws and bearing retainer. Press bearing out of drive end housing.

Slip Ring Bearing Replacement

1. With a soldering iron remove the wire connecting the rotor coil to the outside slip ring.
2. Bend unsoldered wire so it is parallel to the shaft.
3. Unsolder the wire from the inside slip ring.
4. With a gear puller or an arbor press, pull off the slip ring assembly and the insulation washer.
5. Remove the bearing using a gear puller; an arbor press may also be used with fixture plates behind the bearing.

NOTE: While replacing the bearing keep the new slip ring in a warm place so it will press on easily without cracking.

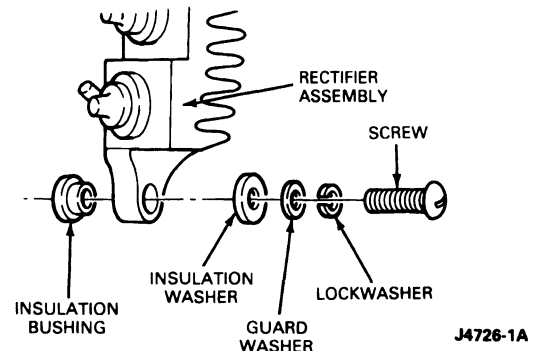
6. Install the new bearing using a pipe or tube to press on the inner race of bearing.
7. After the new bearing has been pressed on the rotor shaft, press on the new slip ring assembly making sure the slot lines up with the slot in the shaft.
8. Press new slip ring assembly on the shaft. Apply enough pressure to prevent the insulation washer from turning all the way to the shoulder.
9. Solder the rotor coil leads to new slip ring assembly.

10. Put the rotor assembly in a lathe. Take a light cut from the circumference of slip rings so they are concentric with the shaft.

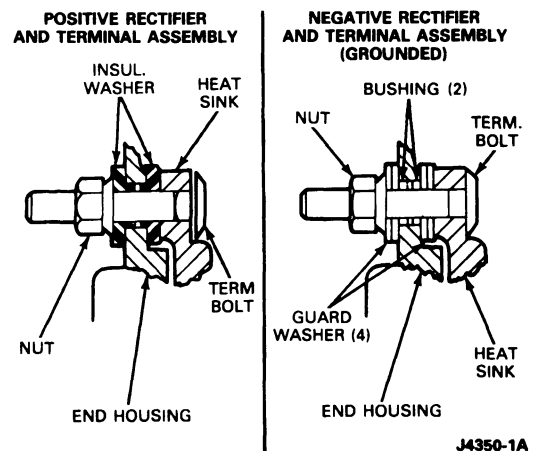
NOTE: Concentricity of the slip rings with the bearing surfaces of the shaft should be held to within .002 inch total indicator reading.

Assembly

1. Place slip ring end of rotor shaft in an arbor press making sure slip rings are not damaged.
2. Press the drive end housing on rotor shaft. Use a sleeve or pipe so pressure is applied on drive end bearing inner race only.
3. Place positive and negative rectifier assemblies in the slip ring end housing and install the lower mounting screws. Do not tighten screws at this time.



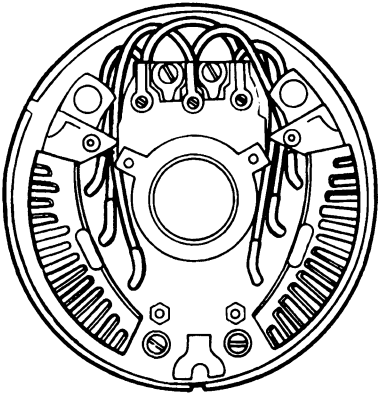
4. Install positive and negative output terminals as shown.



5. Tighten two screws on bottom of the two rectifier assemblies to complete installation.
6. Install capacitor and capacitor terminals to bottom of rectifier assemblies with self tapping screws. Clean paint from around holes before installing leads.

DISASSEMBLY AND ASSEMBLY (Continued)

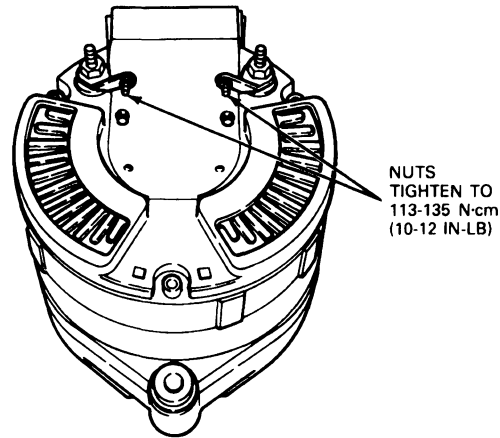
7. Place a positive rectifier terminal and a negative rectifier terminal on each of the three terminal screws on the terminal board. Route the leads as shown.



J4727-1A

8. Inspect O-ring in slip ring end housing bearing bore and replace if necessary.
9. Place the stator on the slip ring end housing. Place the stator leads on the three terminal board screws.
10. Make sure assembly screw holes in the stator and slip ring end housing are aligned.
11. Install rectifier leads and stator leads with self-locking nuts.
12. Support the slip ring end housing on flat plates in an arbor press.
13. Press the slip ring end bearing in slip ring end housing by pressing on the rotor shaft.
14. Align assembly screw holes in the slip ring end housing, stator and the drive end housing.
15. Install three assembly screws and fasten generator (alternator) together with elastic stop nuts tightened to 5.08-5.65 N·m (45-50 in·lb).
16. Install brush holder with four #8 round head screws. Apply Threadlock Sealer EOAZ-19554-AA (ESE-M4G204-A Type II) or equivalent. Make sure sealing ring is properly installed between the brush holder and the slip ring end housing.
17. Press brushes in brush openings and temporarily pin into place with a 1/32-inch diameter drill or a piece of stiff wire.
18. Install regulator with #6 nuts, Belleville washers and jumpers.
19. Remove pin to release brush springs.
20. Tighten nuts to secure the regulator to brush holder.

21. Install jumpers to negative and positive output terminals and to regulator terminals with nuts and lockwashers.

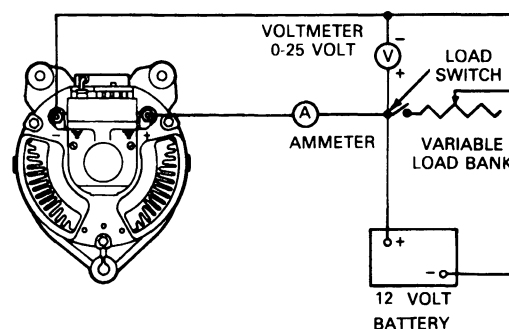


J4348-1A

22. Install lead to regulator terminal with #10 nut and lockwasher.
23. Slide fan spacer on shaft and install woodruff key, fan, pulley, and nut. Hold the pulley with a strap wrench and tighten nut with an impact gun. Torque to 25.8-29.5 N·m (19-21 ft·lb).

Testing After Assembly

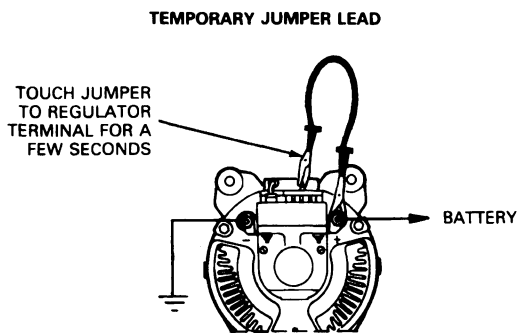
Because of the integral regulator used on this generator (alternator), the test block hook-up is very simple, consisting of connecting the positive and negative output leads. If a commercial test block is not available, the test setup shown may be used.



J4729-1A

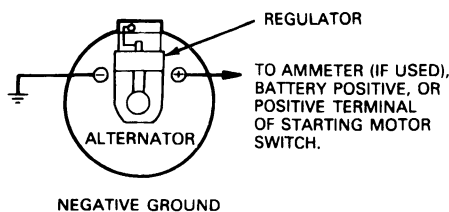
DISASSEMBLY AND ASSEMBLY (Continued)

NOTE: Before beginning the test and after the battery has been connected, momentarily flash the field by connecting a jumper between the charge indicator light terminal and the generator (alternator) positive output terminal. This will restore residual magnetism which may have been weakened by handling or repair procedures.



J4730-1A

The cut-in speed is the rotor speed when the unit first begins to produce output. This speed should not be higher than 1500 rotor rpm.



TYPICAL WIRING

J4731-1A

ADJUSTMENTS

Before performing any tests or adjustments on the generator (alternator), refer to Section 03-05 for belt inspection and adjustment procedures.

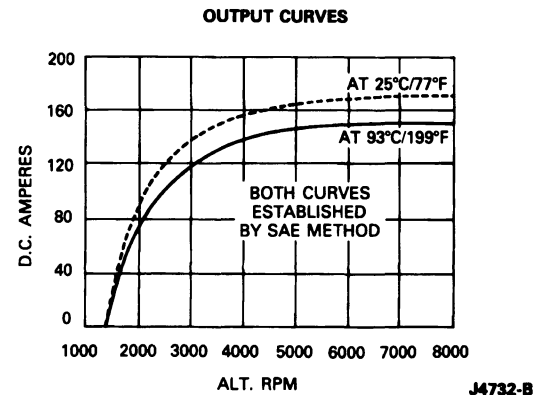
Refer to Section 14-00 for battery inspection and state of charge condition.

SPECIFICATIONS

TORQUE SPECIFICATIONS


Description	N-m	Lb-Ft
Generator (Alternator) Plastic Stop Nuts	5-6	44-53 (In-Lb)
Regulator Pulley Nut	26-30	19-22
Brush Housing Screws and Nuts	113-135 (N-cm)	10-12 (In-Lb)

Output Curves



J4732-B

SPECIAL SERVICE TOOLS/EQUIPMENT

Tool Number / Description	Illustration
T63L-8620-A Belt Tension Gauge	 T63L-8620-A

ROTUNDA EQUIPMENT

Tool Number	Description
021-00019	Belt Tension Gauge
014-00407	Digital Volt-Ohmmeter

SECTION 14-02C

Generator (Alternator), Integral Rear Mount Regulator, Internal Fan Type

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
Circuit Description	14-02C-2	Generator (Alternator)	14-02C-3
DIAGNOSIS AND TESTING	14-02C-3	Regulator	14-02C-3
DISASSEMBLY AND ASSEMBLY	14-02C-4	SPECIFICATIONS	14-02C-4
		VEHICLE APPLICATION	14-02C-1

VEHICLE APPLICATION

Econoline Vehicles; F-Series and Bronco Vehicles with 5.0L and 5.8L Gasoline Engines and 7.3L Diesel Engines

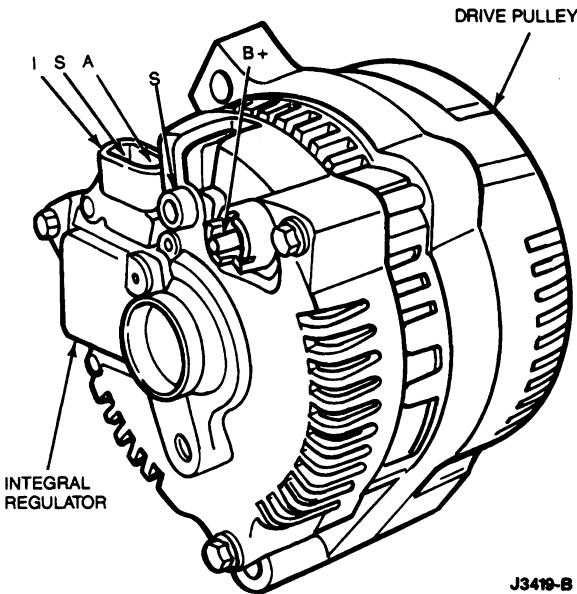
DESCRIPTION AND OPERATION

The electrical charging system is a negative ground system consisting of an integral generator (alternator) voltage regulator (IGR), charge indicator, storage battery, and the necessary wiring and cables. Refer to the Electrical and Vacuum Troubleshooting manual for schematics and locations of components and wiring.

With the ignition key in the RUN position, voltage is applied through the charge indicator lamp 'I' circuit to the voltage regulator. This turns the regulator on allowing current to flow from the battery sense 'A' circuit to the generator (alternator) field coil. When the engine is started, the generator (alternator) begins to generate alternating (AC) current which is converted to direct (DC) current by the rectifier assembly internal to the generator (alternator). This current is then supplied to the vehicle's electrical system through the output connector Battery Positive Voltage (B+) located on the rear of the generator (alternator).

Once the generator (alternator) begins generating current, a voltage signal is taken from the generator (alternator) stator and fed back to the regulator S circuit, turning off the charge indicator.

With the system functioning normally, the generator (alternator) output current is determined by the voltage at the A circuit (battery sense voltage). The A circuit voltage is compared to a set voltage internal to the regulator, and the regulator controls the generator (alternator) field current to maintain proper output. The set voltage will vary with temperature and is typically higher in the winter than in the summer, allowing for better battery recharge in the winter and reducing the chance of overcharging the battery in the summer.



DESCRIPTION AND OPERATION (Continued)

Circuit Description

Battery Positive Voltage (B+) Output

The generator (alternator) output is supplied through the Battery Positive Voltage (B+) output connection to the battery and electrical system.

I Circuit

The I circuit, or ignition circuit is used to turn on the voltage regulator. This circuit is powered up with the ignition key in the RUN position. This circuit is also used to turn the indicator on if there is a fault in the charging system operation or associated wiring circuits

A Circuit

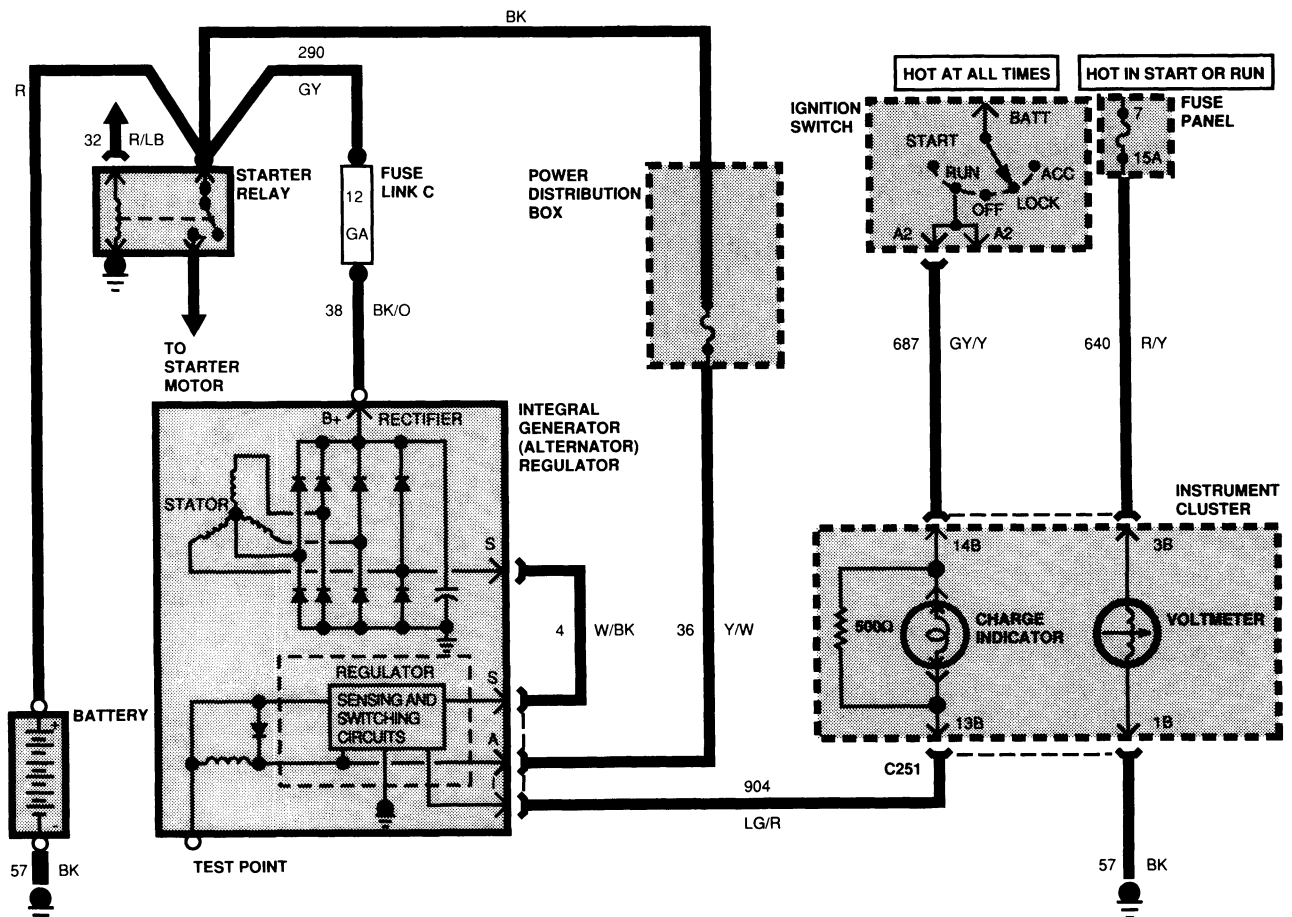
The A circuit, or battery sense circuit, is used to sense the battery voltage. This voltage is used by the regulator to determine the output. This circuit is also used to supply power to the generator (alternator) field coil. This circuit is connected back to the load distribution point and is a protected circuit.

S Circuit

The S circuit, or stator circuit, is used to feedback a voltage signal from the generator (alternator) to the regulator. This voltage, typically 1/2 battery voltage, is used by the regulator to turn off the indicator.

See EVTM for more details of this circuit

RANGER WITH 2.3L, 3.0L AND 4.0L



J5353-A

DIAGNOSIS AND TESTING

Refer to Section 14-00 for Charging System diagnosis procedures.

REMOVAL AND INSTALLATION

WARNING: BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED SUBSTANCES TO COME NEAR THE BATTERY. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.

WHEN LIFTING A PLASTIC-CASED BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.

WARNING: KEEP BATTERIES OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH THE SKIN, EYES OR CLOTHING, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

Generator (Alternator)

Removal

1. Disconnect battery ground cable.
2. Remove snow / ice shield.
3. Remove fresh air inlet tube.
4. Disconnect the wire harness attachments to the integral generator (alternator) / regulator assembly.
5. Remove wiring connector bracket.
6. Loosen the drive belt tensioner and remove the drive belt.
7. Remove the bolts holding the generator (alternator) / regulator assembly to the alternator mounting bracket.
8. Remove the generator (alternator) / regulator assembly from the alternator mounting bracket.

Installation

1. Position the generator (alternator) / regulator assembly on the alternator mounting bracket.
2. Install the mounting bracket bolts and tighten to 40.3-54.7 N·m (30-40 ft-lb).

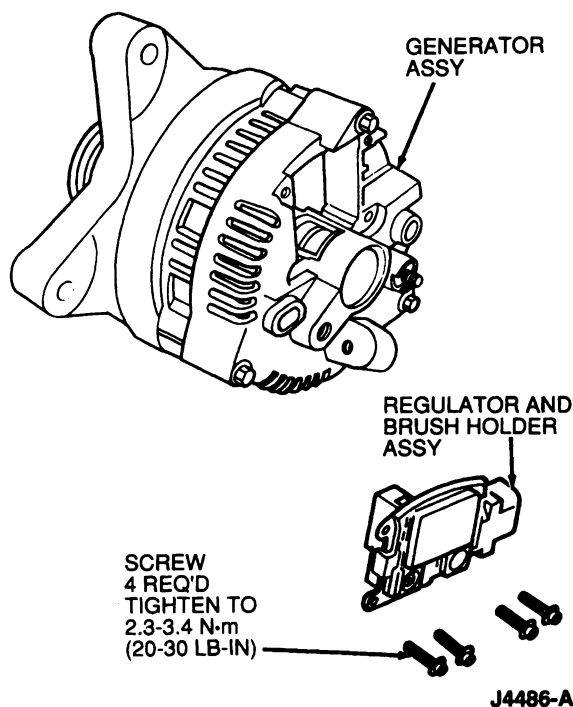
3. Install the drive belt over the generator (alternator) pulley.
4. Adjust the drive belt tensioners as outlined in Section 03-05, Accessory Drive.
5. Connect generator (alternator) wiring harness to the generator (alternator) / regulator assembly. Tighten generator (alternator) Battery Positive Voltage (B+) wire attaching nut to 8.9-12.1 N·m (6.5-9 ft-lb).
6. Install wiring connector bracket.
7. Install fresh air inlet tube.
8. Install snow / ice shield.
9. Connect negative battery cable.

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Regulator

Removal

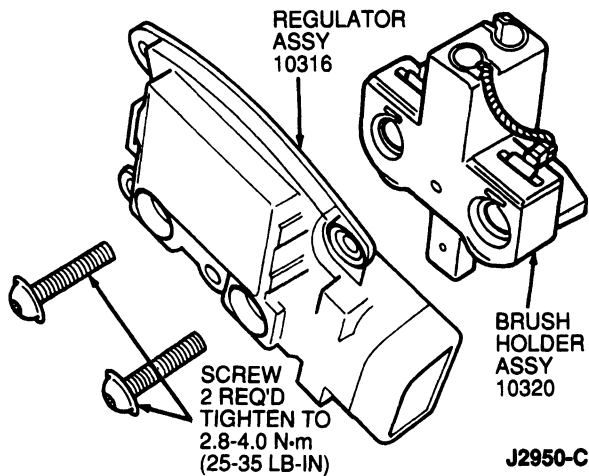
1. Remove the four screws (T20 Torx® type head) attaching the regulator to the generator rear housing. Remove the regulator, with brush holder attached, from the generator.



2. Hold the regulator in one hand and pry off the cap covering the A screw head with a screwdriver.

REMOVAL AND INSTALLATION (Continued)

3. Remove two screws (T20 Torx® type head) attaching the regulator to the brush holder. Separate the regulator from brush holder assembly.

**Installation**

1. Replace brush holder to regulator and install attaching screws.
2. Replace cap on the head of the A terminal screw.

3. Depress the brushes into the holder and hold the brushes in position by inserting a standard size paper clip (or equivalent) through both the location hole in the regulator and through the holes in the brushes.
 4. Install the regulator and brush holder assembly to the generator assembly with attaching screws.
- NOTE: Remove paper clip (or equivalent) from the regulator.

DISASSEMBLY AND ASSEMBLY

NOTE: The regulator, brush holder, fan and pulley are serviceable. If the generator assembly needs further service, it must be replaced as an assembly.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	Lb·Ft
Mounting Bracket Bolts	40.3-54.7	30-40
Wire Attaching Nut	8.9-12.1	6.5-9

GROUP

AUDIO 15

(17000 & 18000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
ANTENNAS	15-02-1	RADIO AND TAPE PLAYER	15-01-1
AUDIO, GENERAL	15-00-1	SPEAKERS.....	15-03-1

SECTION 15-00 Audio, General

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING		DIAGNOSIS AND TESTING (Cont'd.)	
Periodic Cleaning of Tape Player.....	15-00-10	Stereo Indicator Inoperative or Flickering (AM	
DESCRIPTION AND OPERATION		and FM Reception are OK)	15-00-3
Radio Reception	15-00-1	Tape Player Diagnosis	15-00-3
DIAGNOSIS AND TESTING		Tape Player Performance.....	15-00-3
Diagnosis Guides.....	15-00-3	SPECIAL SERVICE TOOLS/EQUIPMENT	15-00-10
Radio Tester	15-00-3	VEHICLE APPLICATION	15-00-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and
Bronco Vehicles

DESCRIPTION AND OPERATION

Radio Reception

Antenna Position

If adjustable, adjust the antenna to full height.

Tuning

The electronic radio automatically tunes to the center of station frequency.

FM multiplex has a range of about 32 km (20 miles) before reception noises are heard. This means that in areas with tall buildings or hills it is necessary to select the strongest possible station.

Experience will dictate which FM stations offer the best reception.

Tone Control

Turn the single tone control on AM radios clockwise to decrease bass (low frequencies) and turn counterclockwise to decrease the treble (high frequencies).

Antennas and Mobility

Although a vehicle radio will give outstanding mobile reception, it cannot provide the continuous reception of home audio components. The home receiver is not limited by the vehicle operating characteristics and certain geographical effects as is the mobile unit. For example, for the best FM reception, the vehicle antenna should be designed similar to a TV antenna and pointed in the direction of the station. The best AM antenna is a long piece of wire; the higher the wire the better the reception. However, because of design necessity, the vehicle antenna is restricted in size, height and direction and must receive both AM and FM stations. This means that a limited amount of the station's signal reaches the vehicle radio.

DESCRIPTION AND OPERATION (Continued)**Interfering Noise**

The vehicle ignition system is a source of radio interference. This high-voltage switching system produces a radio frequency electromagnetic field that radiates at AM, FM and CB frequencies. Although components have been designed into the vehicle to minimize this concern, the noise is more noticeable if the radio is tuned slightly off channel when listening to FM programs. Vehicle electrical accessories and owner add-on accessories may also contribute to radio interference. Furthermore, there are many noise sources which are external to the vehicle. These include power lines, communication systems, ignition systems of other vehicles, neon signs, etc.

Noise or static may result from many causes. Two of the most common sources of radio noise are listed below.

Ignition Noise

The most effective method of evaluating ignition noise is to compare the radio performance with the engine on versus engine off. If ignition noise is present with engine running:

- Check to see that the spark plug wires are the suppressor type and that the spark plugs are the correct resistor type.
- If so equipped, check to see that the carbon center insert in distributor cap is secure.
- If so equipped, check distributor cap and rotor electrodes for silicone grease as this may cause ignition noise on FM. This noise is characterized by a "motor boat" type sound on weak to moderate strength stations. The noise can only be eliminated by replacing the distributor cap and rotor with a cap and rotor that does not have grease.

NOTE: Silicone grease must not be removed from vehicles equipped with electronic engine controls (EEC-IV).

Missing or Malfunctioning Noise Suppression Components

- Noise suppression components may be malfunctioning or missing.
- Check bond strap grounding effectiveness by wedging a large file between metal parts to make sure of proper ground, such as between the tail pipe and body, or between the fender and frame, while radio is playing and engine is running. Listen for a decrease in the objectionable radio noise. If a reduction in radio noise is noted, first try tightening body and exhaust system clamps and brackets. Then, if necessary, install a new bond strap between the two metal parts to ensure proper ground.

FM Flutter

Flutter can best be described as repeated pops and hissing bursts heard in the speaker, during an otherwise good broadcast. Usually this condition exists while traveling in the fringe area of the station. Flutter will become more severe beyond approximately 40 km (25 miles) of the station. The signal loss becomes greater away from the station, until finally noise takes over and reception becomes impossible. Flutter may also be noticed near the station because of the line-of-sight characteristics of FM radio waves. This condition can happen when a building or large structure is between the radio receiver and the station being received. Some of the FM signal bends around the building, but certain spots have almost no signal. Some of these signal losses are only a few inches wide and if the vehicle is parked in one of these dead spots, you will only hear noise from the speaker. After moving out of the shadow of the structure, the station will return to normal. Flutter will not occur on AM because the AM radio waves are much longer than FM waves.

FM Multi-Path Cancellation

Another effect caused by the line-of-sight characteristic is called cancellation. This condition exists when the radio waves are reflected from objects or structures. The noise produced by cancellation is similar to flutter, with the addition of distortion in the program. A more familiar description of cancellation is its similarity to the multiple ghosts and picture jumping that occurs on television when a low flying plane passes. The same condition exists in the vehicle, except that the vehicle is moving and the reflecting structure is stationary. The reflected signal cancels the normal signal, causing the antenna to pick up noise and distortion. Cancellation effects are most prominent in metropolitan areas, but can also become quite severe in hilly terrain and depressed roadways.

FM Strong Signal Capture and AM Overloading

FM capture is an unusual condition that occurs when traveling in the vicinity of a broadcast tower. If listening to a weak FM station, when passing the broadcast tower, a stronger station may interfere without changing the radio dial. When passing the tower, the station may switch back and forth a few times before returning to the station originally tuned. When several broadcast towers are present (common in metropolitan areas) several stations may overload the receiver resulting in considerable station changing, mixing and distortion. Fortunately, this condition is localized and it will not harm the receiver. Some overloading may also be noticed on AM, but usually to a lesser degree.

DESCRIPTION AND OPERATION (Continued)**Receiving FM Stereo**

Because more data is carried in the FM stereo waves than in the monaural FM broadcasts, flutter, cancellation and capture are even more noticeable. The FM stereo noise-free broadcast range is approximately 8 km (5 miles) less than that received with the monaural FM radio. The AM/FM, FM stereo radio may never encounter any of these troublesome conditions as they are more prominent in metropolitan areas, hilly terrain and depressed roadways. However, when diagnosing FM stereo, it is recommended to accurately tune to the strongest FM stereo station.

Tape Player Diagnosis

Tape Player Will Not Accept Cassette, Entangles Tape on Capstan, Plays Too Fast or Too Slow, etc. (AM and FM Operating Properly)

- Check operation of the tape player by using a known good cassette.
- If the condition is not corrected by the substitution of a known good cassette, the radio chassis must be removed and sent to an authorized service facility for service.

DIAGNOSIS AND TESTING**Radio Tester**

A radio tester is designed for in-vehicle usage to rapidly diagnose radio malfunctions and determine if the problem is in the radio, antenna or the speaker.

A radio tester can save considerable time in servicing all models and makes of radios. Use of tester eliminates the need for substituting known quality components.

Tape Player Performance

If weak or wavering sound is encountered, it is suggested that the player be checked by using a tape of known quality. If the tape cartridge is ruled out as the cause, routine cleaning may restore normal operation.

Stereo Indicator Inoperative or Flickering (AM and FM Reception are OK)

- Verify that customer is listening to stereo stations.
- A weak or distant signal may cause the stereo indicator to flicker. Tune radio to a nearby FM stereo station. If reception is good, but stereo indicator is still intermittent, remove radio chassis for service.

Diagnosis Guides

Use the following diagnosis guides, along with a radio tester, to diagnose and repair the radio system. When performing Premium Sound system diagnosis, use the following illustrations. Testing can be performed using Rotunda Volt-Ohmmeter 007-00001 or equivalent.

DIAGNOSIS AND TESTING (Continued)

RADIO HAS WEAK RECEPTION — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK RADIO RECEPTION		
	<ul style="list-style-type: none"> Extend antenna to maximum height (if so equipped) and position vehicle in an open area away from steel buildings. Check radio reception by counting the number of stations received and compare to the known properly functioning radio system station count. 	Good radio reception Poor radio reception	Radio operating properly. GO to A2.
A2	CHECK ANTENNA CONNECTIONS		
	<ul style="list-style-type: none"> Check antenna connections and clean or tighten as required. Check radio reception. 	Good radio reception Poor radio reception	Radio operating properly. GO to A3.
A3	RE-CHECK ANTENNA		
	<ul style="list-style-type: none"> Check antenna system using appropriate diagnostic procedures. 	Procedure shows antenna needs repair Procedure shows antenna is OK	REPAIR antenna system as required. CHECK operation of radio. Have radio chassis repaired by authorized service center.

TCK5324C

RADIO POWER CONNECTORS

ALL RADIOS			
Pin No.	Circuit No.	Function	
2, 8	—	Not Connected	
7	747	At Output/Sense ^①	
6	694	Radio Ground ^②	
5	484	Display Back Lighting	
4	19	Radio Graphics Lighting	
3	137	Radio Power (B +)	
1	54*	Radio Memory (A +)	

^①Used with premium sound only^②Not required on Econoline

CK10464-2A

RADIO IS INOPERATIVE OR INTERMITTENT — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK RADIO OPERATION		
	<ul style="list-style-type: none"> Check operation of radio to determine fault. 	Radio is inoperative Radio is intermittent	GO to B2. GO to B3.
B2	CHECK FUSE		
	<ul style="list-style-type: none"> Check radio fuse. 	Fuse is OK Fuse is not OK	GO to B3. GO to B4.
B3	CHECK POWER FEED		
	<ul style="list-style-type: none"> Check power feed for proper connection. 	Connection is OK Connection is not OK	GO to B5. CONNECT power feed cable correctly. RE-CHECK radio for proper operation.

DIAGNOSIS AND TESTING (Continued)

RADIO IS INOPERATIVE OR INTERMITTENT — TEST B (Continued)

TEST STEP		RESULT	ACTION TO TAKE
B4	REPLACE FUSE		
	<ul style="list-style-type: none"> Turn ignition switch and radio to OFF. Replace fuse. Turn on ignition switch only. Recheck Fuse. 	<p>Fuse is not OK</p> <p>Fuse is OK</p>	<p>TURN ignition to OFF. Determine location of power feed to radio. REPAIR or REPLACE damaged wiring as required. REPLACE fuse. Refer to the 1993 Wiring Diagrams book.</p> <p>Operate radio and tape player. If any fuse fails again have radio chassis serviced by an authorized service center. If fuse is still OK, radio is now operational.</p>
B5	CHECK POWER TO RADIO		
	<ul style="list-style-type: none"> Using a test light or Rotunda Model 007-00001 Digital Volt-Ohmmeter or equivalent, check power to radio. 	<p>Radio has power</p> <p>Radio has no power</p>	<p>GO TO B6.</p> <p>REPLACE or REPAIR harness as required.</p>
B6	CHECK GROUND CIRCUIT		
	<ul style="list-style-type: none"> Using a DVOM or self-powered test lamp, check continuity of circuit 694. 	<p>Continuity in circuit 694</p> <p>No continuity in circuit 694</p>	<p>GO to B7.</p> <p>SERVICE ground circuit.</p>
B7	CHECK SPEAKERS		
	<ul style="list-style-type: none"> Is concern present on all speakers? 	<p>Concern present on all speakers</p> <p>Concern not present on all speakers</p>	<p>GO to B8.</p> <p>GO to B9.</p>
B8	CHECK ANTENNA		
	<ul style="list-style-type: none"> Check antenna system using appropriate diagnostic procedures. 	<p>Antenna system is OK</p> <p>Antenna system is not OK</p>	<p>GO to B9.</p> <p>CONNECT, REPAIR, or REPLACE antenna components as outlined.</p>
B9	CHECK RADIO CHASSIS		
	<ul style="list-style-type: none"> Check radio chassis using known good speaker connected directly to radio chassis. 	<p>Reception is OK</p> <p>Reception is not OK</p>	<p>REPLACE speaker or CONNECT, REPAIR or REPLACE speaker wiring as required.</p> <p>Have radio chassis REPAIRED by authorized service center.</p>

NOISY AM RECEPTION — ENGINE RUNNING, VEHICLE IN OR NOT IN MOTION — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	CHECK ANTENNA CONNECTIONS		
	<ul style="list-style-type: none"> Check antenna connections including extension cable (if so equipped). Connections must be clean and secure. 	<p>Connections are not clean and secure</p> <p>All connections OK</p>	<p>CLEAN and/or SECURE antenna cable connections as required.</p> <p>GO to C2.</p>

DIAGNOSIS AND TESTING (Continued)

NOISY AM RECEPTION — ENGINE RUNNING, VEHICLE IN OR NOT IN MOTION — TEST C (Continued)

TEST STEP		RESULT	ACTION TO TAKE
C2	CHECK ANTENNA MOUNTING		
	<ul style="list-style-type: none"> Check to make sure antenna is securely mounted to body at ground points. Contacts must be clean and metal-to-metal. 	Contacts are not OK Contacts are OK	CLEAN and/or SECURE ground connections as required. GO to C3.
C3	CHECK SUPPRESSION EQUIPMENT		
	<ul style="list-style-type: none"> Check for presence of all required suppression equipment, body grounding strap usage security, cleanliness and metal-to-metal connections. 	Connections are bad and/or suppression equipment not installed Connections are secure and suppression equipment installed correctly	INSTALL or TIGHTEN and/or CLEAN connections as required. GO to C4.
C4	CHECK HOOD BONDING STRAP, HOOD HINGE		
	<ul style="list-style-type: none"> Check hood bonding strap for excessive usage, secureness of mounting to sheet metal and contact with hood. Hood bonding strap must scratch hood paint. 	Strap/hinge not OK Strap/hinge OK	INSTALL, SECURE, or FORM hood bonding strap as required. GO to C5.
C5	CHECK WIRES AND MOUNTING OF VOLTAGE REGULATOR CAPACITOR, IGNITION COIL CAPACITOR		
	<ul style="list-style-type: none"> Check the mounting and connecting wires of the voltage regulator capacitor and ignition coil capacitor (if so equipped) for secureness, cleanliness and metal-to-metal contact. <p>NOTE: IMPORTANT — The capacitor mounting points are used to complete the electrical circuit and must be mounted securely to clean surfaces.</p>	Connections are not OK Connections are OK	CLEAN and/or SECURE connections as required. GO to C6.
C6	CHECK OPERATION OF THE VOLTAGE REGULATOR CAPACITOR AND IGNITION COIL CAPACITOR		
	<ul style="list-style-type: none"> Check the operation of the voltage regulator capacitor and ignition coil capacitor by replacing with known good components. 	Voltage regulator capacitor and/or ignition coil capacitor bad Capacitor(s) are OK	REPLACE capacitor(s) with known good component(s). GO to C7.
C7	CHECK ALTERNATOR		
	<ul style="list-style-type: none"> Check alternator by disconnecting wiring harness from voltage regulator. 	Noise eliminated Noise still present	CHECK alternator as directed in Group 14. REPAIR or REPLACE as required. GO to C8.
C8	CHECK SPARK PLUG WIRES		
	<ul style="list-style-type: none"> Check spark plug wires for proper routing, grounding and secureness of connections. 	Spark plug wires not routed, grounded or secured Spark plug wires OK	REROUTE or REPLACE spark plug wires or SECURE connections as required. GO to C9.
C9	CHECK IGNITION SYSTEM		
	<ul style="list-style-type: none"> Check ignition system for proper operation. (Use ignition system analyzer or check for open spark plug wires using ohmmeter.) Also check spark plug for cracked insulators. 	Ignition system and/or spark plugs not OK Ignition system and spark plugs OK	REPAIR or REPLACE components as required. GO to C10.

DIAGNOSIS AND TESTING (Continued)**NOISY AM RECEPTION — ENGINE RUNNING, VEHICLE IN OR NOT IN MOTION — TEST C (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
C10	CHECK RADIO CHASSIS MOUNTING		
	<ul style="list-style-type: none"> Check all radio chassis mounting points for secureness, cleanliness and metal-to-metal contact. <p>NOTE: F-Series / Bronco radios are grounded to the side cowl through Circuit 694.</p>	Mounting not OK Mountings OK	CLEAN and / or SECURE as required GO to C11 .
C11	SUBSTITUTE A KNOWN GOOD SPEAKER AND ANTENNA		
	<ul style="list-style-type: none"> Substitute a known good speaker, antenna and antenna extension cable (if so equipped). Be sure to ground antenna to an unpainted metal surface. 	Noise eliminated Noise not eliminated	REPAIR or REPLACE antenna, speaker or antenna extension cable. GO to C12 .
C12	SUBSTITUTE KNOWN GOOD RADIO		
	<ul style="list-style-type: none"> Substitute known good radio. 	Noise eliminated Noise not eliminated	Have radio unit REPAIRED by authorized service center. GO to C13 .
C13	REPOSITION ANTENNA, SPEAKER OR RADIO POWER FEED		
	<ul style="list-style-type: none"> Check to see if noise can be eliminated by repositioning antenna, speaker or radio power feed wires. 	Noise eliminated Noise not eliminated	REPOSITION permanently by taping. GO to C14 .
C14	GROUND VARIOUS PARTS OF TRUCK		
	<ul style="list-style-type: none"> Ground various parts of the truck to the frame using a jumper cable. For example: engine, fenders, quarter panel, stone deflectors, air cleaner, body sheet metal. 	Noise eliminated	PROVIDE permanent ground where required.

TCK5326D

NOISY FM RECEPTION — ENGINE RUNNING, VEHICLE NOT IN MOTION — TEST D

TEST STEP		RESULT	ACTION TO TAKE
D1	NOISE IS ONLY ON FM STEREO		
	<ul style="list-style-type: none"> Check to see if noise is only on FM stereo. Determine if customer concern is due to FM stereo reception limitation. Refer to normal operation description. 	Noise only on FM stereo Noise is on both FM stereo and FM mono	EXPLAIN and DEMONSTRATE to customer. Inform customer of methods for obtaining best reception. GO to D2 .
D2	CHECK ANTENNA CABLE CONNECTIONS		
	<ul style="list-style-type: none"> Check antenna cable connections including extension cable (if so equipped). Connections must be clean and secure. 	Connections are not OK Connections are OK	CLEAN and / or SECURE as required. GO to D3 .
D3	CHECK ANTENNA MOUNTING		
	<ul style="list-style-type: none"> Check to ensure antenna is securely mounted to body at mounting nut above antenna; and also, ensure that prongs of grounding collar, at fender underside, are contacting metal. Contact must be clean and metal-to-metal. 	Connections are not OK Connections are OK	CLEAN and / or SECURE as required. GO to D4 .

DIAGNOSIS AND TESTING (Continued)

NOISY FM RECEPTION — ENGINE RUNNING, VEHICLE NOT IN MOTION — TEST D (Continued)

TEST STEP		RESULT	ACTION TO TAKE
D4	CHECK DISTRIBUTOR ROTOR		
	<ul style="list-style-type: none"> Check for adequate distributor rotor contact spring tension. Height of spring should be 8.9 mm (0.35 in.) from top of rotor (not applicable to recreational vehicles). 	Spring tension is not OK Spring tension is OK	REPLACE rotor. GO to D5 .
D5	CHECK DISTRIBUTOR CAP		
	<ul style="list-style-type: none"> Check to see if carbon center insert in distributor cap is secure. 	Carbon center not secure Carbon center OK	REPLACE distributor cap. GO to D6 .
D6	CHECK SPARK PLUG WIRES		
	<ul style="list-style-type: none"> Check spark plug wires for proper routing and secureness of connections. 	Routing and / or connections are not OK Routings and connections good	REROUTE or SECURE connections as required. GO to D7 .
D7	CHECK IGNITION SYSTEM		
	<ul style="list-style-type: none"> Check ignition system for proper operation. (Use ignition system analyzer or check for open spark plug wires using ohmmeter). Also check spark plug for cracked insulators. 	Ignition system and / or spark plug wires not working properly, and / or spark plug insulators cracked Ignition system, spark plug wires and spark plugs in good condition	REPAIR or REPLACE components as required. GO to D8 .
D8	CHECK RADIO CHASSIS MOUNTING		
	<ul style="list-style-type: none"> Check all radio chassis mounting points for secureness, cleanliness and metal-to-metal contact. <p>NOTE: F-Series / Bronco radios are grounded to the side cowl through Circuit 694.</p>	Contact are not secure or clean Contacts are OK	CLEAN and / or SECURE as required. GO to D9 .
D9	SUBSTITUTE A GOOD SPEAKER AND ANTENNA		
	<ul style="list-style-type: none"> Substitute a known good speaker and antenna being sure to ground antenna base to unpainted metal surface. 	Noise eliminated Noise not eliminated	REPAIR or REPLACE antenna or speaker. GO to D10 .
D10	SUBSTITUTE EXTENSION CABLE		
	<ul style="list-style-type: none"> If equipped with antenna extension cable, substitute with a known good cable. (If not equipped with extension cable GO to D11.) 	Noise eliminated Noise not eliminated	REPLACE antenna extension cable. GO to D11 .
D11	SUBSTITUTE KNOWN GOOD RADIO		
	<ul style="list-style-type: none"> Remove radio and substitute with a known good radio. 	Noise eliminated Noise not eliminated	Have radio unit REPAIRED by authorized service center. GO to D12 .
D12	REPOSITION ANTENNA, SPEAKER, OR RADIO FEED WIRES		
	<ul style="list-style-type: none"> Check to see if noise can be eliminated by repositioning antenna, speaker or radio power feed wires. 	Noise eliminated Noise not eliminated	REPOSITION permanently by taping. REPLACE distributor cap and rotor with new ungreased cap and rotor.

TCK5327E

DIAGNOSIS AND TESTING (Continued)**NOISY RECEPTION — ENGINE RUNNING, VEHICLE IN MOTION — TEST E**

TEST STEP		RESULT	ACTION TO TAKE
E1	VISUALLY INSPECT CONNECTIONS		
	<ul style="list-style-type: none"> Inspect all connections to battery; antenna leads, speaker leads, and radio receiver. <p>NOTE: F-Series / Bronco radios are grounded to the side cowl through Circuit 694.</p>	Connections not OK Connections OK	REPAIR or REPLACE wires as necessary. GO to E2.
E2	CHECK ANTENNA LEAD-IN CABLE		
	<ul style="list-style-type: none"> Check for loose antenna lead-in cable or loose antenna. 	Antenna and / or cable are loose Antenna and cable secure	CONNECT antenna and / or lead-in cable securely. Have radio repaired by a qualified radio technician.

TCK10467B

NOISY RECEPTION — ENGINE NOT RUNNING — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	VISUALLY CHECK FOR LOOSE CONNECTIONS		
	<ul style="list-style-type: none"> Check all connections to battery; antenna leads, speaker lead and radio receiver for proper connection. <p>NOTE: F-Series / Bronco radios are grounded to the side cowl through Circuit 694.</p>	Connections are not OK Connections are OK	REPAIR or REPLACE connections or wires as required. GO to F2.
F2	CHECK ANTENNA LEAD-IN CABLE		
	<ul style="list-style-type: none"> Check all antenna lead-in cables for bent or missing male pins. Also check the female connectors for position of receptacle with respect to the insulator. The receptacle should not be visible. 	Connectors and / or connections are not OK Connections are OK	REPLACE antenna lead-in cables. Have radio REPAIRED by a qualified radio technician.

TCK10468B

PREMIUM SOUND**NO SOUND FROM ONE OR MORE SPEAKERS, RADIO TURNED ON — PREMIUM SOUND IS OFF — TEST G**

TEST STEP		RESULT	ACTION TO TAKE
G1	BYPASS PREMIUM SOUND CIRCUITS		
	<ul style="list-style-type: none"> Bypass premium sound control circuits for the inoperative speakers as follows: Disconnect connectors between radio and premium sound amplifier and between speakers and premium sound amplifier. Connect jumper wires from radio to wiring harness for defective speaker. Check connector locations and wiring color codes. Test radio for sound from speaker(s). 	Speaker(s) work Speaker(s) do not work	GO to G2. GO to G3.
G2			
	<ul style="list-style-type: none"> Check power and control circuits to amplifier as follows: Connect all connectors of the radio and premium sound system. Turn ignition switch to ACC and turn radio ON. Check for battery voltage at the amplifier on the orange-lt. blue dot wire and on the yellow-black hash wire. 	Yes No	REPLACE the premium sound amplifier. Vehicle wiring is damaged. FOLLOW standard procedure for diagnosis and service of damage.

DIAGNOSIS AND TESTING (Continued)

PREMIUM SOUND
NO SOUND FROM ONE OR MORE SPEAKERS, RADIO TURNED ON — PREMIUM SOUND IS OFF — TEST G (Continued)

TEST STEP		RESULT	ACTION TO TAKE
G3	CHECK OPERATION OF SPEAKER AND CHECK SPEAKER WIRING		
	<ul style="list-style-type: none"> Check operation of speaker, and vehicle wiring as follows: Connect jumper wire from a radio speaker harness that is working properly to the damaged speaker harness. 	<p>Speaker works</p> <p>Speaker does not work</p>	<p>Radio is damaged. SEND radio to authorized service station for service.</p> <p>Vehicle wiring or speaker is damaged. FOLLOW standard procedure for diagnosis and service of damage.</p>

TCK5331F

PREMIUM SOUND SYSTEM — NO PREMIUM SOUND FROM ONE OR MORE PREMIUM SOUND SPEAKERS — PREMIUM SOUND ON (NORMAL SOUND FROM ALL SPEAKERS WITH PREMIUM SOUND OFF) — TEST H

TEST STEP		RESULT	ACTION TO TAKE
H1	VERIFY CONDITION		
	<ul style="list-style-type: none"> Check for premium sound at each speaker. 	<p>Premium sound at all speakers</p> <p>No premium sound at one or more speakers</p>	<p>System OK.</p> <p>REPLACE amplifier.</p>

TK5332E

CLEANING**Periodic Cleaning of Tape Player**

Over a period of time, the playback head, capstans and pinch rollers gather an oxide residue from the tape as it passes these components while playing. Oxide accumulation can cause weak or wavering sound and damage to the cassette tape and player.

It is recommended, for best performance, that the player be cleaned every 10 to 12 hours of playing time using a Ford cassette player cleaning cartridge available at your Ford or Lincoln-Mercury dealer. The use of other cleaning cassette products is not recommended, as these could cause damage to player or cassette tapes.

SPECIAL SERVICE TOOLS/EQUIPMENT**ROTUNDA TOOLS**

Tool Number	Description
007-00001	Digital Volt-Ohmmeter

SECTION 15-01 Radio and Tape Player

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING		REMOVAL AND INSTALLATION	
Cassette Tape Player.....	15-01-8	Radio.....	15-01-2
DESCRIPTION AND OPERATION		F-150-250-350, F-Super Duty Chassis Cab and Bronco	15-01-2
Cassette Tape Player.....	15-01-1	Radio Suppression Equipment	15-01-3
Chassis Connectors.....	15-01-2	SPECIAL SERVICE TOOLS	15-01-8
Radio.....	15-01-1	VEHICLE APPLICATION	15-01-1
DIAGNOSIS AND TESTING	15-01-2		

VEHICLE APPLICATION

F-150-250-350, F-Super Duty, E-150-250-350
Bronco and 5.8L Lightning Truck Vehicles

DESCRIPTION AND OPERATION

Radio

An electronic AM radio, electronic AM/FM/MPX and electronic AM/FM/MPX/cassette radio are optional.

Cassette Tape Player

Insert the tape cassette, open edge to the right, to play (radio on, ignition in RUN or ACC position). Adjust volume, tone and speaker balance as for radio programs. At the end of the tape, the cassette automatically reverses and plays the other side of the tape. At any time the tape transport mechanism can be changed to play the other side of the tape by pressing the two REVERSE buttons.

The Dolby® System is a noise reduction system manufactured under license from Dolby Laboratories. Dolby® and the double-D symbol are trademarks of Dolby Laboratories Licensing Corporation.

NOTE: Before turning off radio or the ignition of vehicle, always eject any cassette being played. Leaving the tape mechanism stopped while a tape is engaged can result in damage to the tape, pinch roller or capstan.

Operating Precautions

When inserting a tape cassette into the tape slot, it should be firmly pushed in and down to ensure that it is properly seated. To play a full tape, insert the cassette so the empty hub of the cassette goes into the slot first.

Do not leave a tape cassette engaged in the tape player slot when not in use. Remove it completely to permit the slot door to close and keep out airborne dirt. Disengaging the cassette from the tape playback head in this manner will also prevent a flat spot from developing on the capstan roller.

Take care to protect the open edge of the cassette from damage, dirt, oil and grease. When not in use, store cassettes in their protective cases with hub locks in place. Otherwise, there will be a risk of having the tape loosen on its hubs, which could cause the tape to spill or jam in the player. If a cassette is found with loose tape, make sure it is rewound firmly around the hubs before using it. Never try to open a cassette or try to pull the tape out of it. To avoid tape damage, do not use cassettes that have been soiled by liquid spills.

Cassette Irregularities

Cassette tapes can vary in performance and size, resulting in occasional concerns with certain specific cassettes.

If any one cassette gives continual trouble because of this, it is best to discontinue use.

For best results, use cassette tapes with no more than 90 minutes of playing time. The thinness of the tapes used in C120 and C180 cassettes makes the tape more likely to stretch and break. A stretched tape will result in poor sound quality.

Tape Player will not Accept Cartridge, Eats Tape, Plays Too Fast or Too Slow, etc. (AM and FM Operating Properly)

- Make sure cassette has not come to the end of the tape.
- Check operation of the tape player by using a known good cassette / cartridge.

DESCRIPTION AND OPERATION (Continued)

- If the condition is not corrected by the substitution of a known good cassette / cartridge, the radio chassis must be removed and sent to an authorized service facility for service.

Temperature Extremes

Do not expose tape cassettes to intense sunlight or other temperature extremes. If they do become exposed to high or low temperatures, allow each cassette to reach a moderate temperature before playing. During cold weather, it is advisable to take cassettes indoors overnight to protect them.

In extremely cold weather, the tape player may need a few minutes to warm up before delivering full sound quality.

Chassis Connectors

The antenna lead-in receptacle is located on the back of the radio at the lower right corner. The power and speaker leads are located on the back side of the radio at the left corner.

DIAGNOSIS AND TESTING

For diagnosis and testing of radio and tape player, refer to Section 15-00.

WARNING: USE ONLY PROPERLY INSTALLED FCC APPROVED RADIO TRANSMITTING EQUIPMENT. USE OF OTHER TRANSMITTING EQUIPMENT MAY CAUSE THE VEHICLE TO MALFUNCTION OR STALL. IF THE ENGINE STALLS, POWER BRAKE AND POWER STEERING ASSIST WILL STOP. CONSULT YOUR AUTHORIZED DEALER BEFORE INSTALLING ANY RADIO TRANSMITTER.

REMOVAL AND INSTALLATION

Radio

F-150-250-350, F-Super Duty Chassis Cab and Bronco

Removal

1. Disconnect the battery ground cable.
2. Insert Radio Removal Tool T87P-19061-A into radio face plate. Press in 25.4mm (1 inch) to release radio retaining clips. While flexing the radio removal tool outward (away from radio) pull radio outward from instrument panel using tool as handles.
3. Disconnect the antenna lead-in cable and radio wiring connectors.

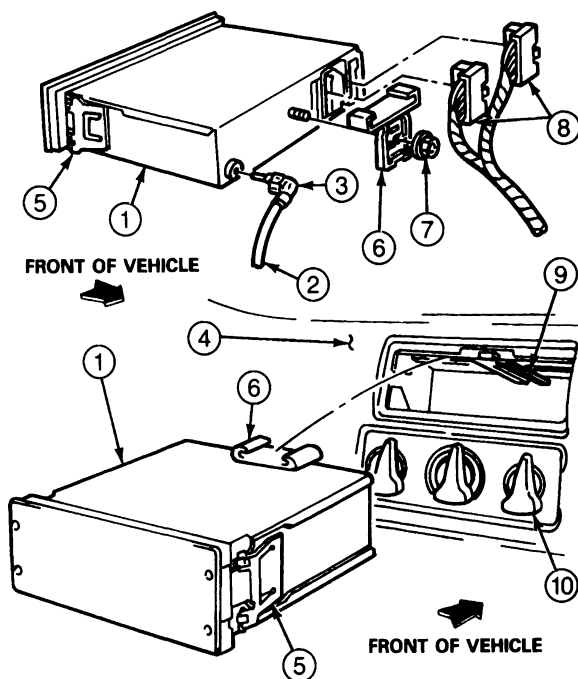
Installation

If radio is being replaced, transfer support to new radio.

1. Connect the antenna lead-in cable and radio wiring connectors.

2. Position the radio in the instrument panel and slide the radio on the mounting bracket until holding brackets engage.
3. Connect the battery ground cable.
4. Check the operation of the radio and engine.

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.



K16596-A

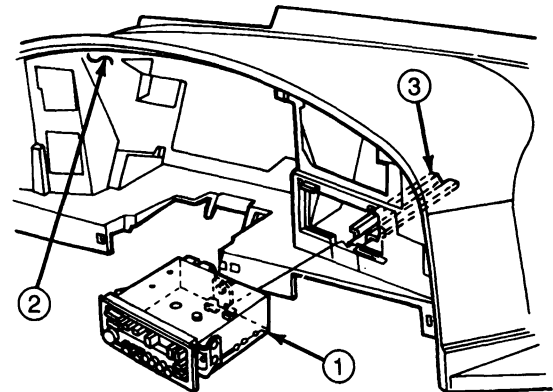
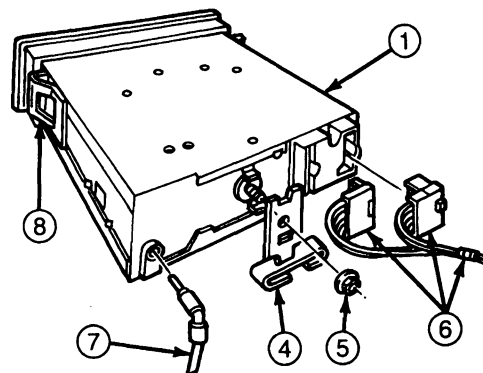
Item	Part Number	Description
1	19B159 19B131 19B132	Radio Receiver
2	18812	Antenna Cable
3	—	Antenna Cable Jack (Part of 18812 Antenna Cable Assembly)
4	—	Instrument Panel
5	—	Spring Clips (Part of Radio Assembly)
6	18888	Radio Support
7	N621903-S2	Nut
8	14401	Wiring Assembly to Radio
9	10A860	Mounting Bracket
10	—	Heater / A / C Control

REMOVAL AND INSTALLATION (Continued)**E-150-250-350****Removal**

1. Disconnect the battery ground cable from the battery.
2. Remove the ash receptacle. Refer to Section 01-12.
3. Remove two air conditioner vents. Refer to Section 01-12.
4. Remove the headlight knob.
5. Remove the two lower finish panels. Refer to General Trim Panel Information in Section 01-05A and 01-05B.
6. Remove the ash receptacle support and the cigar lighter. Refer to Section 01-12.
7. Remove the steering column lower shroud panel. Refer to 11-04A.
8. Being careful not to mar or scratch the instrument panel, insert a screwdriver or similar tool and pry (pop out) the cluster panel at two locations.
9. Insert Radio Removal Tool T87P-19061-A into radio face plate. Press in 25.4mm (1 inch) to release radio retaining clips. While flexing the radio removal tool outward (away from radio) pull radio outward from instrument panel using tool as handles.
10. Disconnect the antenna lead-in cable and radio wiring connectors.

Installation

1. Connect the antenna lead-in cable and radio wiring connectors.
2. Position the radio in the instrument panel and slide the radio on the mounting bracket until holding brackets engage.
3. Install the instrument cluster finish panel. Refer to Section 01-12.
4. Install the steering column lower shroud finish panel. Refer to Section 11-04A.
5. Install the cigar lighter and ash receptacle support. Refer to Section 01-12.
6. Install the two lower finish panels. Refer to General Trim Panel Information in Sections 01-05A and 01-05B.
7. Install the headlight control knob and two air conditioner vents.
8. Install the ash receptacle. Refer to Section 01-12.
9. Connect the battery ground cable to the battery.
NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the EEC processor relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
10. Check the operation of the radio and antenna.
11. Check the operation of the engine.

Radio Installation, E-150-250-350**FRONT VIEW OF INSTRUMENT PANEL ASSEMBLY****REAR VIEW OF RADIO RECEIVER**

K16597-A

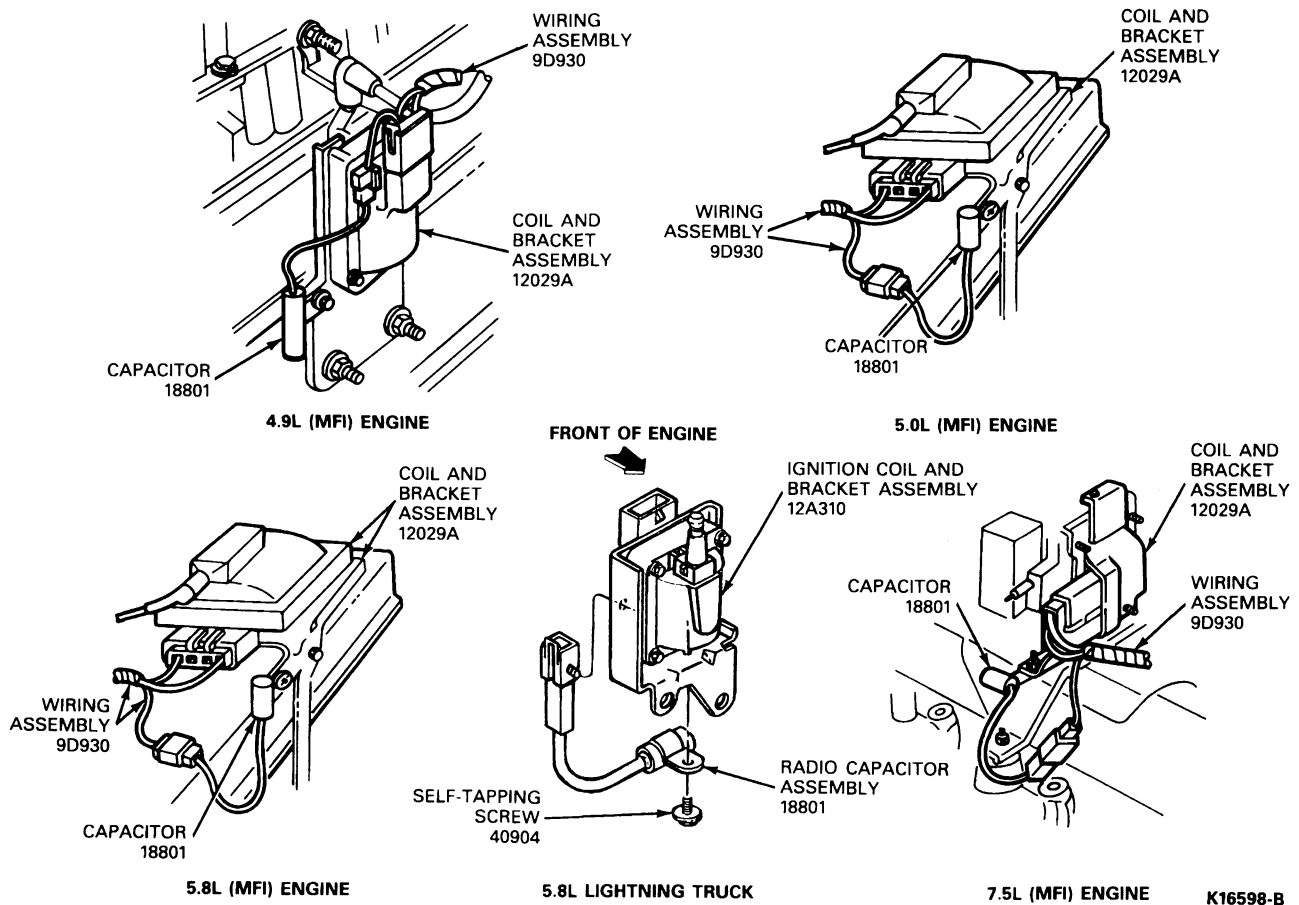
Item	Part Number	Description
1	19B159 19B131 19B132	Radio Receiver
2	—	Instrument Panel
3	10A860	Mounting Bracket
4	18888	Nut and Washer
5	N620392	Nut and Washer
6	14401	Radio Wiring Assembly Connector
7	18812	Antenna Cable
8	—	Holding Bracket

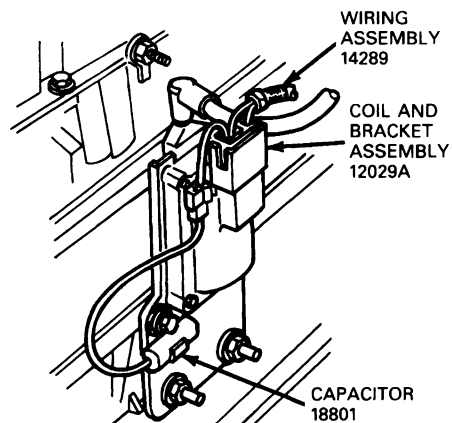
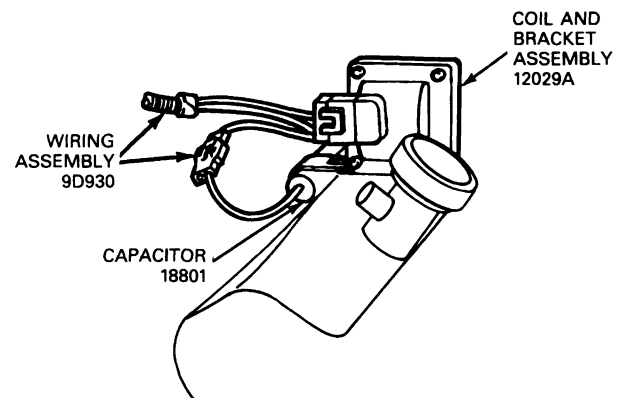
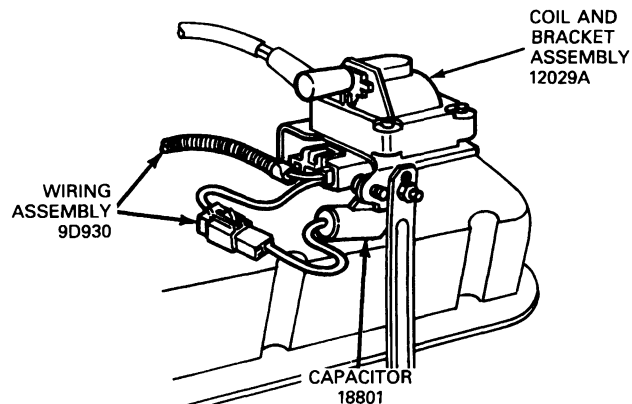
Radio Suppression Equipment

The radio suppression equipment used on the different vehicles is shown in the following illustrations. When replacing any radio suppression equipment components, be sure that a good contact is made at all attachments. Remove any paint or dirt from between a condenser and its ground. Tighten all nuts and bolts securely.

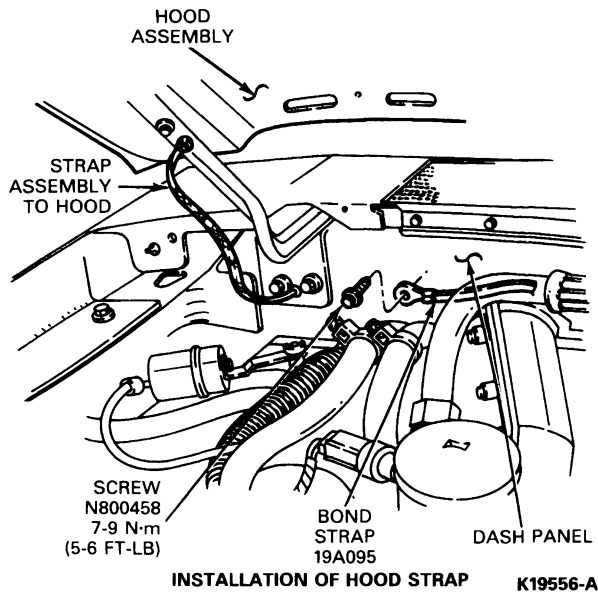
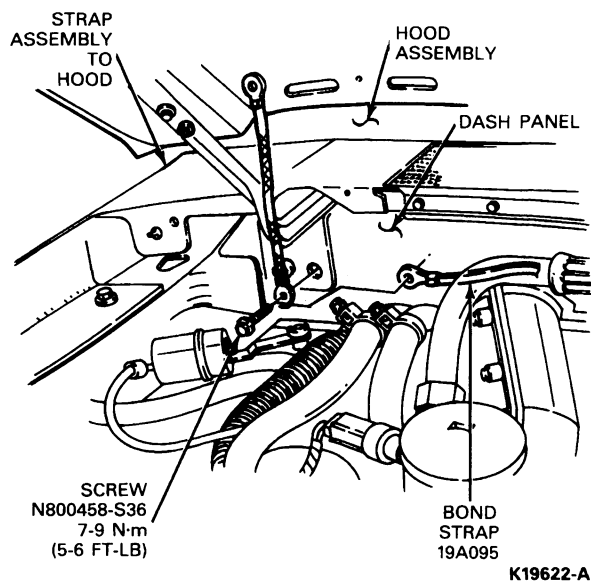
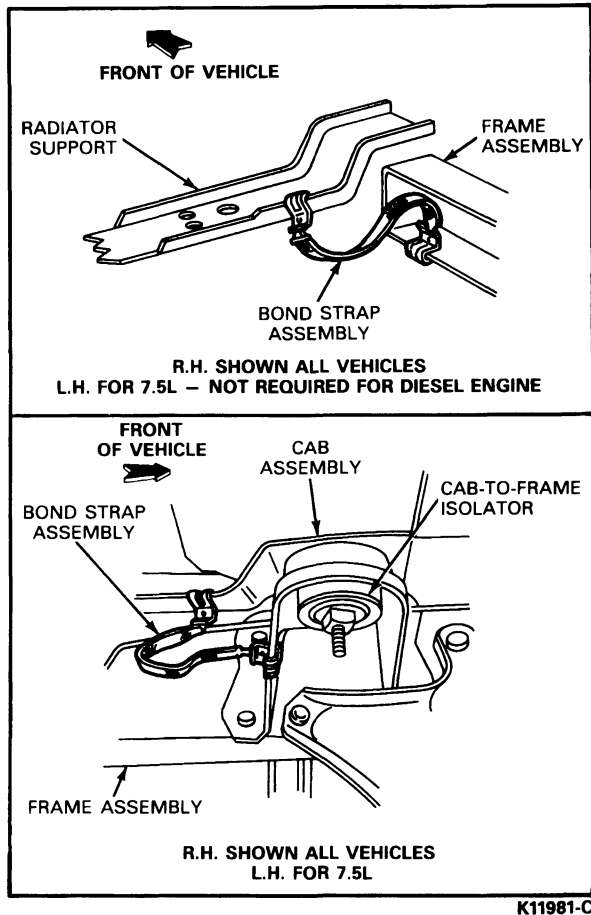
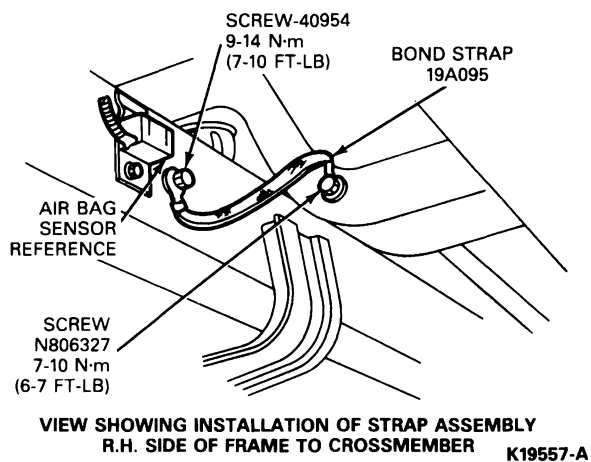
REMOVAL AND INSTALLATION (Continued)

Radio Suppression, Capacitor Installation, F-150-250-350, F-Super Duty and Bronco



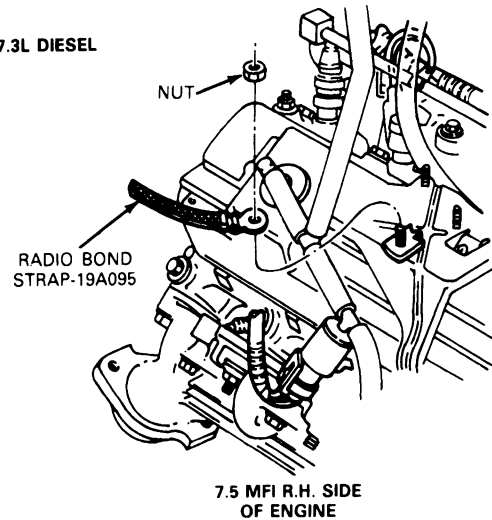
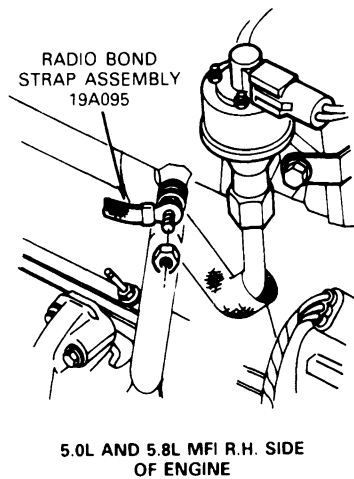
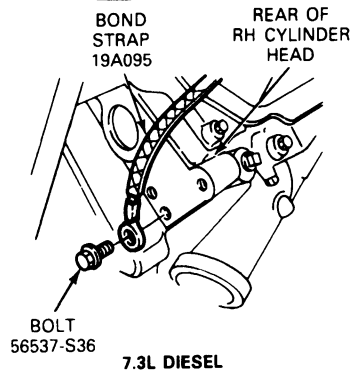
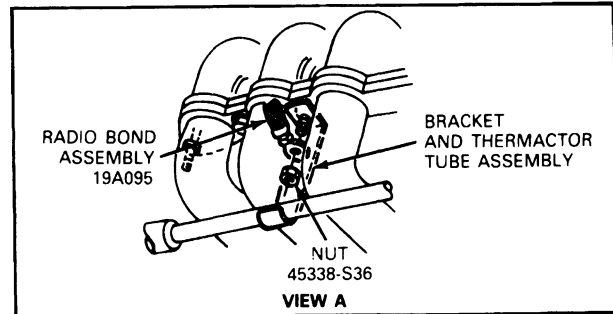
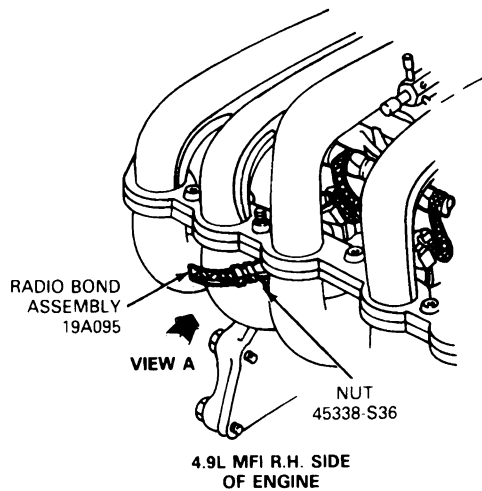
REMOVAL AND INSTALLATION (Continued)**Radio Suppression, Capacitor Installation, E-150-250-350 Vehicles****4.9L (MFI) ENGINE****5.0L AND 5.8L (MFI) ENGINES****7.5 (MFI) ENGINE**

K16599-B

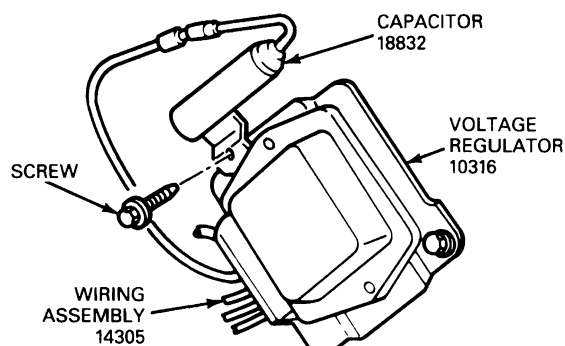
REMOVAL AND INSTALLATION (Continued)**Radio Suppression Bond Strap, Dash, F-150-250-350, F-Super Duty Chassis Cab and Bronco****Radio Suppression Bond Strap, Dash, 5.8L Lightning Truck****Radio Bond Strap, F-150-250-350, F-Super Duty and Bronco****Radio Bond Strap, E-150-250-350**

REMOVAL AND INSTALLATION (Continued)

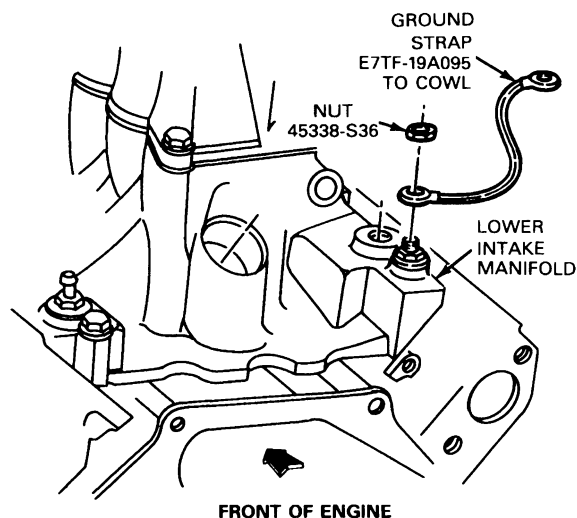
Radio Suppression Equipment, Engine-Mounted



K11980-C

REMOVAL AND INSTALLATION (Continued)**Radio Suppression Equipment, 7.3L Diesel and Gasoline with Heavy Duty Alternator, Econoline**

K16600-B

Radio Suppression Equipment, 5.8L Lightning Truck

K19623-A

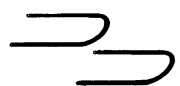
CLEANING**Cassette Tape Player****Head**

The playback head, capstans and pinch rollers may accumulate an oxide residue as the tape passes through the components while playing. Depending on the quality used, more or less oxide will accumulate. Oxide accumulation can cause weak or wavering sound and damage to the cassette tape and/or player.

It is recommended for best performance that the tape player be cleaned after every 10 to 12 hours of playing time with a Ford Cassette Cleaning Cartridge or equivalent.

CAUTION: The use of other cassette cleaners is not recommended. Damage to the cassette player could result.

SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
T87P-19061-A Radio Removal Tool	 <p>T87P-19061-A</p>

SECTION 15-02 Antennas

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Radio Antenna	15-02-6	E-150-250-350	15-02-5
DIAGNOSIS AND TESTING		F-150-250-350, F-Super Duty and	
Diagnosis Guide	15-02-1	Bronco.....	15-02-4
Poor Reception.....	15-02-1	SPECIAL SERVICE TOOLS/EQUIPMENT	15-02-6
REMOVAL AND INSTALLATION		VEHICLE APPLICATION	15-02-1
Antenna Base and Cable	15-02-4		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab and Bronco Vehicles

DIAGNOSIS AND TESTING

Poor Reception

- If AM reception is extremely poor and FM reception drifts or appears to have trouble holding stations, make sure the antenna and antenna connectors are properly mated. If the antenna connectors are properly mated but the reception is still poor, refer to the Diagnosis Guide in this section for Antenna Tests.

- If only FM reception is poor, it is unlikely that the antenna is at fault. Remove the radio chassis for service.

NOTE: Many customers do not understand the limitations of FM reception. Refer the customer to the Owner Guide for information about the limitations of FM radio performance.

Diagnosis Guide

RADIO ANTENNA TEST (ALL ANTENNA TYPES) — TEST A

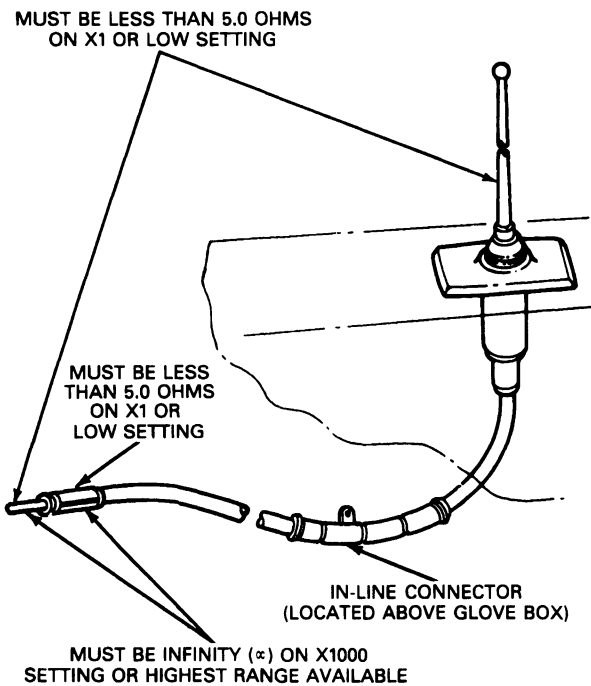
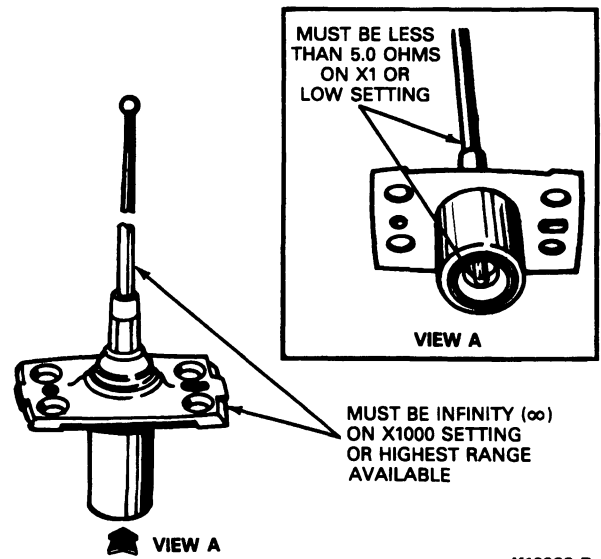
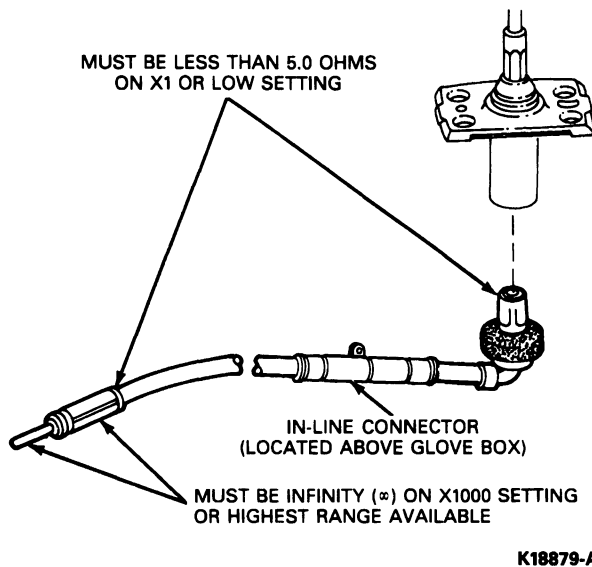
TEST STEP		RESULT	ACTION TO TAKE
A1	RESISTANCE CHECKS		
	<ul style="list-style-type: none"> ● Unplug the antenna cable from the radio. ● Using Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent, measure the resistance between the antenna mast and the center terminal of the male connector. (The resistance should be less than 5 ohms on the lowest setting.) ● Measure the resistance between the antenna base and the antenna connector shield. (The resistance should be less than 5 ohms on the lowest setting.) ● Measure the resistance between the connector end center terminal and the shield. (The resistance should be infinity on the highest range.) ● Do the resistance readings check OK? 	Yes No	Antenna tests OK. REPLACE one-piece antenna assembly. For detachable cable and mast: GO to A2. For manual antenna with extension cable: GO to A4.
A2	RESISTANCE CHECKS, CABLE, DETACHABLE ANTENNA AND MAST		
	<ul style="list-style-type: none"> ● Disconnect the antenna mast and base from the cable. ● Measure the resistance between the connector shields on both ends of the cable. (The resistance should be less than 5 ohms on the lowest setting.) ● Measure the resistance between the male cable connector end center terminal and the shield. (The resistance should be infinity on the highest range.) ● Do the resistance readings check OK? 	Yes No	Cable is OK. GO to A3. REPLACE the cable.

DIAGNOSIS AND TESTING (Continued)

RADIO ANTENNA TEST (ALL ANTENNA TYPES) — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A3	RESISTANCE CHECKS, DETACHABLE ANTENNA AND MAST		
	<ul style="list-style-type: none"> ● Install a new antenna base. ● Measure the resistance between the antenna base and the antenna mast. (The resistance should be infinity on the highest range.) ● Measure the resistance between the antenna assembly connector end center terminal and the antenna mast. (The resistance should be less than 5 ohms on the lowest setting.) ● Do the resistance readings check OK? 	Yes No	Antenna assembly is OK. REPLACE the antenna mast.
A4	RESISTANCE CHECK, MANUAL ANTENNA WITH EXTENSION CABLE		
	<ul style="list-style-type: none"> ● Disconnect the extension cable from the main cable. ● Measure the resistance between the main cable assembly connector end center terminal and the antenna mast. (The resistance should be less than 5 ohms on the lowest setting.) ● Measure the resistance between the extension cable connector end center terminals (female and male ends). (The resistance should be less than 5 ohms on the lowest setting.) ● Measure the resistance between the extension cable male connector end center terminal and the shield. (The resistance should be infinity on the highest range.) ● Measure the resistance between the connector shields (female and male ends). (The resistance should be less than 5 ohms on the lowest setting.) ● Measure the resistance between the antenna base and the main cable assembly connector shield. (The resistance should be less than 5 ohms on the lowest setting.) ● Measure the resistance between the main cable assembly connector end center terminal and the shield. (The resistance should be infinity on the highest range.) 	Resistance readings are OK One or more reading on extension cable not OK. One or more reading on main cable not OK.	GO to A3 . REPLACE extension cable. One-piece assembly: REPLACE complete antenna and main cable assembly. Detachable antenna base and mast: GO to A2 .

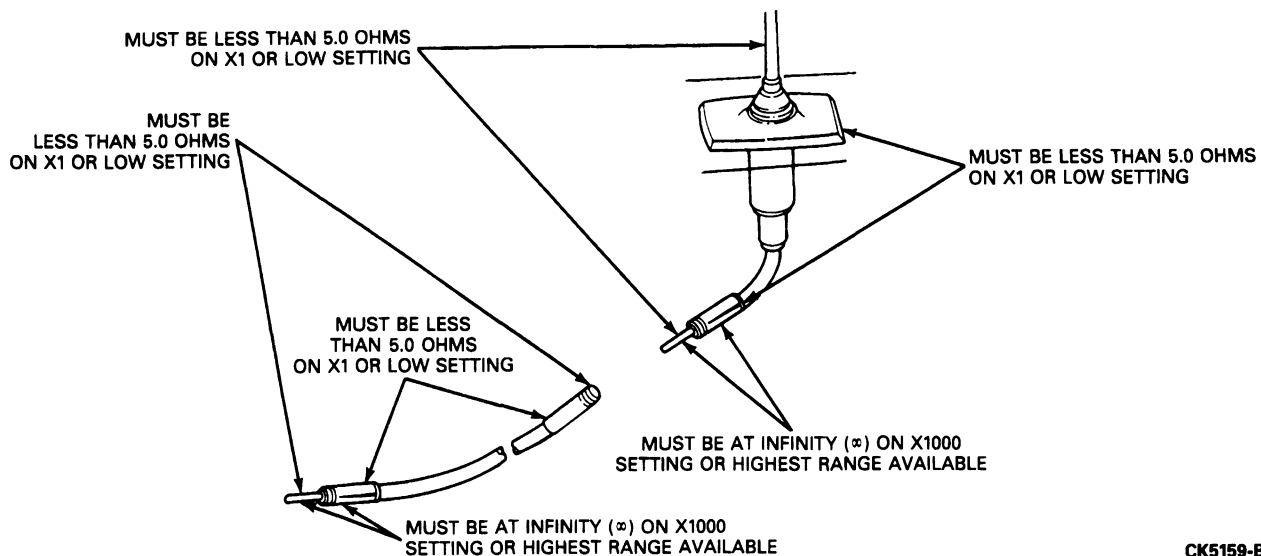
TK18703A

DIAGNOSIS AND TESTING (Continued)**Resistance Checks****Resistance Checks, Cable, Detachable Antenna and Mast**

K16993-B

DIAGNOSIS AND TESTING (Continued)

Resistance Check, Manual Antenna with Extension Cable



REMOVAL AND INSTALLATION

Antenna Base and Cable

F-150-250-350, F-Super Duty and Bronco

Removal

The antenna mast in the F-150-250-350, F-Super Duty, and Bronco is detachable.

1. Disconnect the antenna lead-in cable from the radio.
2. Remove the cable from the retaining clips along the bottom of the instrument panel.
3. Remove the antenna mast from the antenna base.
4. Unsnap the cap from the antenna base and remove the cap.

CAUTION: Use appropriate fender protection so you do not damage paint when removing the base.

5. Remove four antenna base attaching screws and remove the antenna base and gasket.

NOTE: The antenna lead-in cable can now be disconnected from the antenna base.

6. Remove the antenna cable from the dash panel.

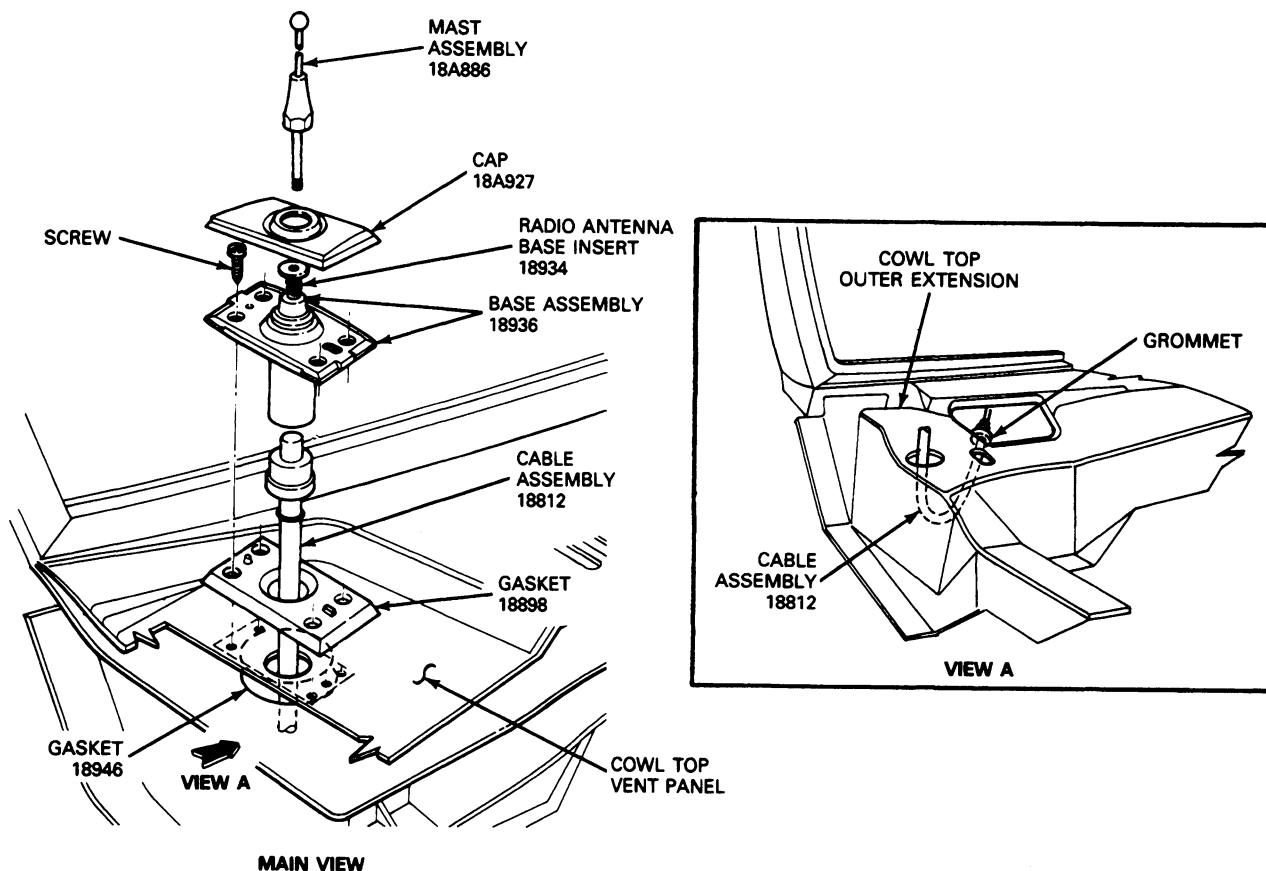
NOTE: It will be necessary to remove the glove compartment to gain access to the antenna lead-in cable.

Installation

1. Insert the antenna lead-in cable from the passenger compartment into the antenna hole in the cowl.
2. From outside of the vehicle, pull the cable through the hole in the cowl until the grommet on the cable is properly seated.
3. Attach the cable to the base and gasket assembly through the hole on the cowl top extension. Seat the assembly on the hole pattern.
4. Install the four antenna base attaching screws.
5. Place the cap in position over the antenna base and snap the cap onto the base.
6. Install the antenna mast to the antenna base.
7. Route the antenna lead-in cable to the retainers on the bottom of the instrument panel.
8. Connect the antenna lead-in cable to the radio and check the operation of the engine and radio.
9. Install the glove compartment.

REMOVAL AND INSTALLATION (Continued)

Antenna Base and Cable, F-150-250-350, F-Super Duty and Bronco



K5132-B

E-150-250-350

Removal

The antenna mast on the E-150-250-350 is detachable.

1. Remove the cowl top grille panel above the radio.
2. Disconnect the antenna lead-in cable from the radio.
3. Unsnap the two retaining clips from the antenna cable.
4. Remove the antenna mast from the antenna base.
5. Unsnap the cap from the antenna base and remove the cap.
6. Remove the four antenna base attaching screws and remove the base and cable assembly from the vehicle.

CAUTION: Use appropriate fender protection to prevent damage to the paint when removing antenna base.

NOTE: The antenna lead-in cable can now be disconnected from the antenna base for testing or replacement.

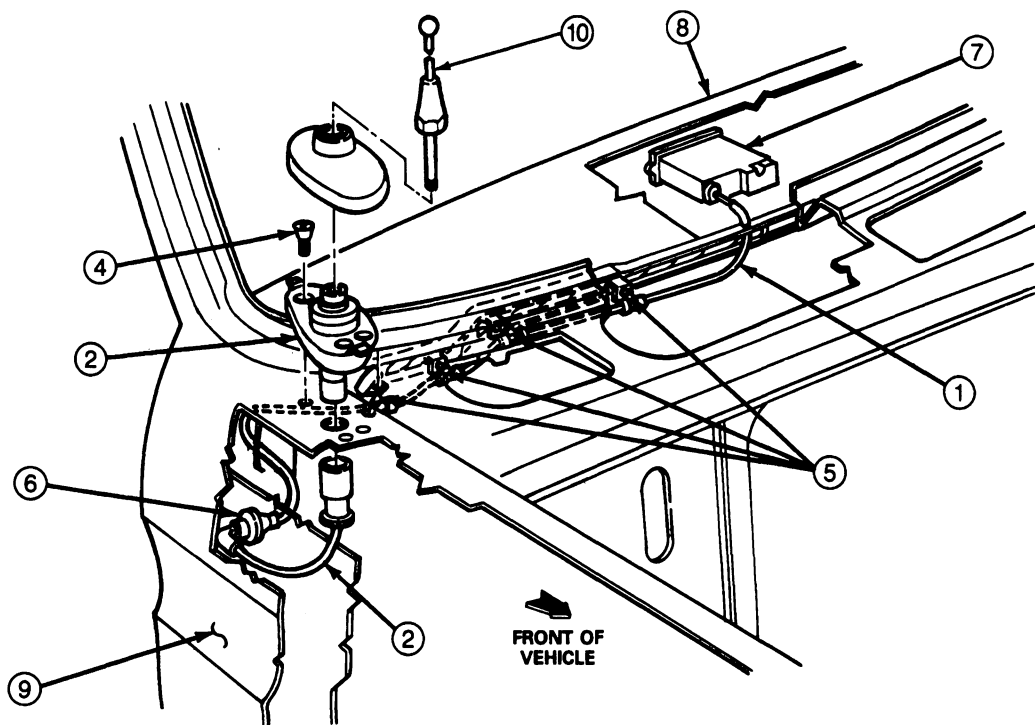
Installation

NOTE: Connect the antenna lead-in cable to the antenna base if it was disconnected during removal.

1. Insert the tip of the new antenna cable through the fender opening and thread the antenna cable to the antenna base. Plug the antenna into the base.
2. Install the four attaching base-to-vehicle screws.
3. Install the cap to the antenna base.
4. Install the antenna mast to the antenna base.
5. Inside the vehicle, snap the antenna cable to the two retaining clips, along the cowl top.
6. Insert the antenna cable through the hole in the dash panel. From inside the vehicle, pull the cable to tightly seat the rubber grommet and seal the cable entry hole.
7. Connect the antenna lead-in cable to the radio and install the cowl top grille panel.

REMOVAL AND INSTALLATION (Continued)

Antenna Base and Cable, E-150-250-350



K16601-B

Item	Part Number	Description
1	18812	Antenna Lead-In Cable
2	18936	Base and Gasket Assembly
3	18898	Cap
4	—	Screw
5	—	Locators

(Continued)

Item	Part Number	Description
6	—	Grommet (Part of 18812 Cable Assembly)
7	18806	Radio Receiver
8	Ref.	Cowl Top
9	Ref.	Fender (R.H.)
10	18A886	Mast Assembly

ADJUSTMENTS

Radio Antenna

The radio antenna is not adjustable.

SPECIAL SERVICE TOOLS/EQUIPMENT

ROTUNDA EQUIPMENT

Tool Number	Description
007-00001	Digital Volt-Ohmmeter

SECTION 15-03 Speakers

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	15-03-1	REMOVAL AND INSTALLATION (Cont'd.)	
DIAGNOSIS AND TESTING		Rear Speakers, Bronco	15-03-7
Diagnostic Guide	15-03-1	Rear Speakers, E-150-250-350	15-03-3
REMOVAL AND INSTALLATION		Rear Speakers, F-150-250-350	15-03-5
Door Speakers, E-150-250-350	15-03-2	VEHICLE APPLICATION	15-03-1
Door Speakers, F-150-250-350, F-Super Duty and Bronco	15-03-4		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and
Bronco Vehicles

DESCRIPTION

F-Series, Bronco and E-Series vehicles are equipped with two door speakers with AM radio. F-Series, Bronco and E-Series have two additional rear speakers with stereo radios. All are premium speakers.

DIAGNOSIS AND TESTING

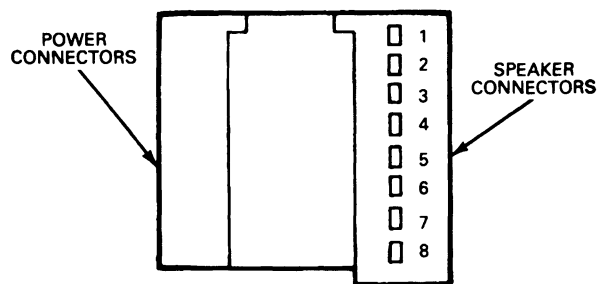
Diagnostic Guide

SPEAKER DIAGNOSTICS: ONE OR MORE SPEAKER DISTORTED OR INOPERATIVE — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	SUBSTITUTE SPEAKER		
	<ul style="list-style-type: none"> If vehicle is equipped with premium sound proceed to Section 15-01, Radio and Cassette Player for speaker diagnostics. Unplug radio from speaker wiring harness. Set radio balance and fader controls at their center. Using a speaker of known good quality and the following chart, jumper the pins corresponding to the suspect speaker of the radio connector to the test speaker. 	Sound from speaker OK Sound from speaker not OK	GO to A2. REMOVE radio for service.
A2	USE JUMPER WIRE ACROSS RADIO CONNECTOR		
	<ul style="list-style-type: none"> Unplug the suspect speaker from the wire harness and jumper the appropriate radio connector ring to the speaker (following charts). 	Sound from speaker OK Sound from speaker not OK	CHECK and REPAIR speaker wiring harness for a short or a break in the harness. REMOVE and REPLACE speaker.

TCK17386A

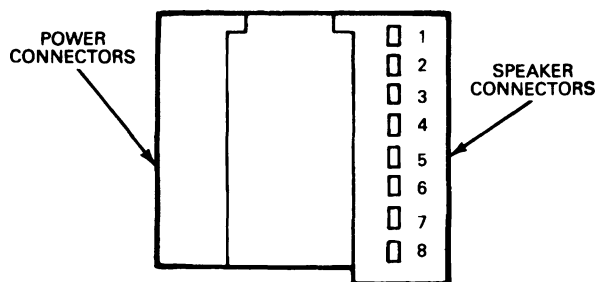
DIAGNOSIS AND TESTING (Continued)



AM ELECTRONIC RADIO INTEGRAL CONNECTOR — SPEAKERS

Pin	Function
1	Front
2	Common
3	
4	
5	Front
6	Common
7	
8	

Models: All

AM/FM & AM/FM/CASS — W/FADER
ELECTRONIC RADIO INTEGRAL CONNECTOR — SPEAKERS

Pin	Function
1	Left Front
2	Common
3	Left Rear
4	Common
5	Right Front
6	Common
7	Right Rear
8	Common

Models: All

CK10451-C

REMOVAL AND INSTALLATION

Door Speakers, E-150-250-350

Removal and Installation

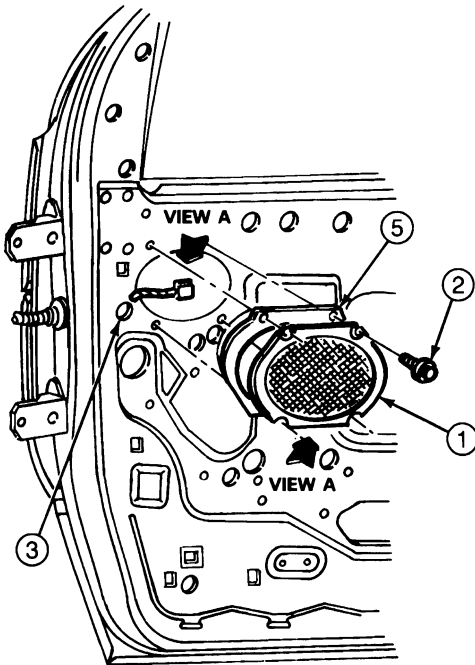
1. Remove trim panel. Refer to Section 01-05.
2. Remove four speaker to door sheet metal screws.
3. Remove speaker and disconnect the wiring connector from the rear of the speaker.

CAUTION: Do not operate the radio with the speaker disconnected.

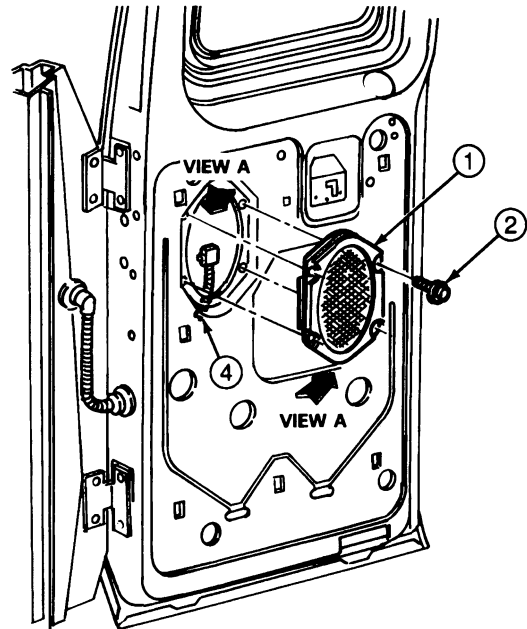
For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

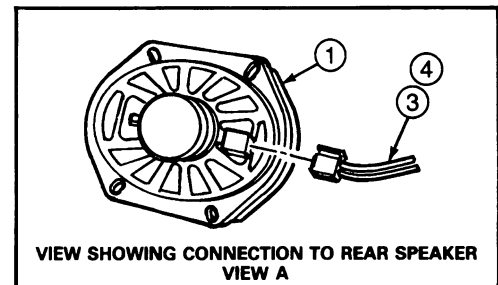
Front Door Speakers, E-150-250-350



R.H. FRONT DOOR SPEAKER INSTALLATION SHOWN
L.H. FRONT DOOR SYMMETRICALLY OPPOSITE
R.H. & L.H. REAR CARGO DOOR SPEAKER
INSTALLATION AND WIRING TYPICAL



R.H. HINGED CARGO DOOR SPEAKER INSTALLATION
AND WIRING SHOWN
R.H. SLIDING CARGO DOOR SPEAKER INSTALLATION
AND WIRING TYPICAL



K16768-A

Item	Part Number	Description
1	18971	Speaker Assembly
2	N806224	Screw

(Continued)

Item	Part Number	Description
3	19A041	Speaker Wiring
4	14026	Speaker Wiring
5	19A034	Water Shield (Front Doors Only)

Rear Speakers, E-150-250-350

Removal and Installation

1. Remove trim panel. Refer to Section 01-05.
2. Remove four speaker to bracket screws.
3. Remove speaker from bracket assembly and disconnect wiring connector from the rear of the speaker.

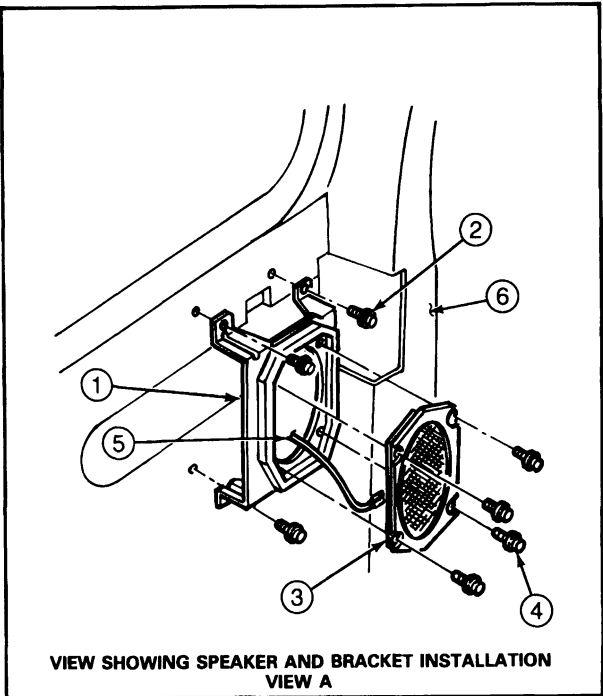
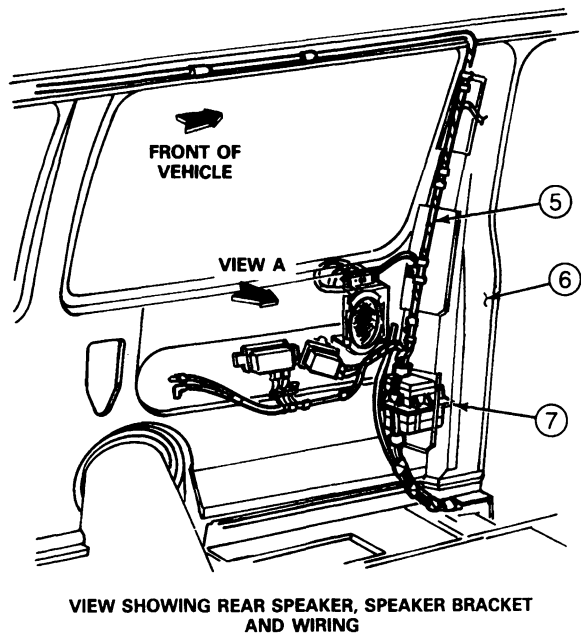
CAUTION: Do not operate the radio with the speaker disconnected.

4. If the speaker bracket needs to be removed, the rear quarter trim panel must be removed. Refer to Section 01-05 for rear quarter trim panel removal and installation procedures.
5. Remove the four bracket screws and remove the bracket.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Rear Speakers, E-150-250-350



K16770-A

Item	Part Number	Description
1	18807	Bracket Assembly
2	N800312-S2	Screw
3	18971	Speaker Assembly

(Continued)

Item	Part Number	Description
4	N806224	Screw and Washer Assembly
5	14405	Wiring Assembly
6	Ref.	B-Pillar (LH Side)
7	Ref.	76 Way-Connector

Door Speakers, F-150-250-350, F-Super Duty and Bronco

Removal and Installation

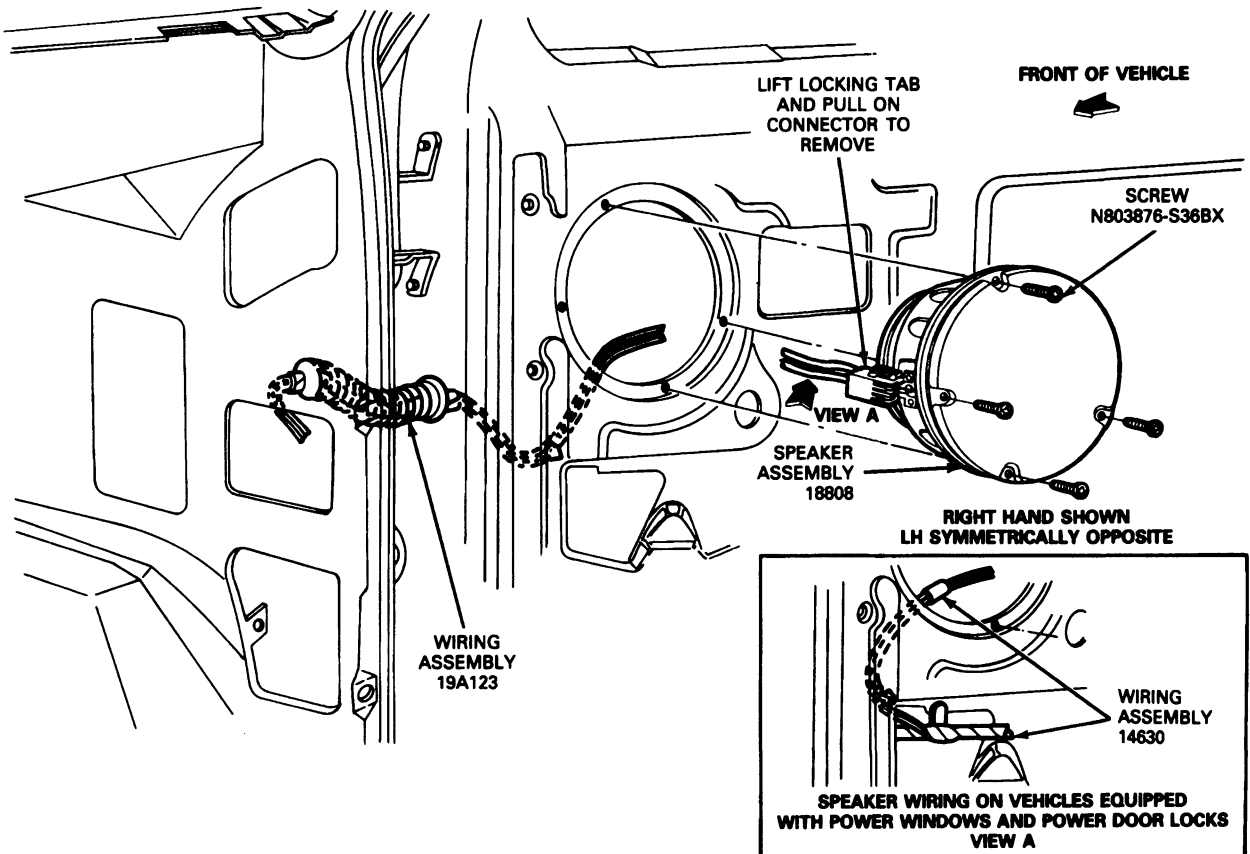
1. Remove door trim panel. Refer to Section 01-05.
2. Remove four speaker screws and disconnect wiring.

CAUTION: Do not operate radio with speakers disconnected.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Door Speakers, F-150-250-350, F-Super Duty and Bronco



K10566-B

Rear Speakers, F-150-250-350

Removal and Installation

1. Remove four speaker screws and bodyside trim panel grille (Regular Cab and Crew Cab vehicles).

NOTE: For SuperCab vehicles, the speaker trim cover must be removed to gain access to the four speaker screws.

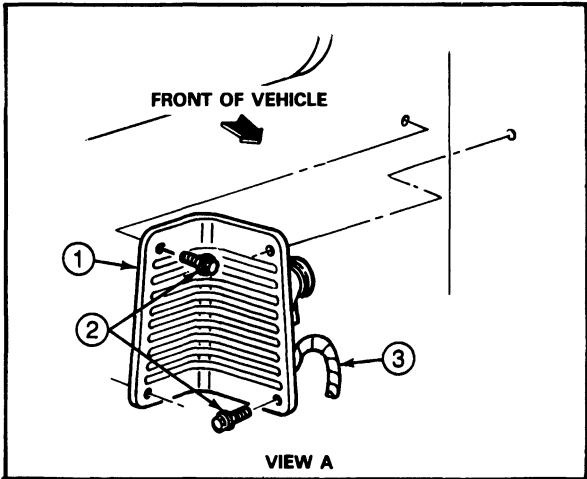
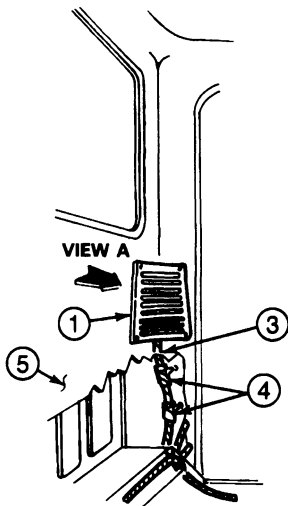
2. Remove the speaker and grille assembly and disconnect the wiring connector at the rear of the speaker.

CAUTION: Do not operate the radio with the speaker disconnected.

For installation, follow removal procedures in reverse order.

REMOVAL AND INSTALLATION (Continued)

Rear Speaker, F-150-250-350, Regular Cab and Crew Cab

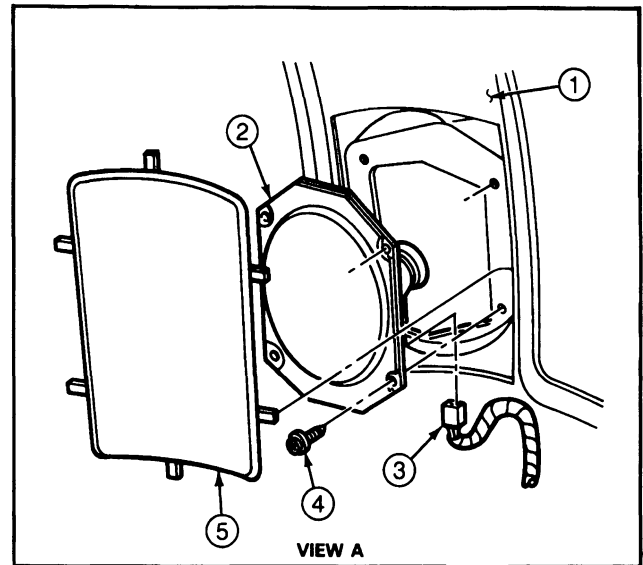
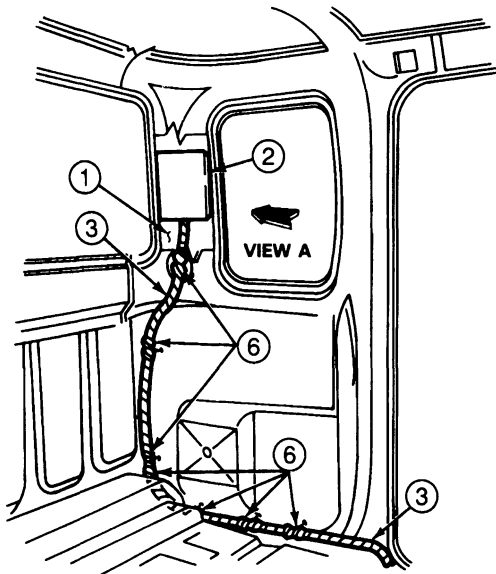


K16772-A

Item	Part Number	Description
1	18932	Speaker and Grille Assembly
2	N803247-S58	Screw
3	14A504	Wiring Assembly
4	—	Locator
5	Ref.	Trim Panel

REMOVAL AND INSTALLATION (Continued)

Rear Speaker, F-150-250-350, SuperCab



K16774-A

Item	Part Number	Description
1	Ref.	Trim Panel
2	18971	Speaker Assembly
3	14A504	Wiring Assembly

(Continued)

Item	Part Number	Description
4	N806222-S36	Screw
5	—	Speaker Trim Cover (Part of 18971 Speaker)
6	—	Locator

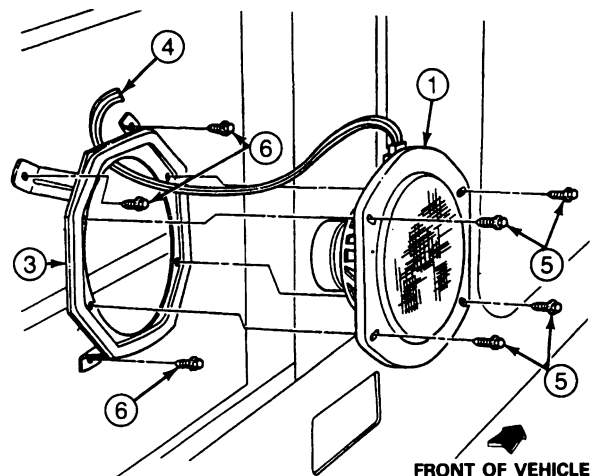
Rear Speakers, Bronco

Removal and Installation

1. Remove grille from trim panel.
2. Remove four speaker screws.
3. Remove speaker and disconnect the wires at the connector located behind the speaker.
CAUTION: Do not operate the radio with the speaker disconnected.
4. If the speaker bracket needs to be removed, the rear quarter trim panel must be removed. Refer to Section 01-05, Trim, Interior for rear quarter trim panel removal and installation procedures.
5. Remove the three bracket screws and remove the bracket.

For installation, follow removal procedures in reverse order.

Rear Speaker Installation, Bronco



L.H. SHOWN, R.H. SYMMETRICALLY OPPOSITE

K16776-A

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	18971	Speaker Assembly
3	18807	Plate Assembly
4	14A507	Wiring Assembly
5	N806222-S36	Screw 2.0-2.5 N·m (17-22 In·Lb)

(Continued)

Item	Part Number	Description
6	381801-S2	Screw 2.0-2.5 N·m (17-22 In·Lb)

GROUP

17

LIGHTING

SECTION TITLE	PAGE	SECTION TITLE	PAGE
DAYTIME RUNNING LAMPS	17-04-1	LIGHTING, INTERIOR	17-02-1
LIGHTING, EXTERIOR	17-01-1		

SECTION 17-01 Lighting, Exterior

SUBJECT	PAGE	SUBJECT	PAGE
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Headlamp Aim	17-01-59	Hi-Mount Stoplamp	17-01-53
DESCRIPTION AND OPERATION		Bronco	17-01-54
Headlamp Switch	17-01-2	Bulb Replacement, Bronco	17-01-55
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Testing Guide	17-01-13	Parking Lamps, F-150-250-350, F-Super Duty	
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Headlamp Bulb and Headlamp Assembly,		Rear Marker Lamps, F-350 Styleside with Dual	
F-150-250-350, F-Super Duty,		Rear Wheels	17-01-53
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Headlamp Bulb Assembly, E-150-250-350,		Turn Signal/Hazard Warning Flasher Switch,	
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Headlamp Switch	17-01-47	E-150-250-350 and Bronco	17-01-59
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Headlamps, F-Series/Bronco	17-01-45		

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty and
Bronco Vehicles

DESCRIPTION AND OPERATION

Headlamps

E-150-250-350, Low Series

Two type 2B rectangular sealed-beam headlamps are used. The lamps have two filaments each, one for low beam and one for high beam. The filaments are identified by the numeral 2 or 2B molded into the lens. Headlamps are controlled by the headlamp switch on the instrument panel and the hand-operated dimmer switch attached to the left side of the steering column.

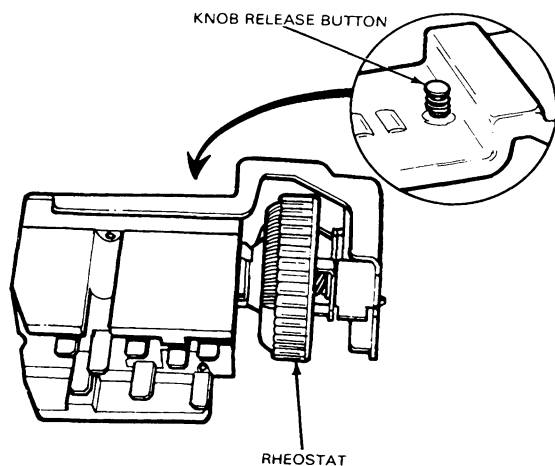
F-150-250-350, F-Super Duty, E-150-250-350, HI Series and Bronco

Two aerodynamically styled headlamps are used. Each lamp uses a halogen bulb. A burned-out bulb may be replaced without removing the headlamp except on E-150-250-350. Headlamps are controlled by the headlamp switch on the instrument panel and the dimmer switch on the left side of the steering column.

Headlamp Switch

The headlamp switch is a combination, three-position switch that controls the circuits to the headlamps, exterior lamps (except stoplamps and turn signal/hazard warning lamps), instrument panel lamps and other interior lamps. A typical headlamp switch is shown below. Circuits are connected to the switch by a molded multiconnector.

The interior lamp circuit is routed through the headlamp switch. To turn the lamp on, turn the switch knob. This circuit is protected by a fuse in the fuse panel.



K1451-1F

Headlamps On Warning Buzzer

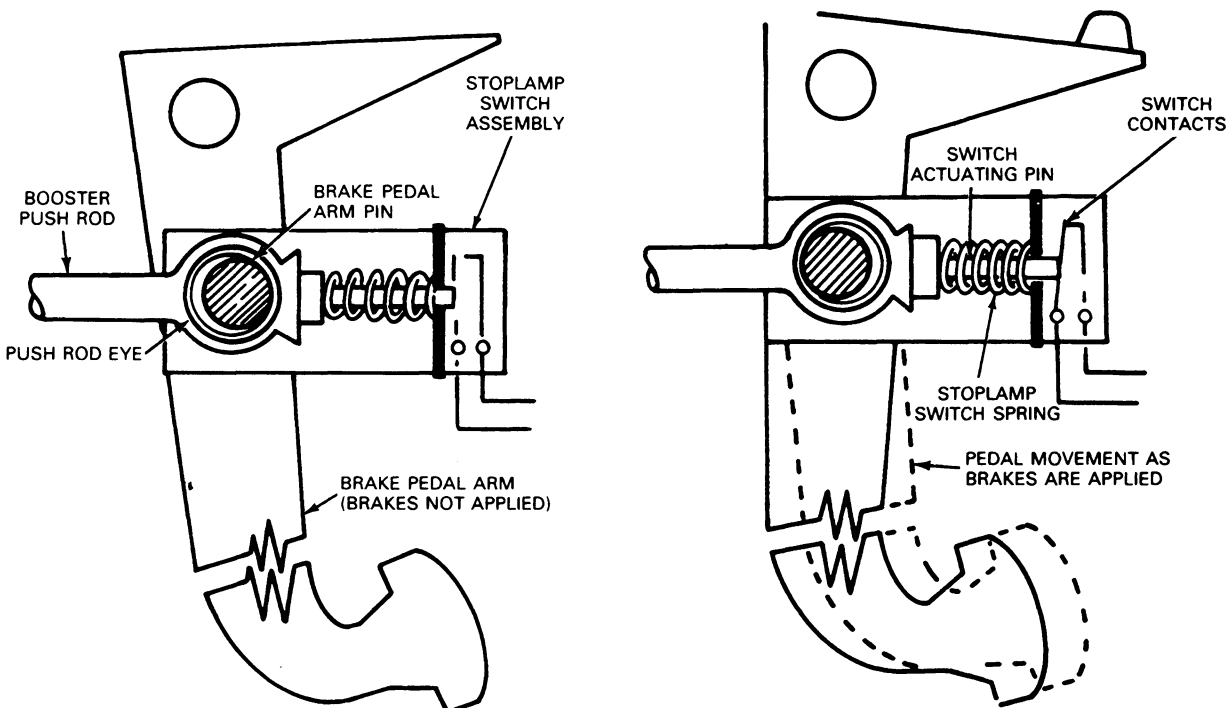
For description and operation, refer to Section 13-09.

Stoplamp Switch

The mechanical stoplamp switch assembly, installed on the pin of the brake pedal arm, straddles the master cylinder push rod, but is not attached directly to the push rod. The switch assembly moves with the pedal arm when the brake pedal is depressed.

The switch actuating pin is held by spring pressure against the rear end of the push rod. Because of the slight clearance between the eye of the master cylinder push rod and the brake pedal arm pin, the pin and the switch move forward slightly before the push rod moves when the pedal is depressed. This relative movement between the switch and the end of the push rod moves the actuating pin rearward in the switch, closing the switch contacts and completing the circuit to the stoplamps.

When the brake pedal is released, the switch moves rearward in relation to the push rod. The spring in the switch returns the actuating pin to its normal position, opening the switch contacts and interrupting the circuit to the stoplamps.

DESCRIPTION AND OPERATION (Continued)**Stoplamp Switch Assembly**

K4891-2C

Turn Signal/Hazard Warning Flashers

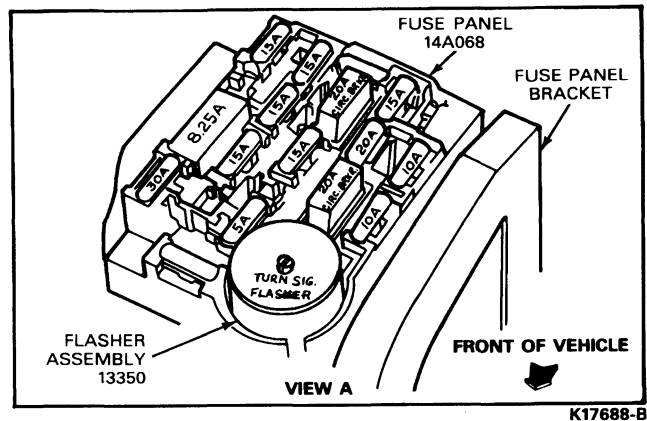
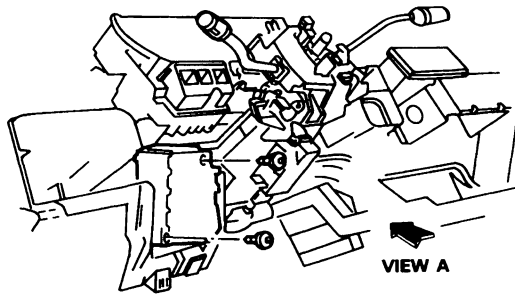
The turn signal/hazard warning flasher switch is located in the upper steering column hub. The turn signal switch is operated by a lever on the left side of the hub. The hazard warning flasher switch is located on the right side of the hub. Two flasher units are used, one for the turn signal circuit and the other for the hazard warning flasher circuit.

On E-150-250-350, the turn signal flasher is mounted on the front of the fuse panel. The hazard warning flasher is mounted to the back of the fuse panel, behind the turn signal flasher. On F-150-250-350, F-Super Duty and Bronco, the turn signal flasher is mounted on the front of the fuse panel and the hazard warning flasher is mounted on the side panel of the instrument panel.

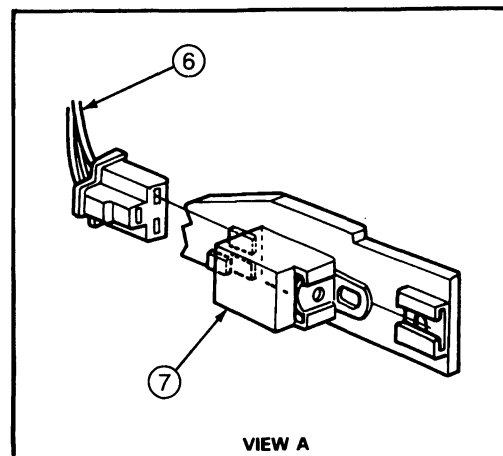
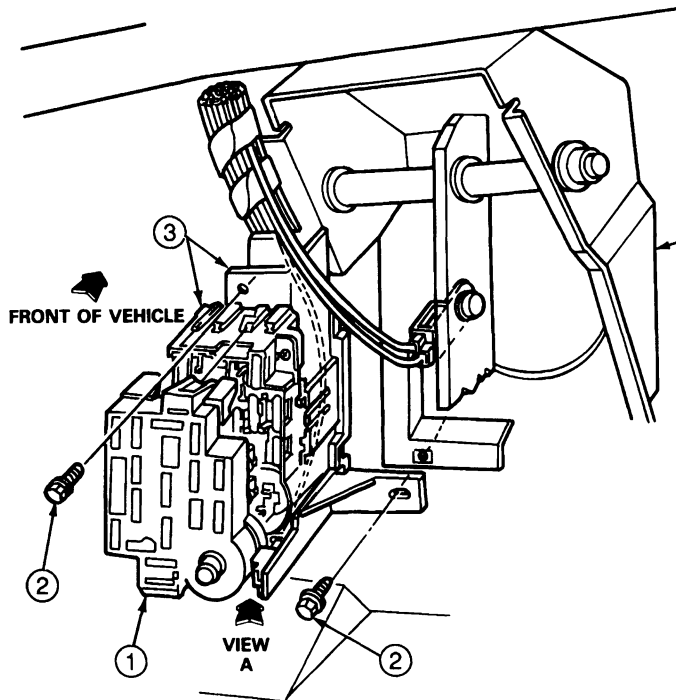
To operate the turn signals, the ignition switch must be in the RUN position on the F-150-250-350, F-Super Duty Chassis Cab and Bronco. The ignition switch must be in either the ACC or RUN position to operate the turn signals on E-150-250-350. The hazard warning system is operated independently of the ignition switch by actuating the hazard warning switch.

DESCRIPTION AND OPERATION (Continued)

Turn Signal and Hazard Warning Flasher, F-150-250-350, F-Super Duty and Bronco



Turn Signal and Hazard Warning Flasher, E-150-250-350



K17690-A

Item	Part Number	Description
1	14A075	Fuse Panel Cover
2	N800947	Screw and Washer
3	Ref.	Fuse Panel and Bracket Assembly

(Continued)

Item	Part Number	Description
4	Ref.	Brake Support Bracket
5	Ref.	Inner Dash Panel Assembly
6	14A200	Wiring Assembly
7	13350	Flasher Assembly

DIAGNOSIS AND TESTING

Before performing any lighting system tests, make sure the battery is in a fully charged condition and all battery cable connections are clean and tight.

DIAGNOSIS AND TESTING (Continued)

A visual inspection is an important part of the lighting system test. Check for wires with frayed or damaged insulation, loose connections and proper harness routing. Refer to the Truck Wiring Diagrams Manual.

Any problems found by the visual inspection should be corrected before performing further tests of the lighting system.

For example, a loose ground strap between the engine and body dash panel may cause an intermittent operation of the lamps and gauges. Inspect and tighten, if necessary, the ground strap attaching screws at the back of the engine and the body dash panel. If a No. 10 screw is required, Use Part No. 42367-S36 hex washer head tapping screw.

NOTE: Any screws or bolts used for attaching the engine-to-body ground strap must have an "S36" finish (zinc plate plus dichromate dip).

Diagnosis Guides

The following Diagnosis Guides provide steps to take when trying to isolate lighting system problems.

Check for burned out bulbs or fuses before proceeding and replace as necessary.

NOTE: All models use a headlamp switch with a circuit breaker for protection of the headlamps. All other vehicle lamps are protected by a fuse in the fuse panel.

Refer to Testing Guide in this section to verify headlamp switch continuity and condition.

CONDITION	POSSIBLE SOURCE	ACTION
HEADLAMPS All exterior lamps do not light.	<ul style="list-style-type: none"> Loose wiring connections. Open circuit in wiring. Bad ground. Worn or damaged headlamp switch. 	<ul style="list-style-type: none"> Check and secure connections at headlamp switch and dash panel connector. Check power to and from headlamp switch. Repair as necessary. Check ground circuit from bulbs. Verify condition. Replace headlamp switch if necessary.
One headlamp does not work.	<ul style="list-style-type: none"> Loose wiring connections. Bulb burned out. Corroded socket. 	<ul style="list-style-type: none"> Secure connections to headlamp and ground. Replace bulb. Repair or replace as required.
All headlamps out — park and taillamps OK.	<ul style="list-style-type: none"> Loose wiring connections. Worn or damaged dimmer switch. Worn or damaged headlamp switch. Open circuit in wiring or poor ground. 	<ul style="list-style-type: none"> Check and secure connections at dimmer switch and headlamp switch. Check dimmer switch operation. Inspect for corroded connector. Replace as required. Verify condition. Replace headlamp switch if necessary. Repair as required.
Both low beam or both high beam headlamps do not work.	<ul style="list-style-type: none"> Loose wiring connections. Worn or damaged dimmer switch. Open circuit in wiring. Bulbs burned out. 	<ul style="list-style-type: none"> Check and secure connection at dimmer switch and headlamp switch. Check dimmer switch operation. Inspect for corroded connector. Replace as required. Repair as required. Replace bulb(s).
TAILLAMPS One taillamp out.	<ul style="list-style-type: none"> Bulb burned out. Open wiring or poor ground. Corroded bulb socket / connector. 	<ul style="list-style-type: none"> Replace bulb. Repair as necessary. Repair or replace socket / connector.
All taillamps and marker lamps out — headlamps OK.	<ul style="list-style-type: none"> Loose wiring connections. Open wiring or poor ground. Blown fuse. Damaged headlamp switch. 	<ul style="list-style-type: none"> Secure wiring connections where accessible. Check operation of front park and marker lamps. Repair as necessary. Replace if blown. Verify condition. Replace headlamp switch if necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
STOPLAMPS Stoplamps do not work.	<ul style="list-style-type: none"> ● Fuse or circuit breaker (C.B.) burned out. ● Worn or damaged turn signal circuit. ● Loose wiring connections. ● Worn or damaged stoplamp switch. ● Open circuit in wiring. 	<ul style="list-style-type: none"> ● Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Section 18-01.) ● Check turn signal operation. Repair as necessary. ● Secure connection at stoplamp switch. ● Replace stoplamp switch. ● Repair as required.
Stoplamps stay on continuously.	<ul style="list-style-type: none"> ● Damaged stoplamp switch. ● Internal short circuit in wiring. 	<ul style="list-style-type: none"> ● Disconnect wiring connector from switch. If lamp goes out, replace switch. ● If lamp stays on, check for internal short circuit. Repair as necessary.
PARKING LAMPS One parking lamp out.	<ul style="list-style-type: none"> ● Bulb burned out. ● Open wiring or poor ground. ● Corroded bulb socket / connector. 	<ul style="list-style-type: none"> ● Replace bulb. ● Repair as necessary. ● Repair or replace socket / connector.
All parking lamps out.	<ul style="list-style-type: none"> ● Loose wiring connections. ● Open wiring or poor ground. ● Bulbs burned out. 	<ul style="list-style-type: none"> ● Secure wiring connections. ● Repair as necessary. ● Replace bulbs.
SIDE OR ROOF MARKER LAMPS Side or roof marker lamp does not light.	<ul style="list-style-type: none"> ● Bulb burned out. ● Open circuit or poor ground. 	<ul style="list-style-type: none"> ● Replace bulb. ● Check socket for corrosion and good ground. Repair as required.
TURN SIGNAL LAMPS All turn signal lamps do not light.	<ul style="list-style-type: none"> ● Fuse or C.B. burned out. ● Worn or damaged turn signal flasher. ● Loose wiring connections. ● Open circuit in wiring or poor ground. ● Damaged turn signal switch. 	<ul style="list-style-type: none"> ● Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Section 18-01). ● Substitute a known good flasher. Replace if required. ● Secure connections where accessible. ● Repair as required. ● Check continuity of switch assembly. Replace turn signal switch and wiring assembly if necessary.
Turn signal lamps light but do not flash.	<ul style="list-style-type: none"> ● Worn or damaged turn signal flasher. ● Poor ground. ● Incorrect bulb size. 	<ul style="list-style-type: none"> ● Substitute a known good flasher. Replace if required. ● Repair ground. ● Replace bulb with correct size.
Front turn signal lamps do not light.	<ul style="list-style-type: none"> ● Loose wiring connector or open circuit. ● Bulb burned out. 	<ul style="list-style-type: none"> ● Repair wiring as required. ● Replace bulb.
Rear turn signal lamps do not light.	<ul style="list-style-type: none"> ● Loose wiring connector or open circuit. ● Bulb burned out. 	<ul style="list-style-type: none"> ● Repair wiring as required. ● Replace bulb.
One turn signal lamp does not light.	<ul style="list-style-type: none"> ● Bulb burned out. ● Open circuit in wiring or poor ground. 	<ul style="list-style-type: none"> ● Replace bulb. ● Repair as required.
LICENSE LAMPS One license lamp does not light.	<ul style="list-style-type: none"> ● Bulb burned out. ● Open circuit in wiring. 	<ul style="list-style-type: none"> ● Replace bulb. ● Repair as required.
All license lamps do not light.	<ul style="list-style-type: none"> ● Bulbs burned out. ● Open circuit in wiring or poor ground. ● Damaged headlamp switch. 	<ul style="list-style-type: none"> ● Replace bulbs. ● Repair wiring as required. ● Replace switch.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
HAZARD FLASHER LAMPS Hazard flasher lamps — do not flash.	<ul style="list-style-type: none"> ● Fuse or C.B. burned out. ● Worn or damaged hazard flasher. ● Worn or damaged turn signal operation. ● Open circuit in wiring. ● Worn or damaged hazard flasher switch. 	<ul style="list-style-type: none"> ● Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Section 18-01.) ● Substitute a known good flasher. Replace flasher if damaged. ● Repair turn signal system. ● Repair as required. ● Repair or replace the turn signal switch and wiring assembly which includes the hazard flasher switch.
BACKUP LAMPS Backup lamps — one lamp does not function.	<ul style="list-style-type: none"> ● Bulb burned out. ● Loose wiring connections. ● Open circuit in wiring. 	<ul style="list-style-type: none"> ● Replace bulb. ● Secure connections where accessible. ● Repair as required.
Backup lamps — both lamps do not function.	<ul style="list-style-type: none"> ● Fuse or C.B. burned out. ● Backup lamp switch out of adjustment. ● Worn or damaged backup lamp switch. ● Loose wiring connections. ● Open wiring or poor ground. ● Bulbs burned out. 	<ul style="list-style-type: none"> ● Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Section 18-01.) ● Adjust switch. ● Replace switch. ● Secure connections where accessible. ● Repair as required. ● Replace bulb.

TK6 165B

TURN SIGNAL LAMPS LIGHT BUT DO NOT FLASH ON BOTH SIDES — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	DISCONNECT FLASHER		
	<ul style="list-style-type: none"> ● Disconnect turn signal flasher. ● Turn on signals. ● Do lamps go out on the side being operated? 	Yes	REPLACE flasher with known good unit. REPEAT test.
		No, lamps stay on	CORRECT short in wiring and INSTALL original flasher. REPEAT test.

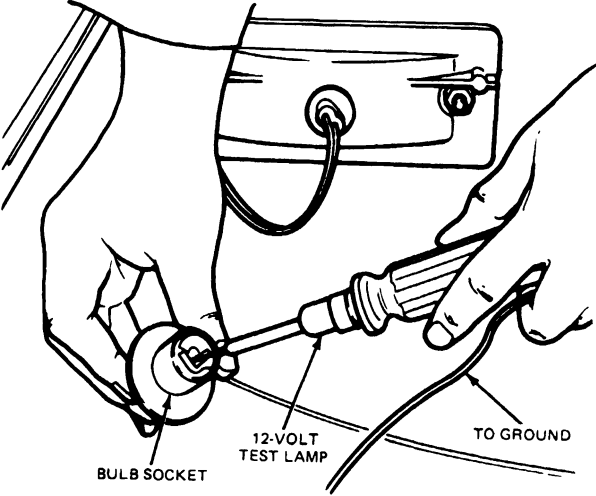
TK6 154C

TURN SIGNAL LAMPS, ALL LAMPS INOPERATIVE — TEST B

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK FUSE		
	<ul style="list-style-type: none"> ● Check operation of a circuit that shares the same fuse — or check fuse. ● Does fuse check OK? 	No	REPLACE fuse. If fuse blows again, CHECK for short circuit(s).
		Yes	GO to B2 .
B2	CHECK TURN SIGNAL FLASHER		
	<ul style="list-style-type: none"> ● Substitute a known good turn signal flasher. ● Is turn signal flasher OK? 	No	GO to B3 .
		Yes	Problem corrected. REPEAT test.
B3	CHECK POWER TO FLASHER		
	<ul style="list-style-type: none"> ● Check for power to the turn signal flasher. F-150-250-350, F-Super Duty and Bronco Circuit No. 298 (P/O). E-150-250-350 Circuit No. 8 (O/Y). ● Does circuit check OK? 	No	REPAIR feed circuit.
		Yes	GO to B4 .
B4	CHECK POWER TO SWITCH		
	<ul style="list-style-type: none"> ● Check for power to turn signal switch Circuit 44(LB). 	No	REPAIR circuit between turn signal flasher and switch (blue wire). Circuit No. 44.
		Yes	GO to B5 .

DIAGNOSIS AND TESTING (Continued)

TURN SIGNAL LAMPS, ALL LAMPS INOPERATIVE — TEST B (Continued)

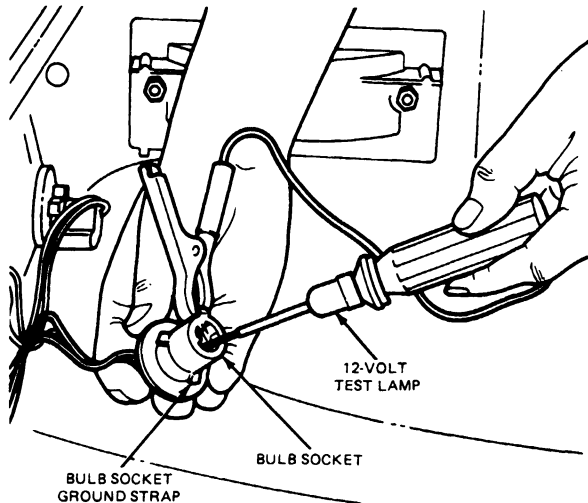
TEST STEP	RESULT	ACTION TO TAKE
B5 CHECK TURN SIGNAL SWITCH <ul style="list-style-type: none"> Connect 12-volt test lamp to a good ground and, with turn signal switch on, check for power out of switch: E-150-250-350, F-150-250-350, F-Super Duty LH Front — Circuit 3 (GR / W) LH Rear — Circuit 283 (Y / BK) RH Front — Circuit 2 (W / BK) RH Rear — Circuit 282 (GR) Bronco: LH Front — Circuit 3 (LG / W) LH Rear — Circuit 9 (LG / O) RH Front — Circuit 2 (W / LB) RH Rear — Circuit 5 (O / LB) OR Check the turn signal switch by plugging a new unit into the main wiring harness. Is switch OK? 	Yes No	► GO to B6 . ► REPAIR or REPLACE turn signal switch.
B6 CHECK FOR POWER TO SOCKETS <ul style="list-style-type: none"> Check for power to bulb sockets with turn signal switch on: E-150-250-350, F-150-250-350, F-Super Duty LH Front — Circuit 3 (GR / W) LH Rear — Circuit 283 (Y / BK) RH Front — Circuit 2 (W / BK) RH Rear — Circuit 282 (GR) Bronco: LH Front — Circuit 3 (LG / W) LH Rear — Circuit 9 (LG / O) RH Front — Circuit 2 (W / LB) RH Rear — Circuit 5 (O / LB) Do circuits check OK? 	No Yes	► REPAIR circuit(s) between turn signal switch and bulbs. ► CHECK all bulbs and assure good ground. REPEAT test.

K3706-1B

TK6164G

DIAGNOSIS AND TESTING (Continued)

TURN SIGNAL LAMPS, ONE OR MORE LAMPS INOPERATIVE — TEST C

TEST STEP		RESULT	ACTION TO TAKE
C1	CHECK FOR POWER TO SOCKETS		
<ul style="list-style-type: none"> Check for power to bulb socket(s) with turn signal switch on: E-150-250-350, F-150-250-350 and F-Super Duty LH Front — Circuit 3 (GR / W) LH Rear — Circuit 283 (Y / BK) RH Front — Circuit 2 (W / BK) RH Rear — Circuit 282 (GR) Bronco: LH Front — Circuit 3 (LG / W) LH Rear — Circuit 9 (LG / O) RH Front — Circuit 2 (W / LB) RH Rear — Circuit 5 (O / LB) Do circuits check OK? <p>NOTE: If one or both of the instrument panel bulbs do not flash, check for power to the bulbs, check the bulb, and / or ground.</p>		No Yes	GO to C2. GO to C3.
C2	CHECK FOR POWER OUT OF SWITCH		
<ul style="list-style-type: none"> Connect 12-volt test lamp to a good ground and, with turn signal switch on, check for power out of switch: E-150-250-350, F-150-250-350 and F-Super Duty LH Front — Circuit 3 (GR / W) LH Rear — Circuit 283 (Y / BK) RH Front — Circuit 2 (W / BK) RH Rear — Circuit 282 (GR) Bronco: LH Front — Circuit 3 (LG / W) LH Rear — Circuit 9 (LG / O) RH Front — Circuit 2 (W / LB) RH Rear — Circuit 5 (O / LB) OR Check the turn signal switch by plugging a new unit into the main wiring harness. Is switch OK? 		No Yes	REPAIR OR REPLACE turn signal switch. REPAIR circuits between switch and bulb socket.
C3	CHECK FOR GROUND		
<ul style="list-style-type: none"> Check for ground to socket. Does ground check OK? 		No Yes	REPAIR socket ground. REPLACE bulb.

TK6167H

DIAGNOSIS AND TESTING (Continued)**ONE TURN SIGNAL LAMP DOES NOT LIGHT — TEST D**

TEST STEP		RESULT	ACTION TO TAKE
D1	CHECK BULB		
	<ul style="list-style-type: none"> Check bulb of inoperative turn signal lamp. Does bulb check OK? 	No	REPLACE bulb.
		Yes	GO to D2 .
D2	CHECK POWER		
	<ul style="list-style-type: none"> Check for power at bulb socket. Is there power? 	No	REPAIR circuit from socket to turn signal switch.
		Yes	SERVICE ground to socket.

TK6751C

HAZARD WARNING FLASHER LAMPS DO NOT TURN ON — TEST E

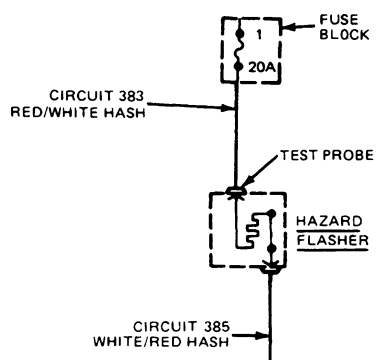
TEST STEP		RESULT	ACTION TO TAKE
E1	CHECK STOPLAMPS		
	<ul style="list-style-type: none"> Check stoplamps and turn signal operations. Do stoplamps and turn signals operate properly? 	No	REFER to turn signal diagnosis to resolve problem and/or SERVICE or REPLACE feed circuit or connections in fuse block or to fuse block.
		Yes	GO to E2 .
E2	CHECK CIRCUIT BETWEEN FUSE AND FLASHER		
	<ul style="list-style-type: none"> Check circuit between fuse and flasher connector, flasher and hazard flasher switch and between hazard flasher switch and bulb feed. Does circuit check OK? 	No	REPAIR circuit wiring as required.
		Yes	CHECK hazard flasher switch, or turn signal switch, or turn signal switch assembly. SERVICE or REPLACE as required.

TK6172D

HAZARD WARNING FLASHER LAMPS TURN ON, BUT DO NOT FLASH — TEST F

TEST STEP		RESULT	ACTION TO TAKE
F1	CHECK TURN SIGNAL		
	<ul style="list-style-type: none"> Check operation of turn signal operation. Does turn signal check OK? 	No	REFER to turn signal diagnosis to resolve the problem.
		Yes	GO to F2 .

DIAGNOSIS AND TESTING (Continued)**HAZARD WARNING FLASHER LAMPS TURN ON, BUT DO NOT FLASH — TEST F (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
F2	CHECK POWER TO HAZARD FLASHER		
<ul style="list-style-type: none"> Check for power to the hazard warning flasher. Red wire with white stripe circuit No. 283. Substitute a known good hazard warning flasher. Is power OK?  <p style="text-align: center;">K5130-1A</p>		No	GO to F3.
		Yes	Problem corrected.
F3	CHECK CIRCUIT 385 FOR POWER		
<ul style="list-style-type: none"> Check for power to the hazard warning flasher switch in the turn signal switch assembly. Circuit 305 (W/R). Is power OK? 		No	SERVICE circuit between hazard warning flasher and switch. Circuit 385 (W/R).
		Yes	GO to F4.
F4	CHECK FOR POWER OUT OF SWITCH		
<ul style="list-style-type: none"> Connect 12-volt test lamp to a good ground and, with hazard warning flasher switch on, — check for power out of switch: E-150-250-350, F-150-250-350, F-Super Duty LH Front — Circuit 3 (GR/W) LH Rear — Circuit 283 (Y/BK) RH Front — Circuit 2 (W/BL) RH Rear — Circuit 282 (GR) Bronco: LH Front — Circuit 3 (LG/W) LH Rear — Circuit 9 (LG/O) RH Front — Circuit 2 (W/LB) RH Rear — Circuit 5 (O/LB) OR Check the hazard warning flasher switch by plugging a new unit into the main wiring harness. Is the switch OK? 		No	SERVICE or REPLACE switch.
		Yes	SERVICE or REPLACE circuit as required.

TK6173E

REAR HAZARD WARNING FLASHER LAMPS DO NOT LIGHT — TEST G

TEST STEP		RESULT	ACTION TO TAKE
G1	CHECK REAR STOPLAMPS		
<ul style="list-style-type: none"> Check rear stoplamps. Both rear stoplamps should light. Are rear stoplamps OK? 		No	SERVICE rear stoplamp circuit.
		Yes	GO to G2.
G2	CHECK TURN SIGNAL LAMPS		
<ul style="list-style-type: none"> Check turn signal lamps. Check turn signal switch. Is lamp OK? 		Yes	REPLACE switch.
		No	REPLACE lamp bulbs.

TK6170D

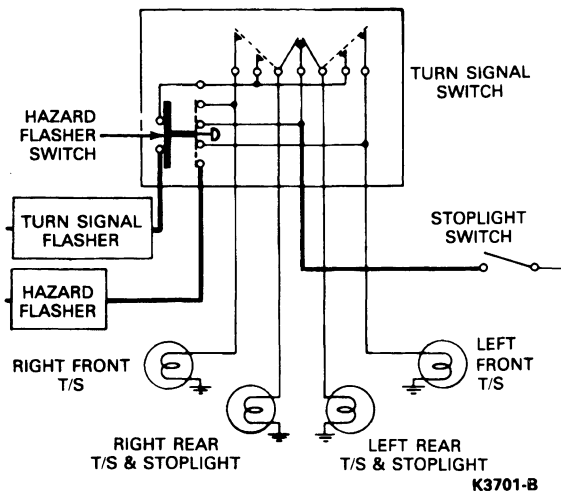
DIAGNOSIS AND TESTING (Continued)

Circuit Common Points

Common point diagnosis should be used to isolate or pinpoint the most probable cause of a problem in a multi-load circuit (a circuit with more than one operating component) without making any tests. If one system functions properly but another does not, the problem must be in the part of the circuit unique to the inoperative system.

If more than one circuit does not operate, check for blown fuses. Refer to Section 18-01.

Circuit Common Points (Typical)



Turn Signal Switch Testing

The turn signal switch is part of the multi-function switch located on the left side of the steering column.

Testing for electrical malfunctions can be accomplished with a continuity tester. Malfunctions can be determined by checking continuity between the feed and function terminals of the switch. For additional testing, refer to Multi-Function Switch in the Diagnosis and Testing portion of Section 11-05.

Hazard Warning Flasher Switch Testing

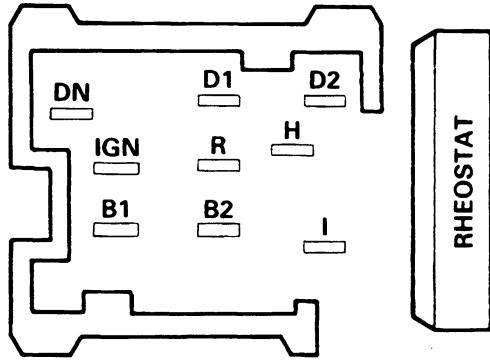
The hazard warning flasher switch is part of the multi-function switch located on the left side of the steering column.

Testing for electrical malfunctions can be accomplished with a continuity tester. Malfunctions can be determined by checking continuity between the feed and function terminals of the switch. For additional testing, refer to Multi-Function Switch in the Diagnosis and Testing portion of Section 11-05.

DIAGNOSIS AND TESTING (Continued)**Testing Guide****Headlamp Switch**

The following test provides a continuity check for the headlamp switch to verify switch condition. If the switch fails to show continuity as indicated in the test, replace switch.

HEADLAMP SWITCH — BENCH CHECK CONTINUITY

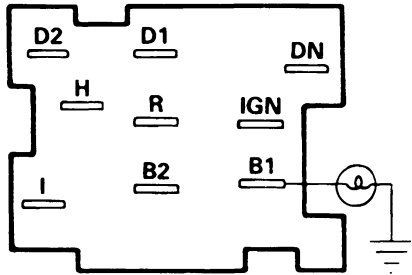
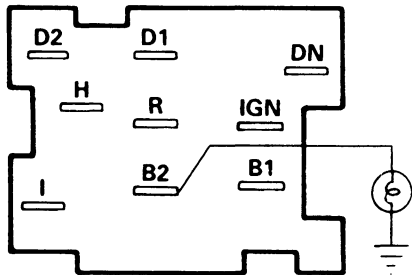
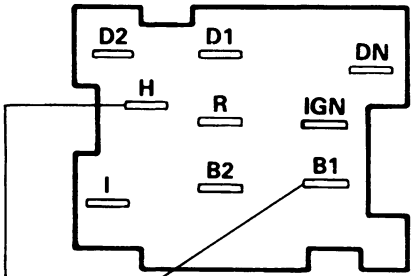
	
CONNECTOR 11A646 <ul style="list-style-type: none"> • Terminal DN — Daytime Illumination • Terminal IGN — DN Feed • Terminal B1 — Headlamp Feed • Terminal B2 — Park/Rear/Instrument Panel Lights Feed • Terminal D1 — Dome Lamp Feed • Terminal D2 — To Dome Lamp • Terminal H — To Headlamps • Terminal R — To Parking/Rear Lamps • Terminal I — To Instrument Panel Lamps • Rheostat — Provides variable resistance between Terminals R and I 	
SWITCH POSITION	CIRCUIT CONTINUITY
Daytime Illumination <ul style="list-style-type: none"> • Ignition Switch ON • Headlamp Switch OFF 	Closed Circuit — IGN Terminal to DN Terminal
Parking/Rear Lamps <ul style="list-style-type: none"> • Headlamp Switch ON — first stop position 	Closed Circuit — DN Terminal to I Terminal B2 Terminal to R Terminal
Headlamps <ul style="list-style-type: none"> • Headlamp Switch ON — second stop position 	Closed Circuit — DN Terminal to I Terminal B2 Terminal to R Terminal B1 Terminal to H Terminal
Instrument Panel Illumination <ul style="list-style-type: none"> • ROTATE Headlamp Switch Knob 	Variable Resistance — Between Terminal R and Terminal I

CK10144-2B

DIAGNOSIS AND TESTING (Continued)

HEADLAMP SWITCH CONNECTOR CHECKOUT

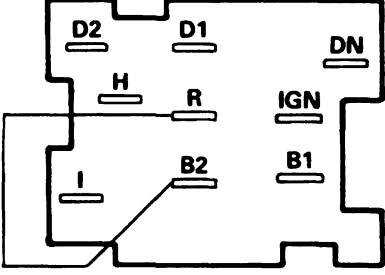
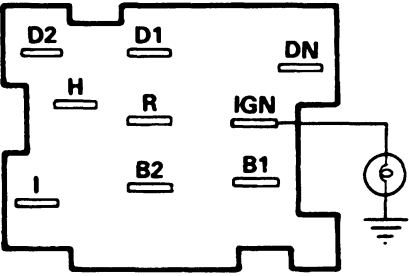
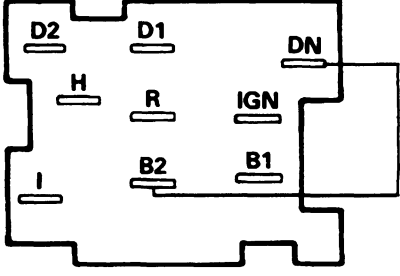
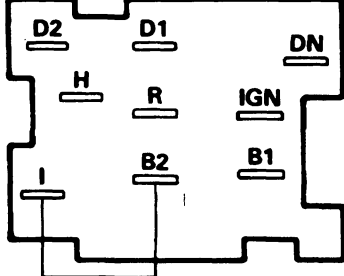
- 1. Replace burned out bulbs and fuses before proceeding.
- 2. A 12-volt test lamp and jumper wire will be required.
- 3. When necessary to trace and/or service the various circuits, refer to the respective vehicle wiring diagrams.
- 4. Terminal identification used on connector checkout procedure corresponds with actual identification on headlamp switch.
- 5. Perform checks in sequence as shown.

OPERATION	RESULT
<div>1</div> <div>Connect a 12-volt test lamp between Terminal B1 and a good ground.</div> <div></div>	<div>Test lamp should light. If not, trace circuit back to fuse link and service as necessary.</div>
<div>2</div> <div>Connect a 12-Volt test lamp between Terminal B2 and a good ground.</div> <div></div>	<div>Test lamp should light. If not, trace circuit back to fuse panel and service as necessary.</div>
<div>3</div> <div>Connect a jumper wire between Terminals B1 and H.</div> <div></div>	<div>Headlamps should light. If not, trace Circuit H back to headlamps and service. If circuit is OK, check ground circuit from headlamps to ground.</div>

CK10441-2A

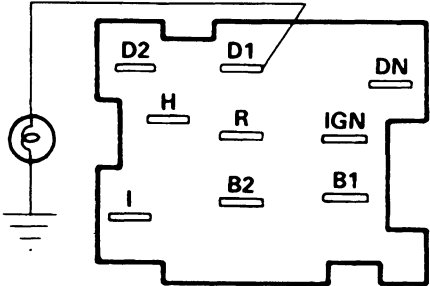
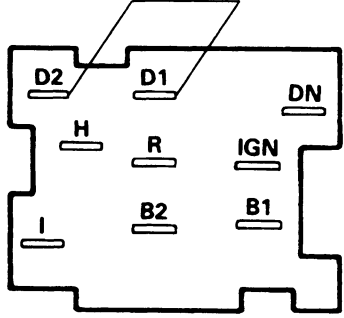
DIAGNOSIS AND TESTING (Continued)

HEADLAMP SWITCH CONNECTOR CHECKOUT — Continued

OPERATION	RESULT
<p>4 Connect a jumper wire between Terminals B2 and R.</p> 	<p>Parking lamps, rear lamps, and marker lamps should light. If not, trace Circuit R and service as necessary. If Circuit R is OK, check ground circuit from lamps to ground.</p>
<p>5 Connect a 12-volt test lamp between Terminal IGN and a good ground.</p> 	<p>With ignition switch in the RUN position, the test lamp should light. If not, trace circuit back to ignition switch and service as necessary.</p>
<p>6 Connect a jumper wire between Terminals B2 and DN.</p> 	<p>Liquid crystal display lamps only, should come on, full bright. If lamps do not light, trace Circuit DN back to lamps and service as necessary. If Circuit is OK, check ground circuit from lamps to ground.</p> <p>NOTE: No other instrument panel lamps will light during this test.</p>
<p>7 Connect a jumper wire between Terminals B2 and I.</p> 	<p>Instrument panel illumination lamps only, should come on, full bright. If panel lamps do not light, trace I circuit back to lamps and service as necessary. If circuit is OK, check ground circuit from lamps to ground.</p> <p>NOTE: Liquid crystal displays will not light during this test.</p>

CK10442-2C

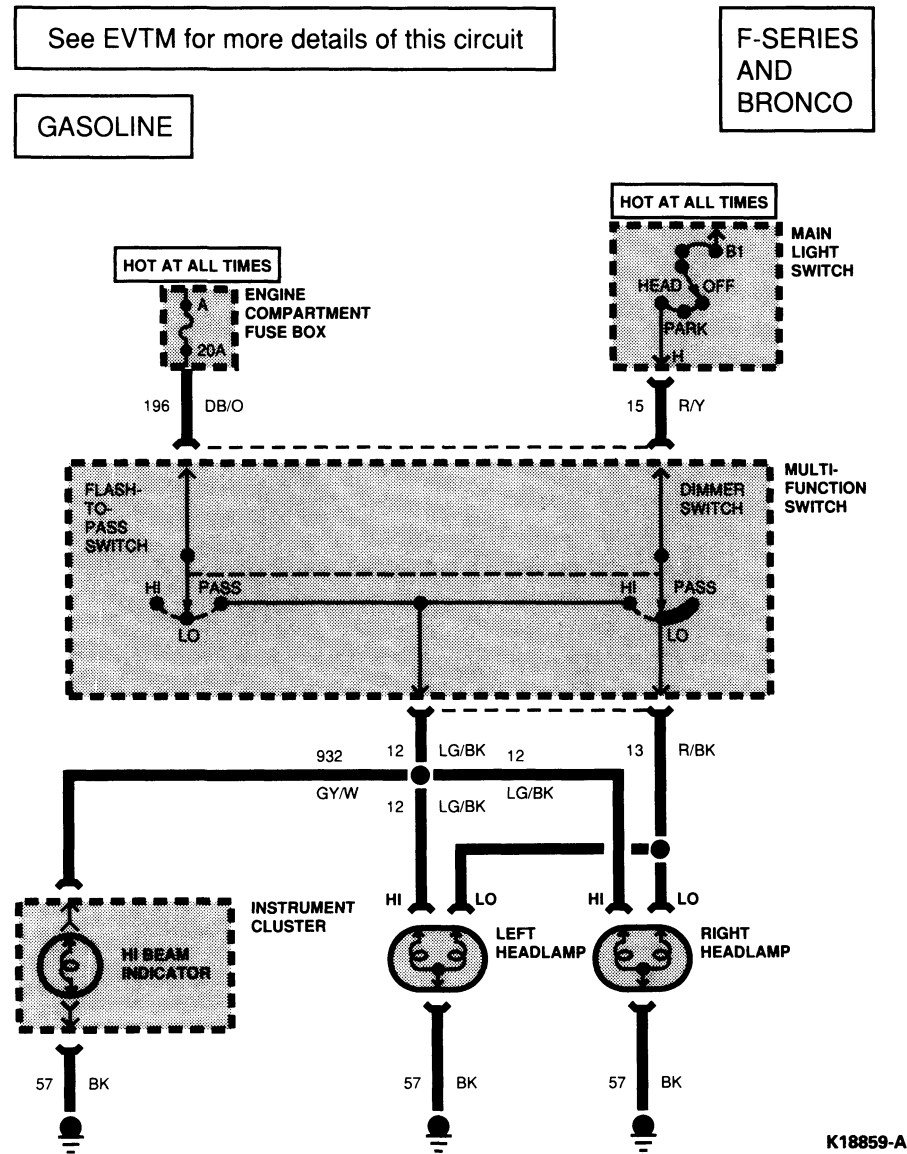
DIAGNOSIS AND TESTING (Continued)

OPERATION	RESULT
<p>8 Connect a 12-volt test lamp between Terminal D1 and a good ground.</p> 	<p>Test lamp should light. If not, trace circuit back to fuse panel and service as necessary.</p>
<p>9 Connect a jumper wire between Terminals D1 and D2.</p> 	<p>With all vehicle doors closed, dome lamp should light. If not, trace circuit D2 back to dome lamp and service as necessary. If circuit is OK, check ground circuit from dome lamp to ground.</p>

CK10443-2B

DIAGNOSIS AND TESTING (Continued)

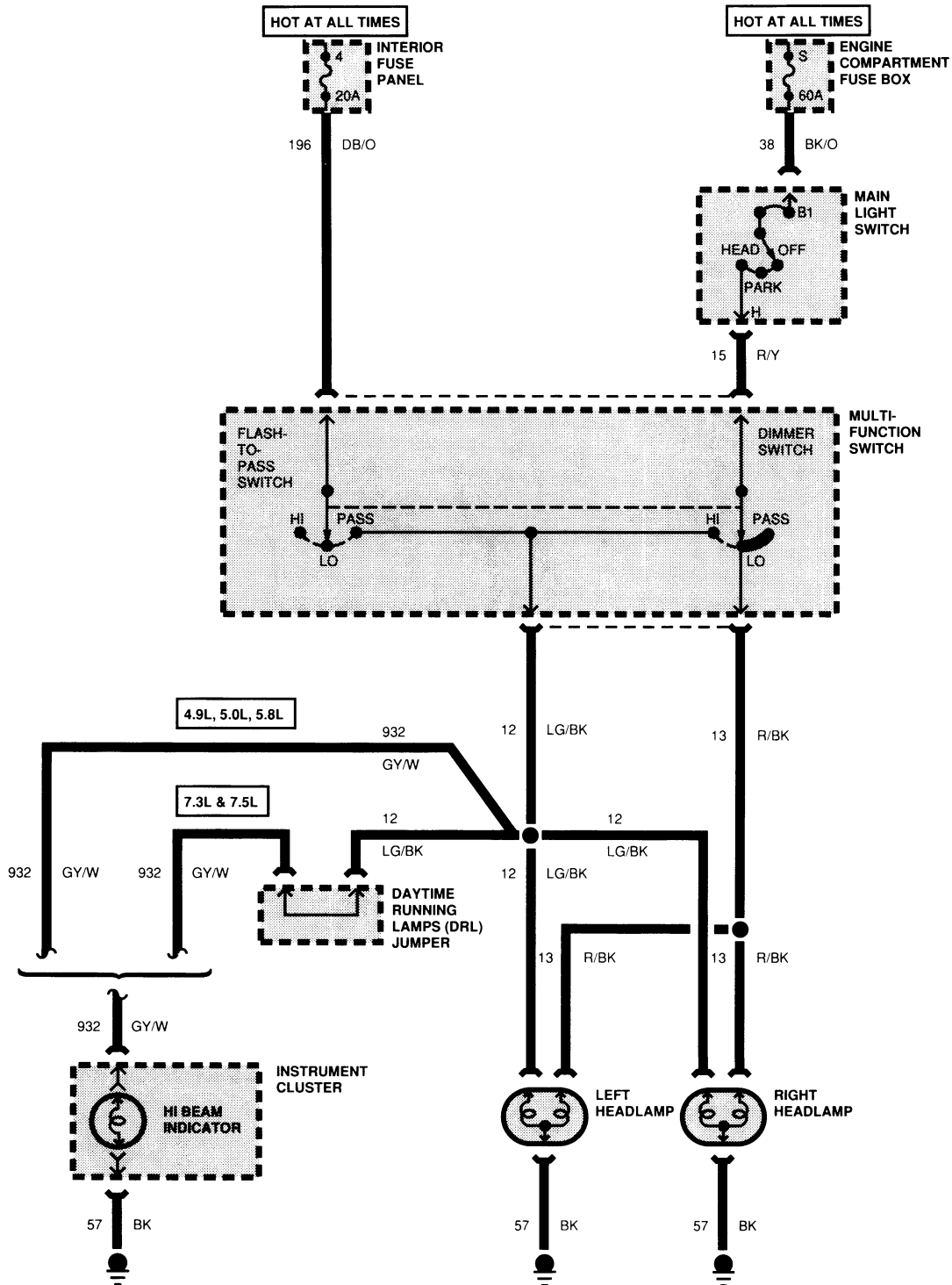
Refer to the following diagrams when diagnosing exterior lighting concerns.



DIAGNOSIS AND TESTING (Continued)

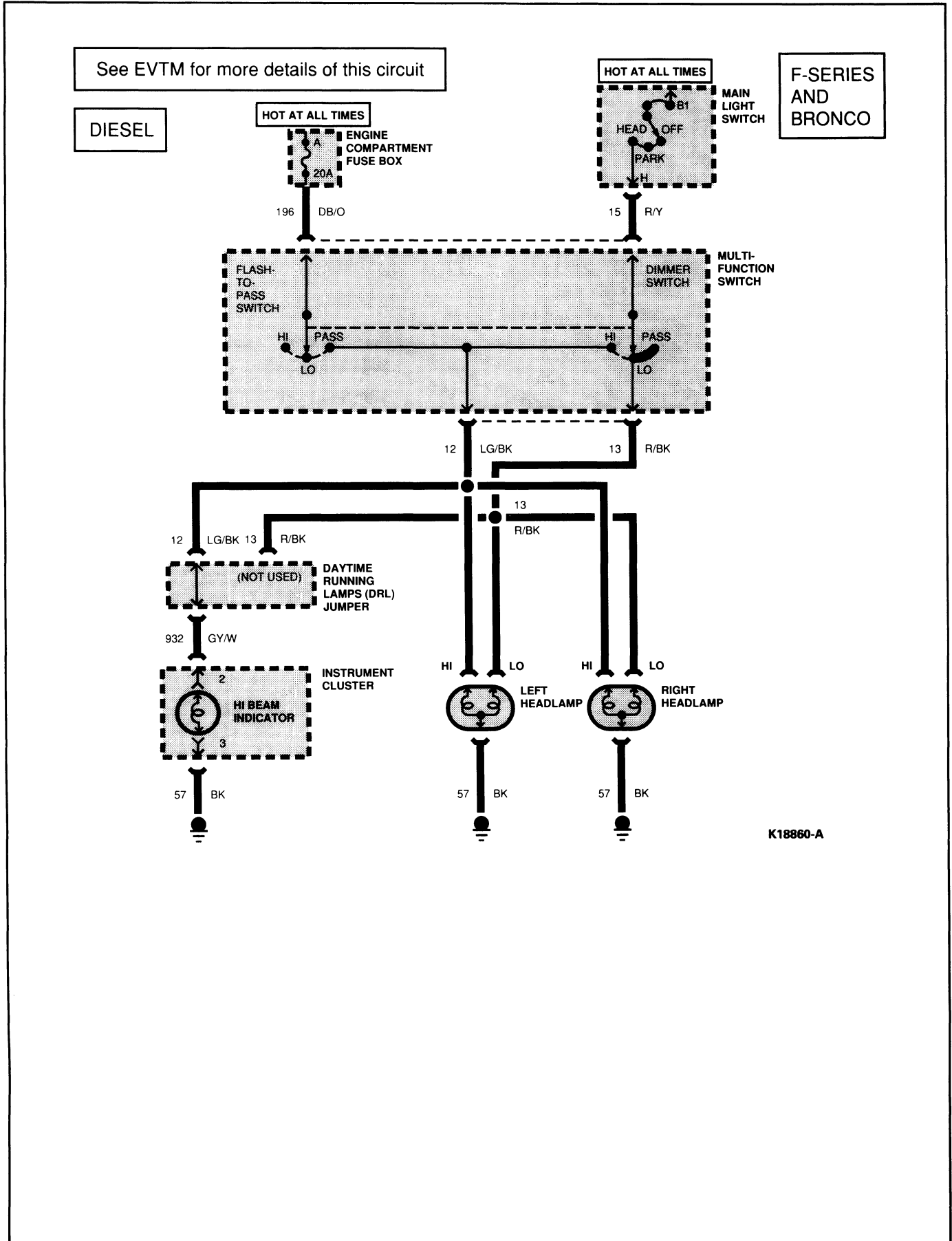
See EVTM for more details of this circuit

ECONOLINE

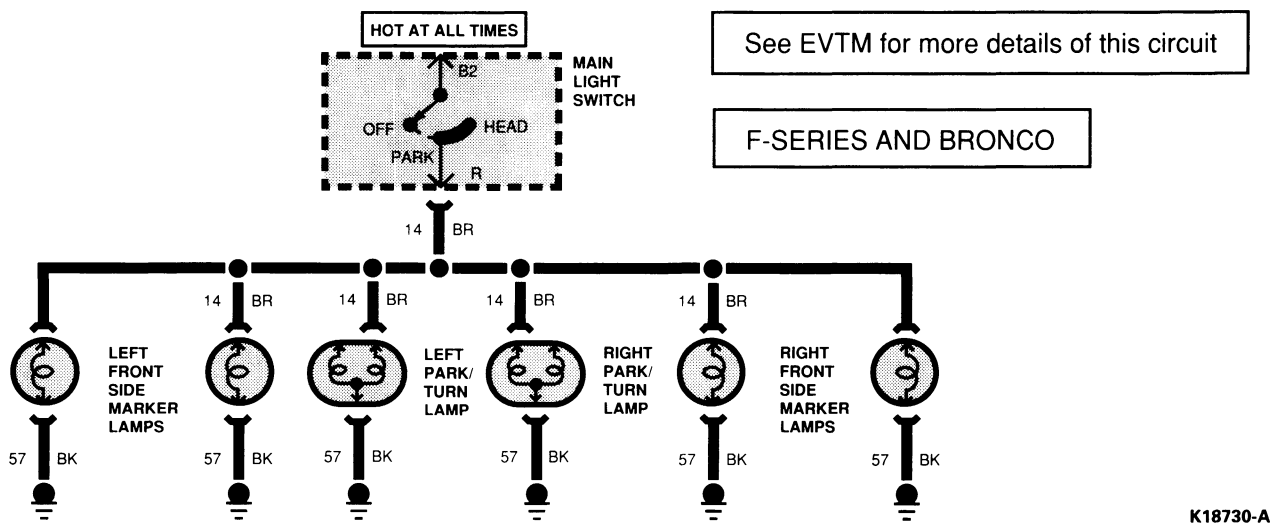
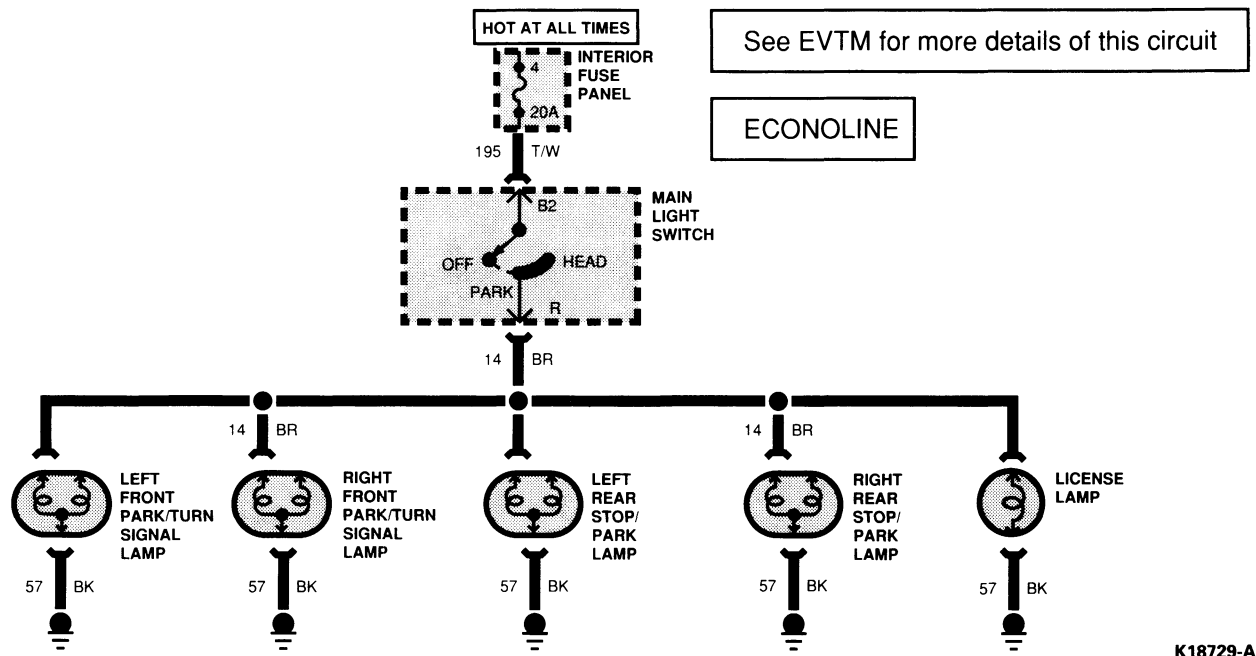


K18861-A

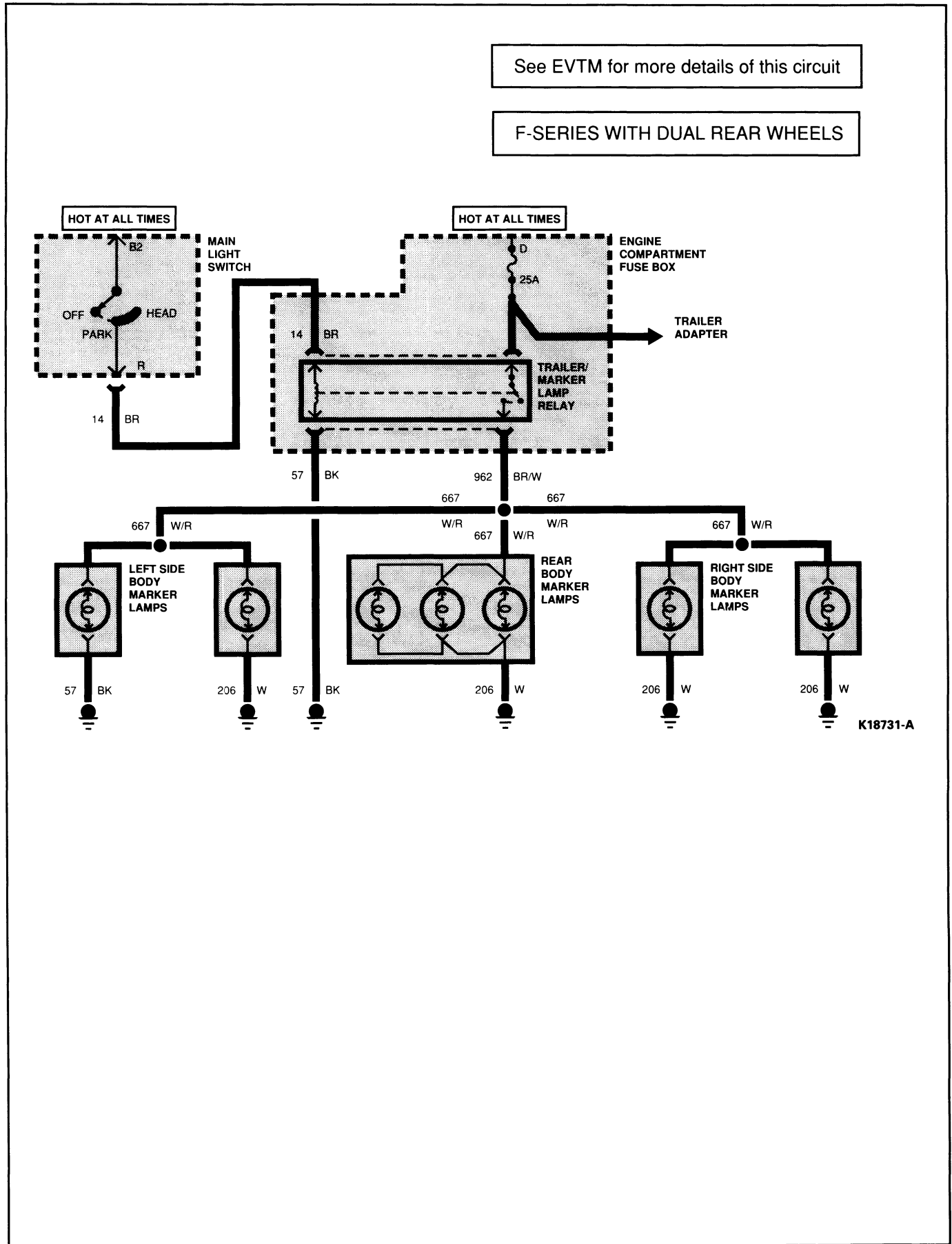
DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)

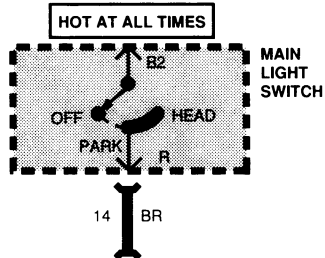


DIAGNOSIS AND TESTING (Continued)

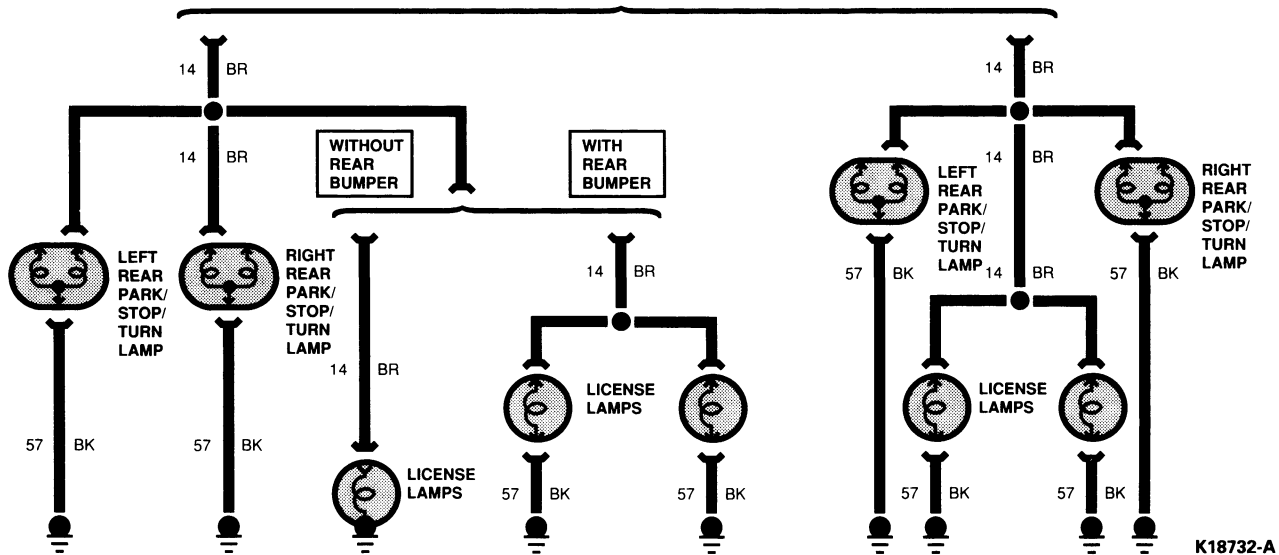
See EVTVM for more details of this circuit

F-SERIES

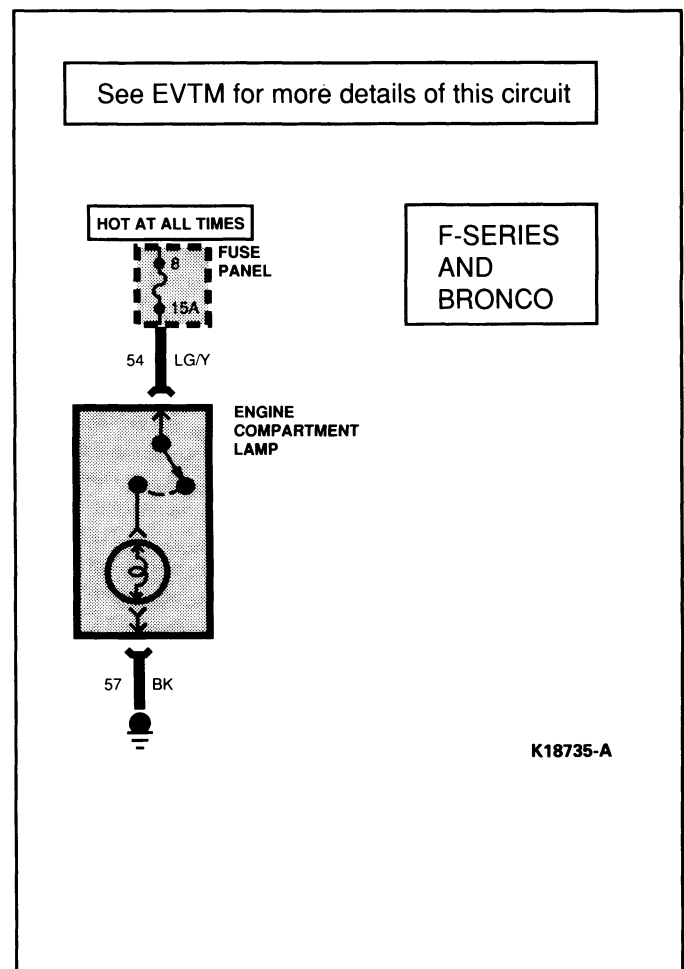
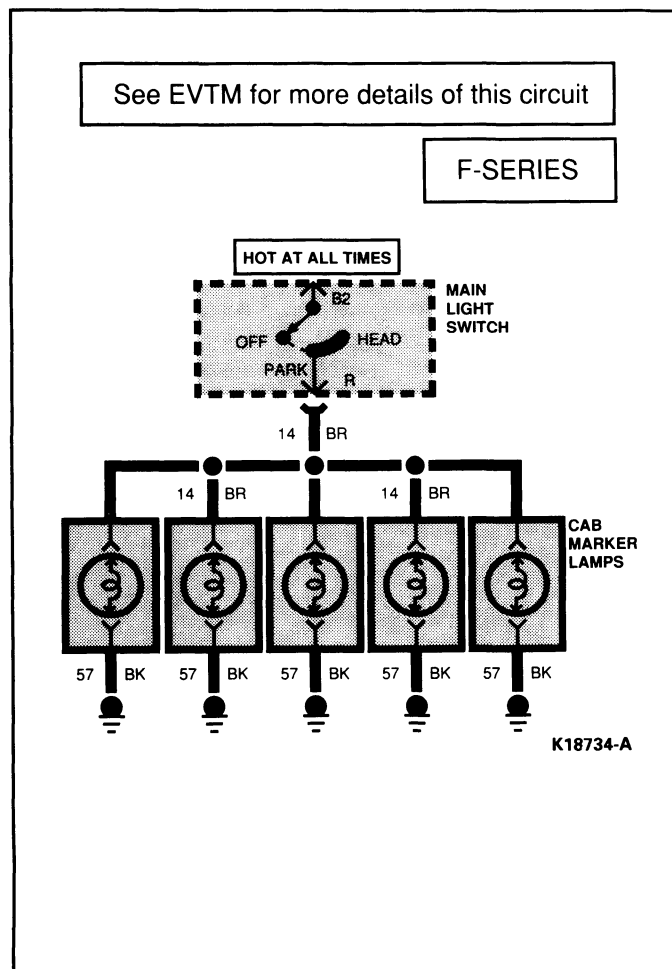
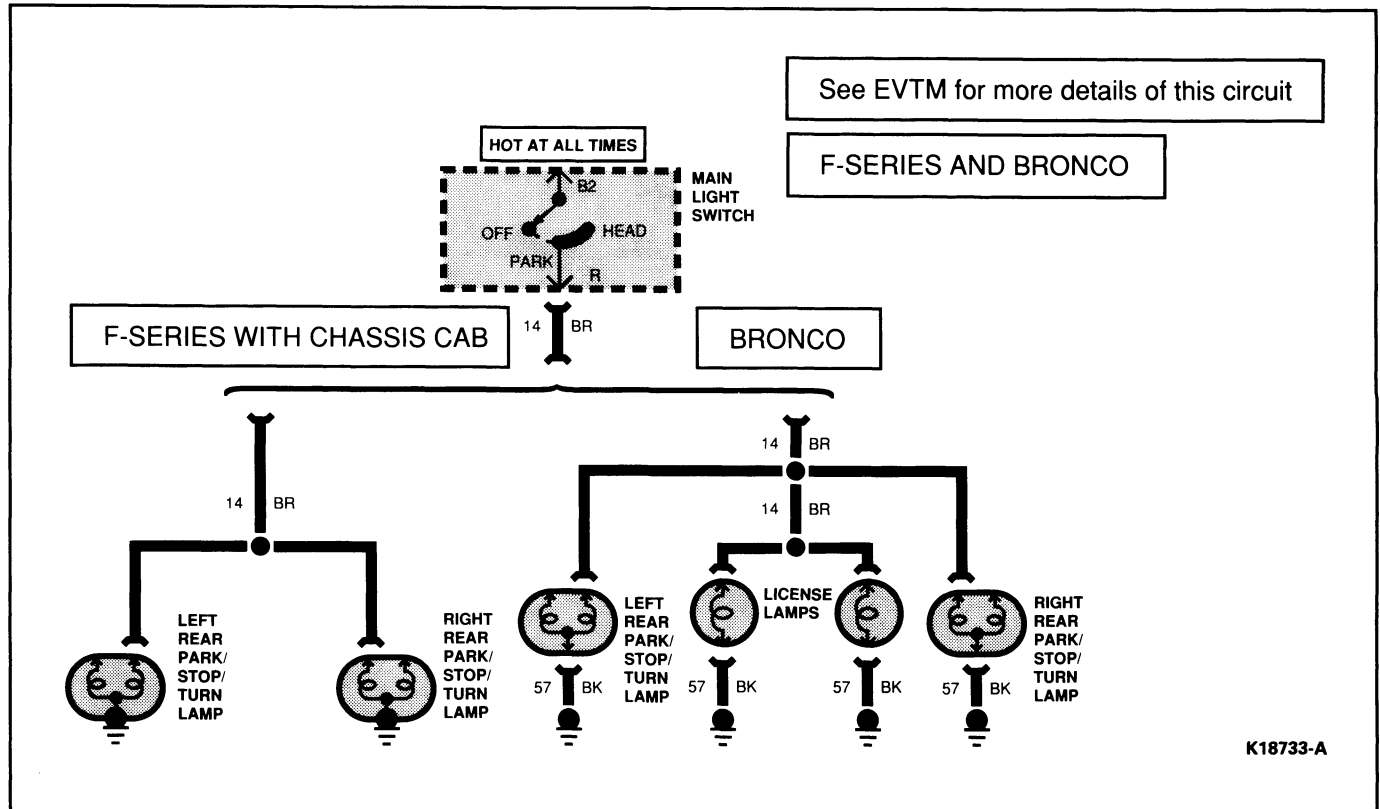
F-SERIES WITHOUT
FLARE SIDE



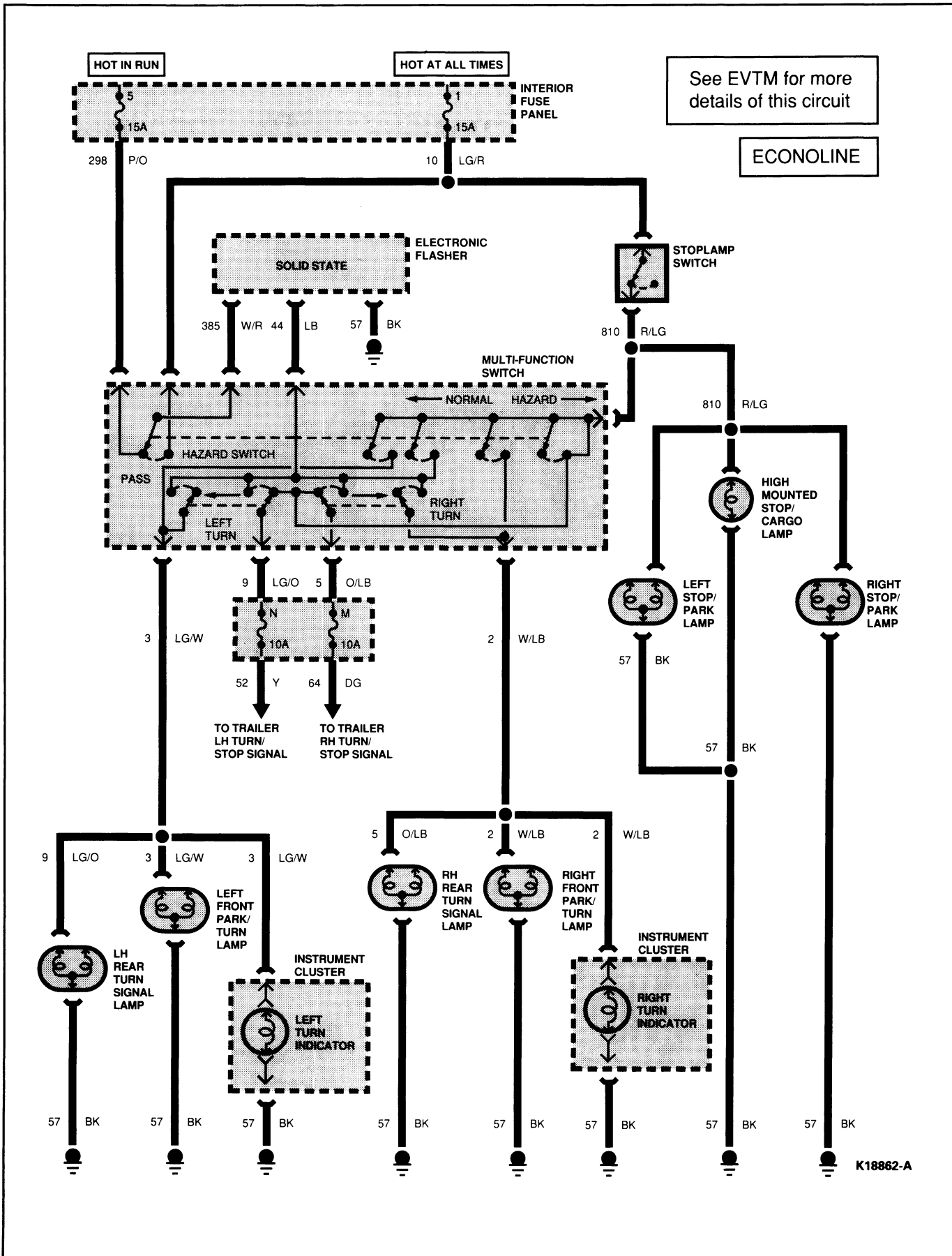
F-SERIES WITH
FLARE SIDE

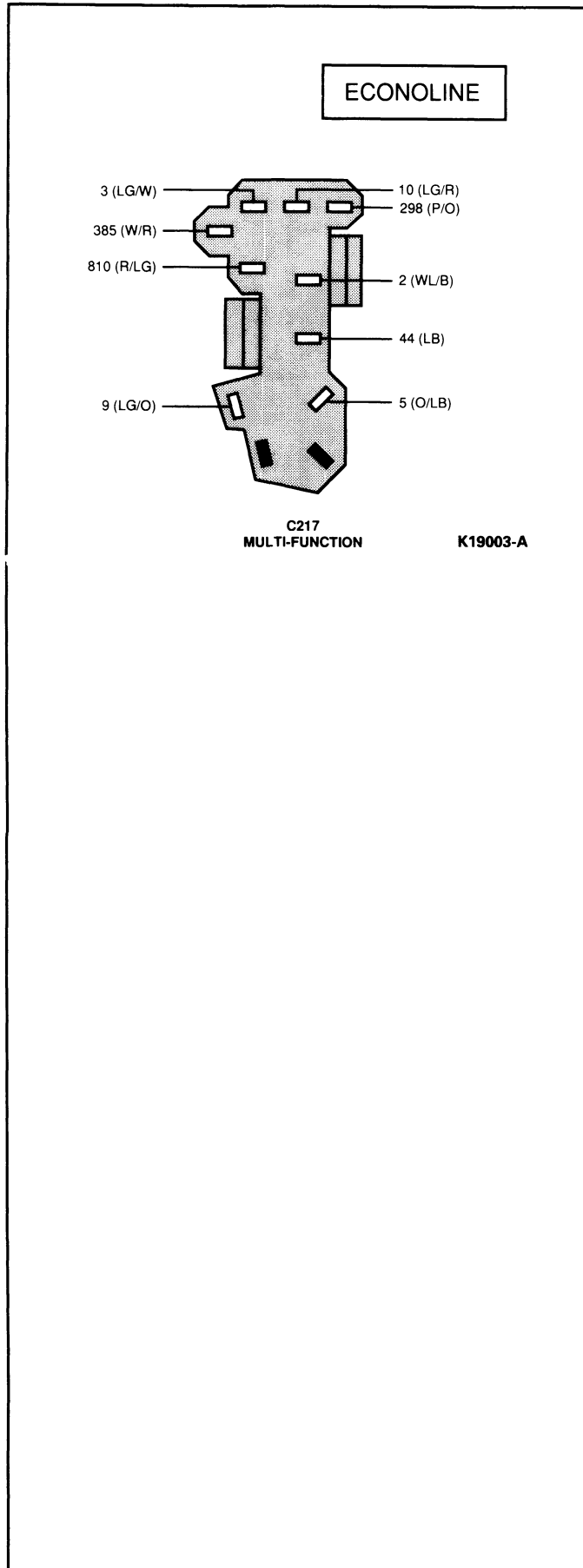


DIAGNOSIS AND TESTING (Continued)

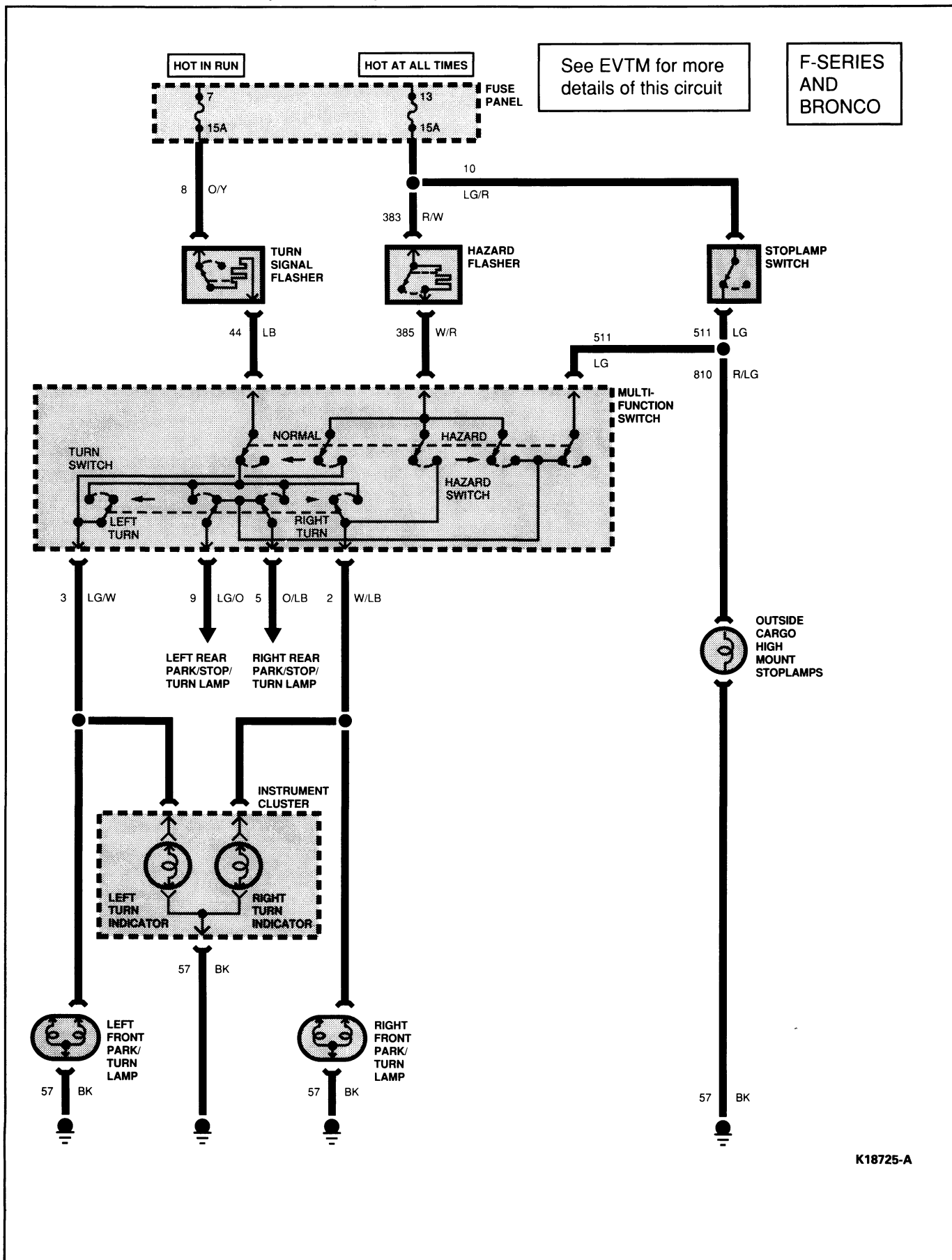


DIAGNOSIS AND TESTING (Continued)



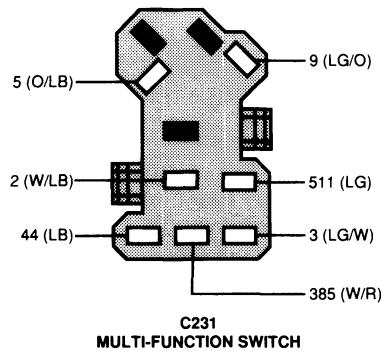
DIAGNOSIS AND TESTING (Continued)

DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)

F-SERIES
AND
BRONCO

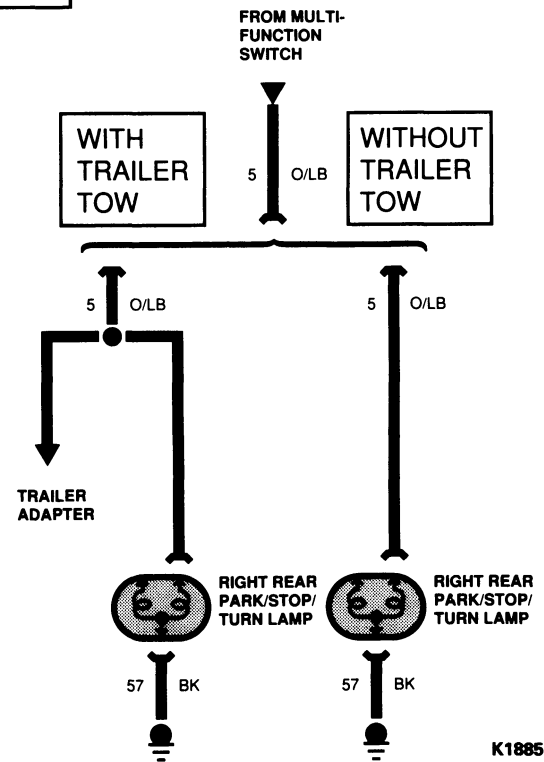
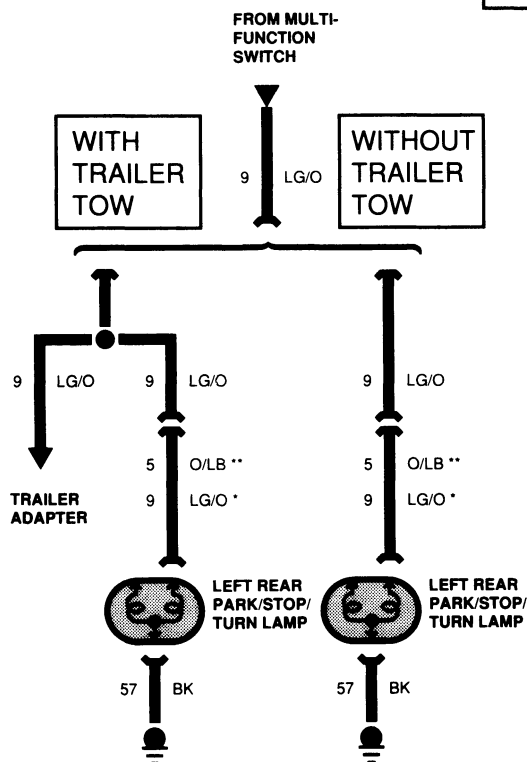


K19004-A

See EVTm for more
details of this circuit

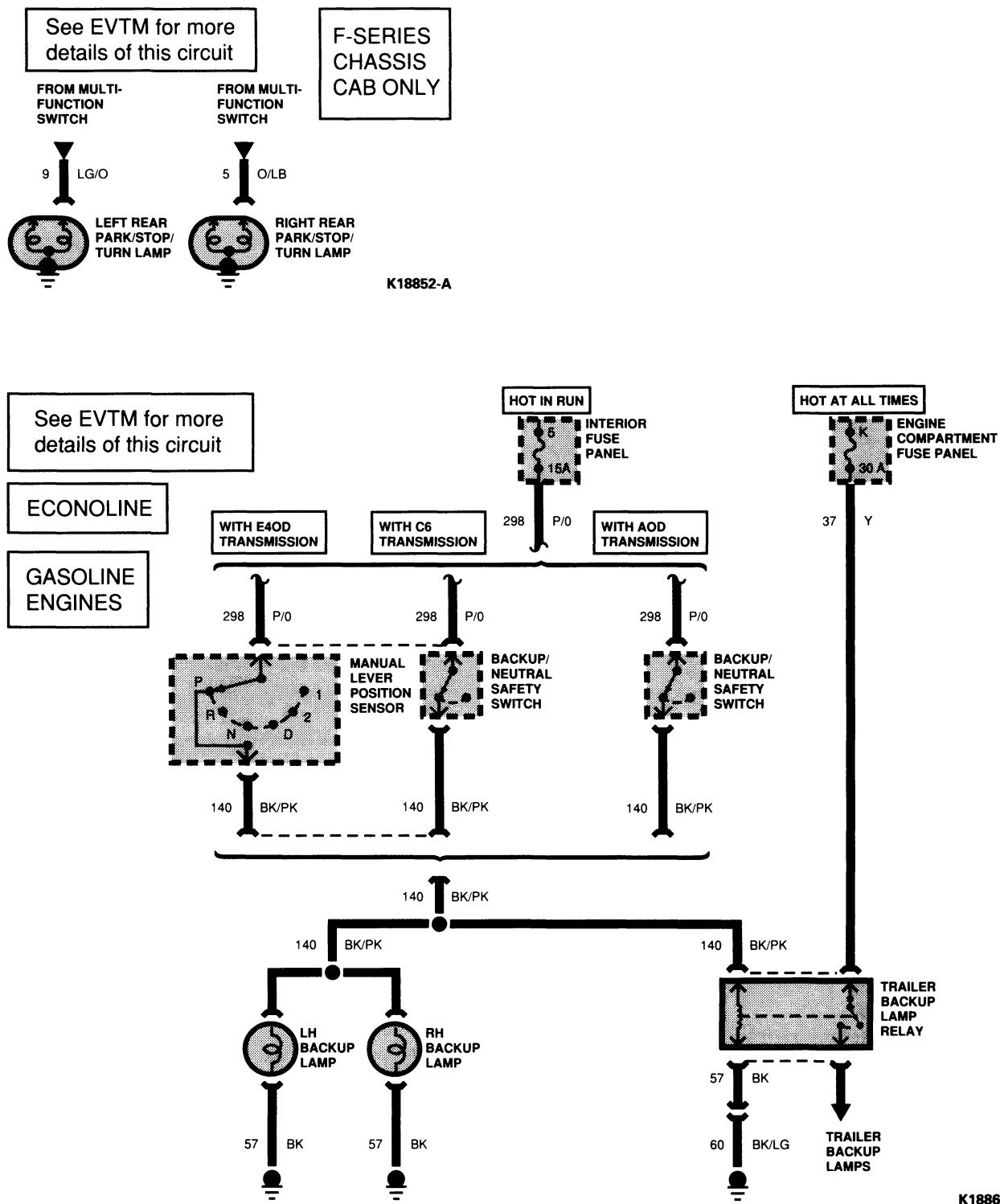
* F-SERIES
**BRONCO AND
FLARE SIDE

ALL EXCEPT
CHASSIS CAB

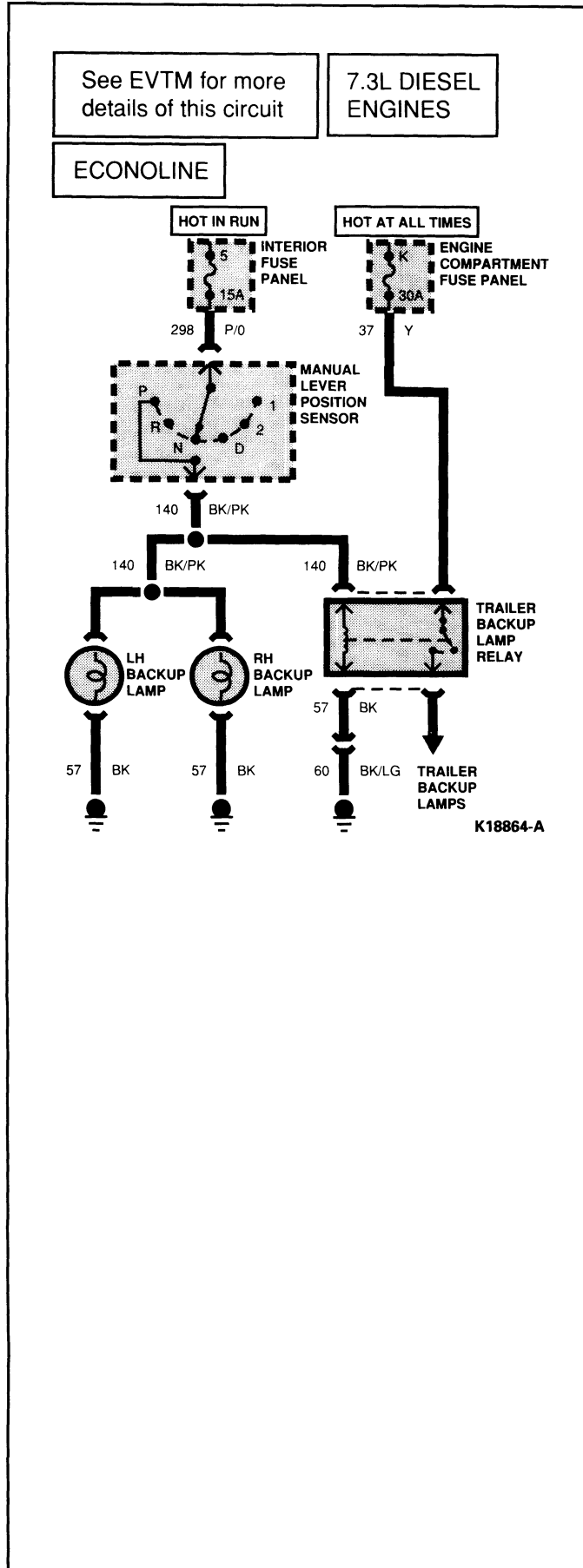


K18851-A

DIAGNOSIS AND TESTING (Continued)



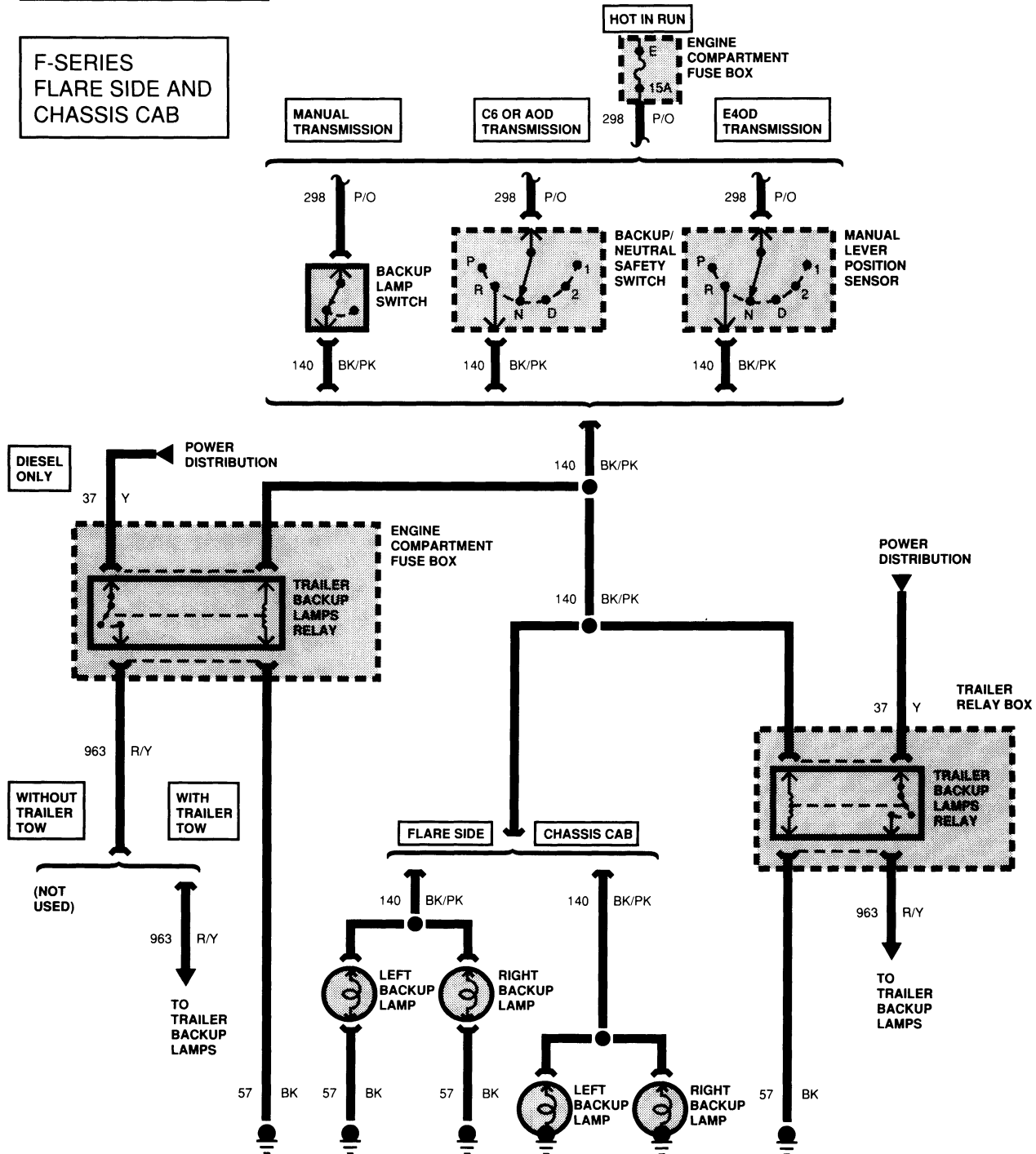
DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)

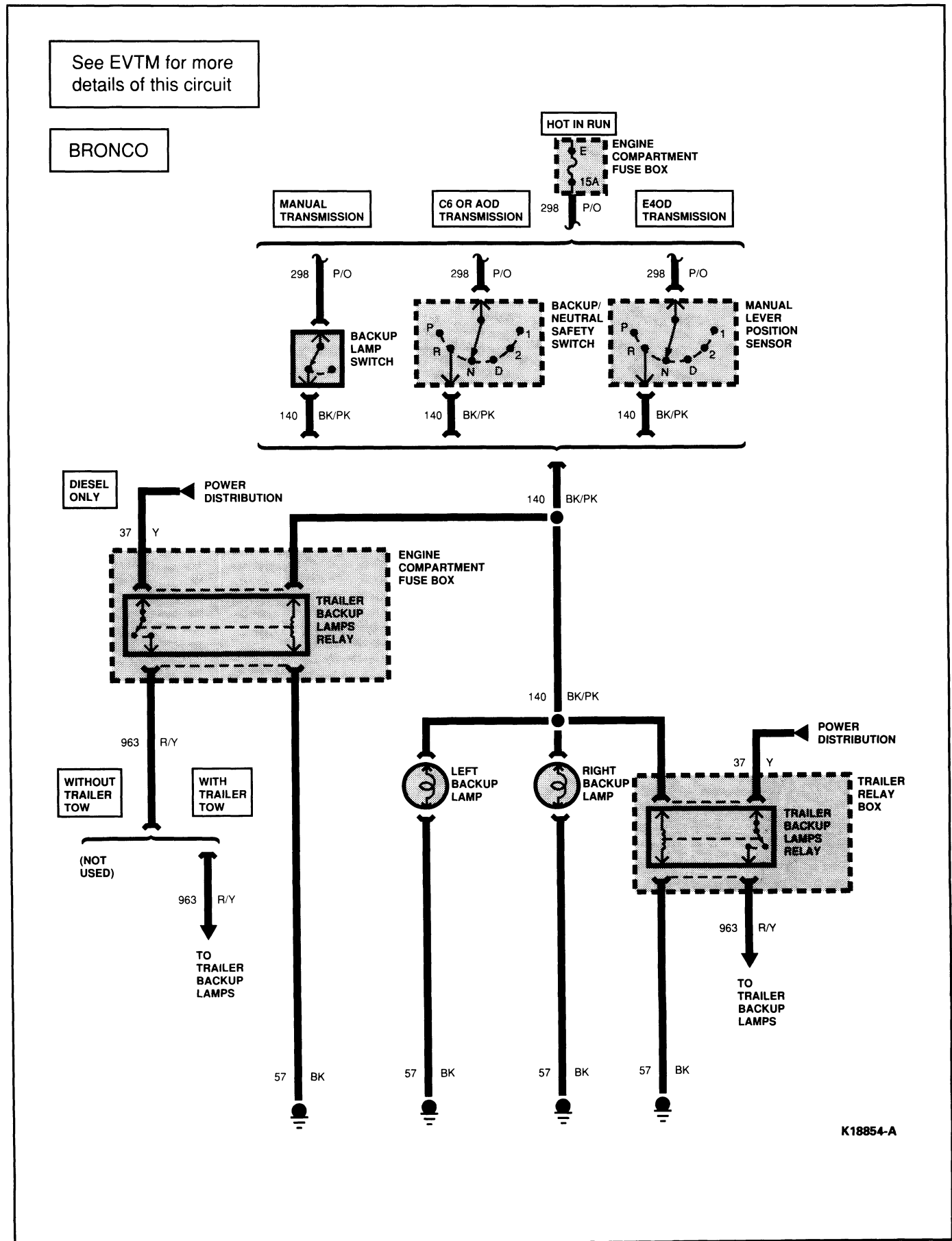
See EVTM for more details of this circuit

F-SERIES
FLARE SIDE AND
CHASSIS CAB



K18853-A

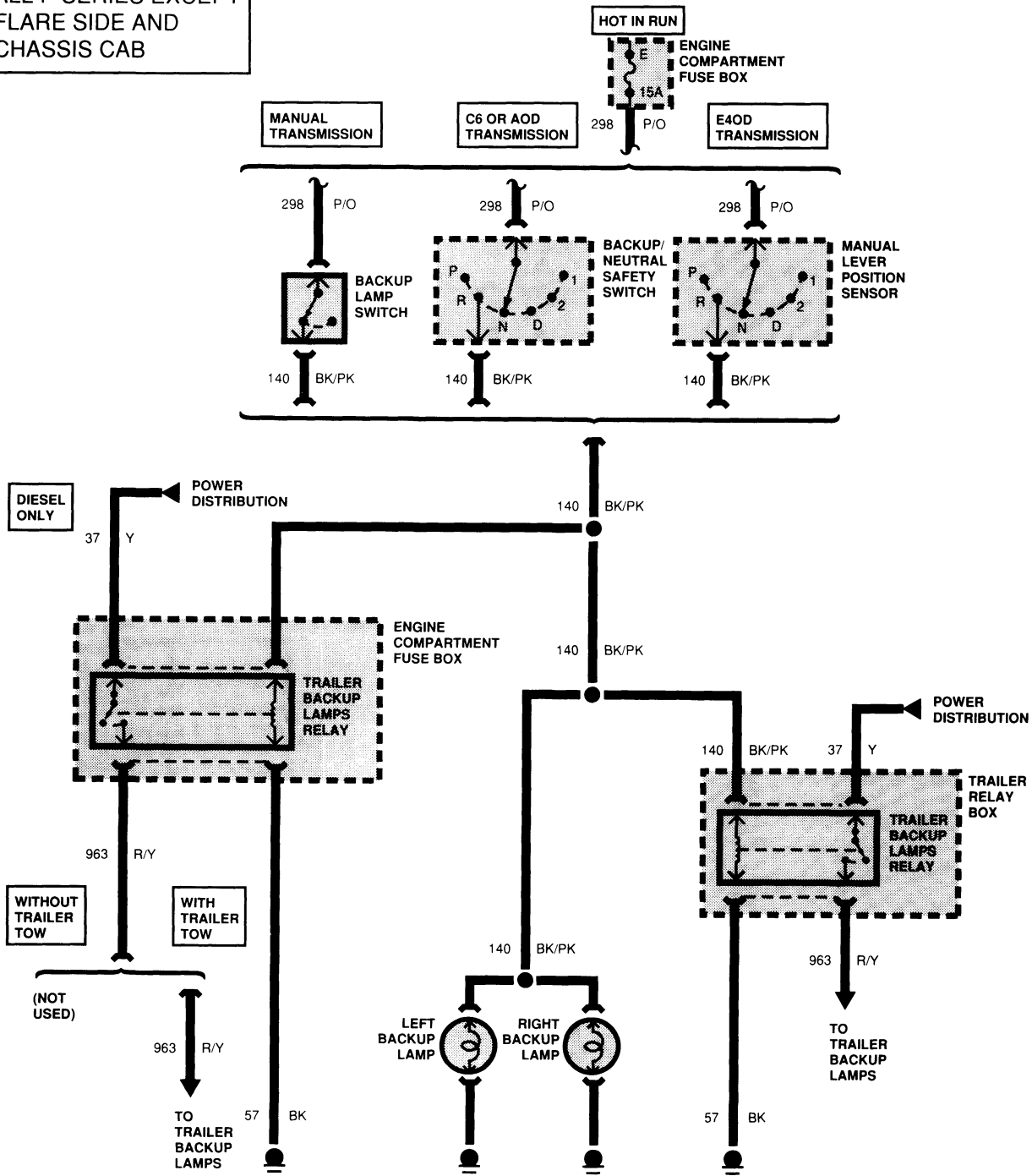
DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)

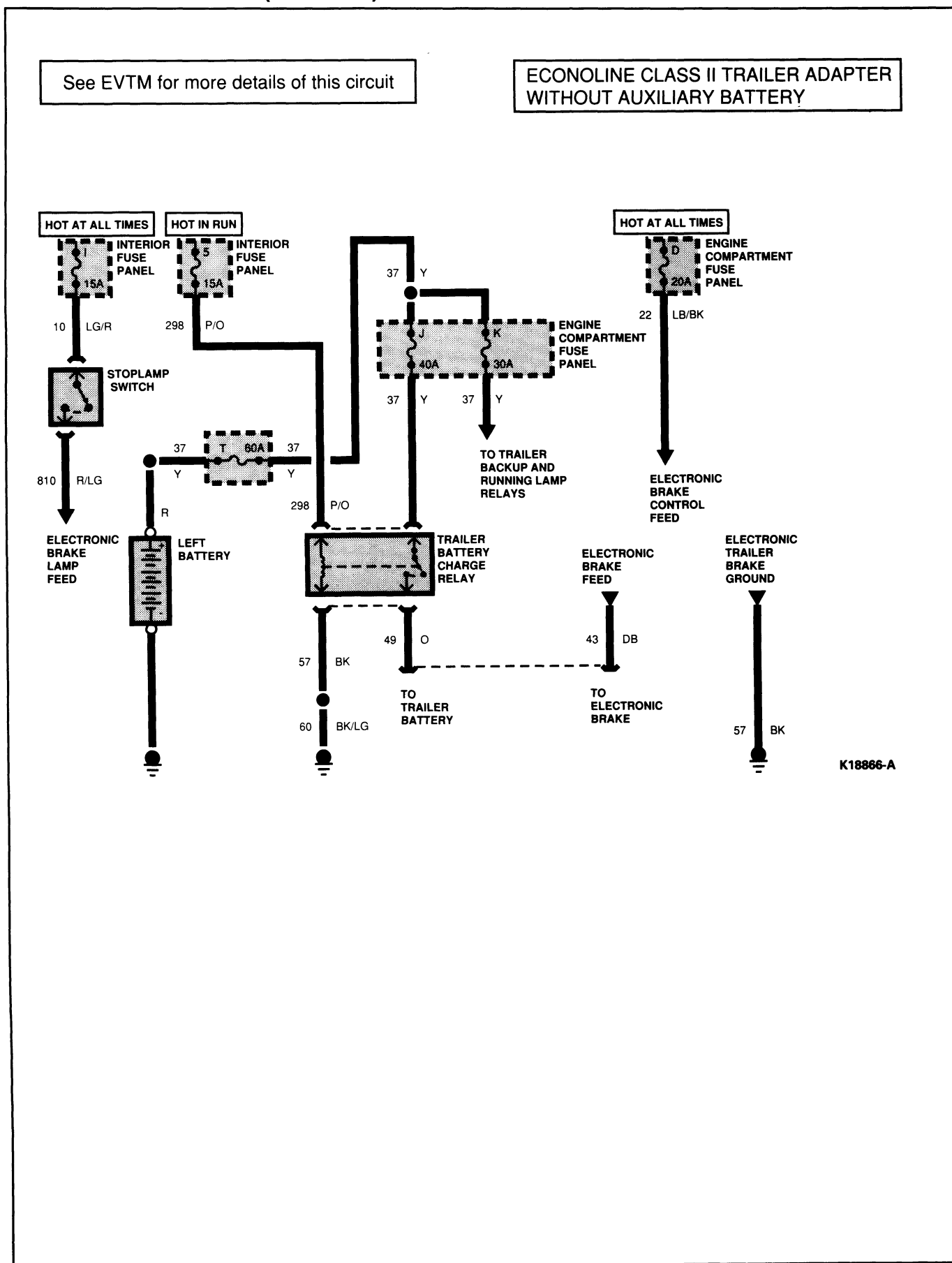
See EVTM for more details of this circuit

ALL F-SERIES EXCEPT FLARE SIDE AND CHASSIS CAB



K18855-A

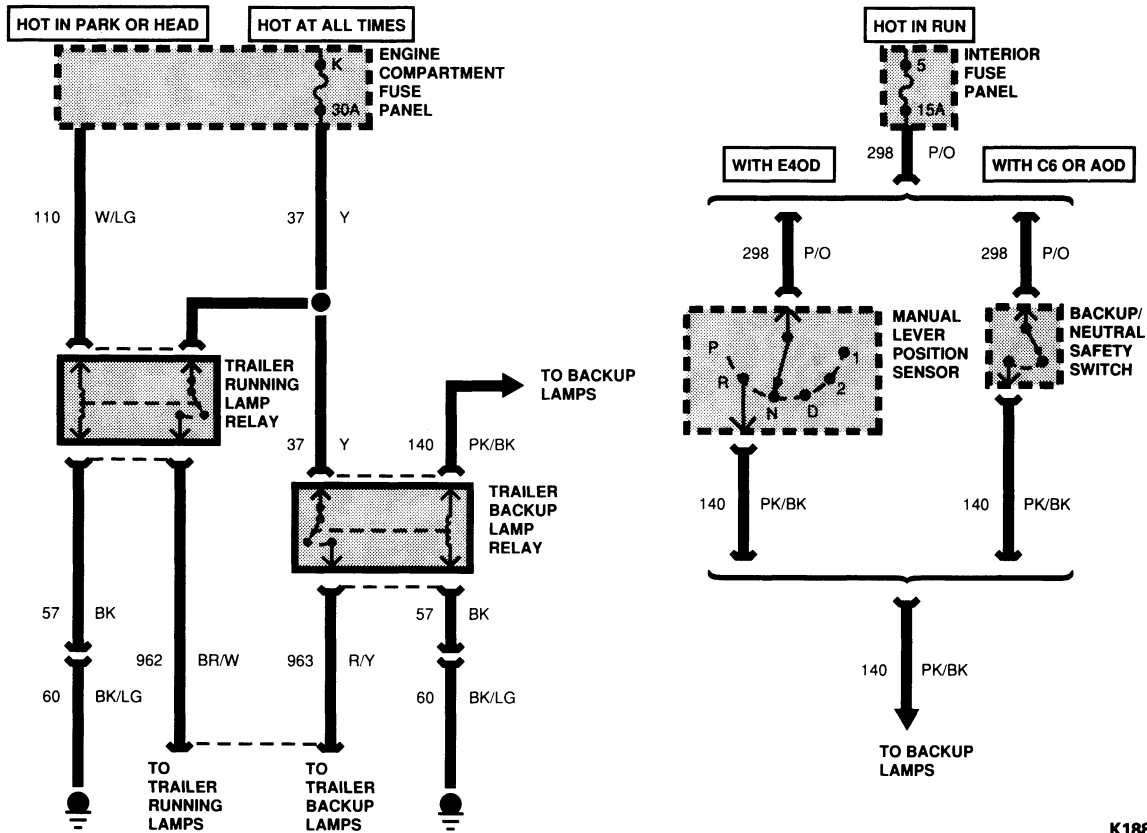
DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)

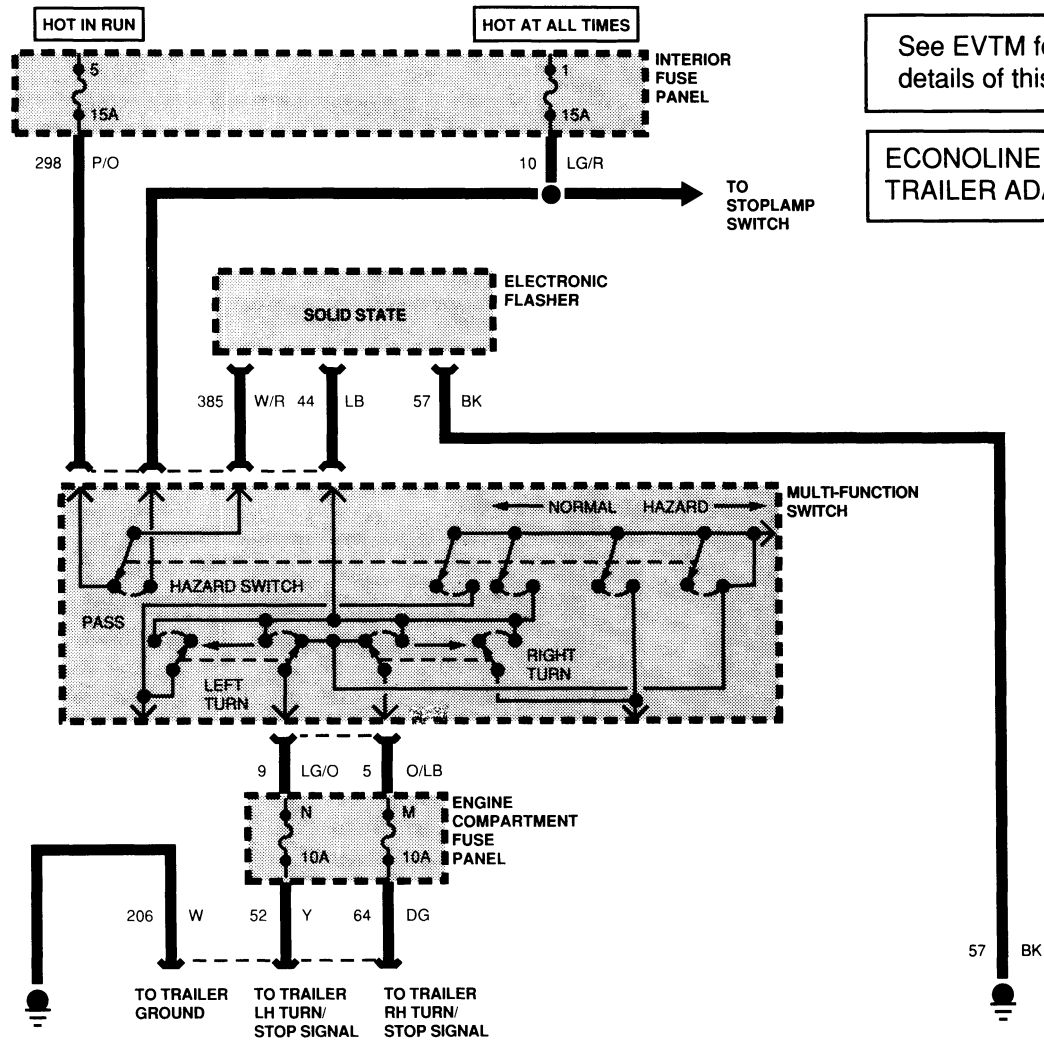
See EVTM for more details of this circuit

ECONOLINE CLASS II TRAILER ADAPTER

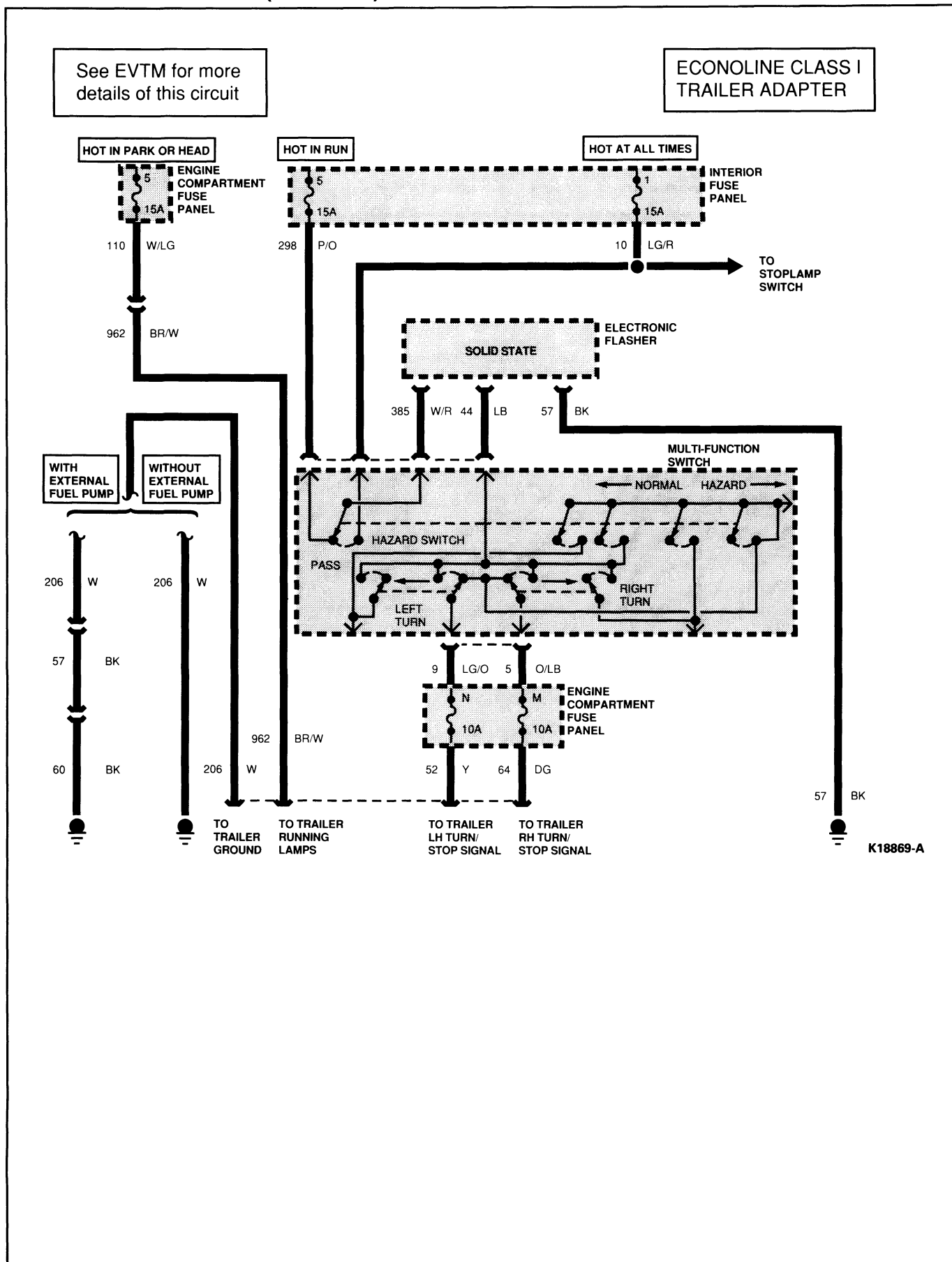


K18867-A

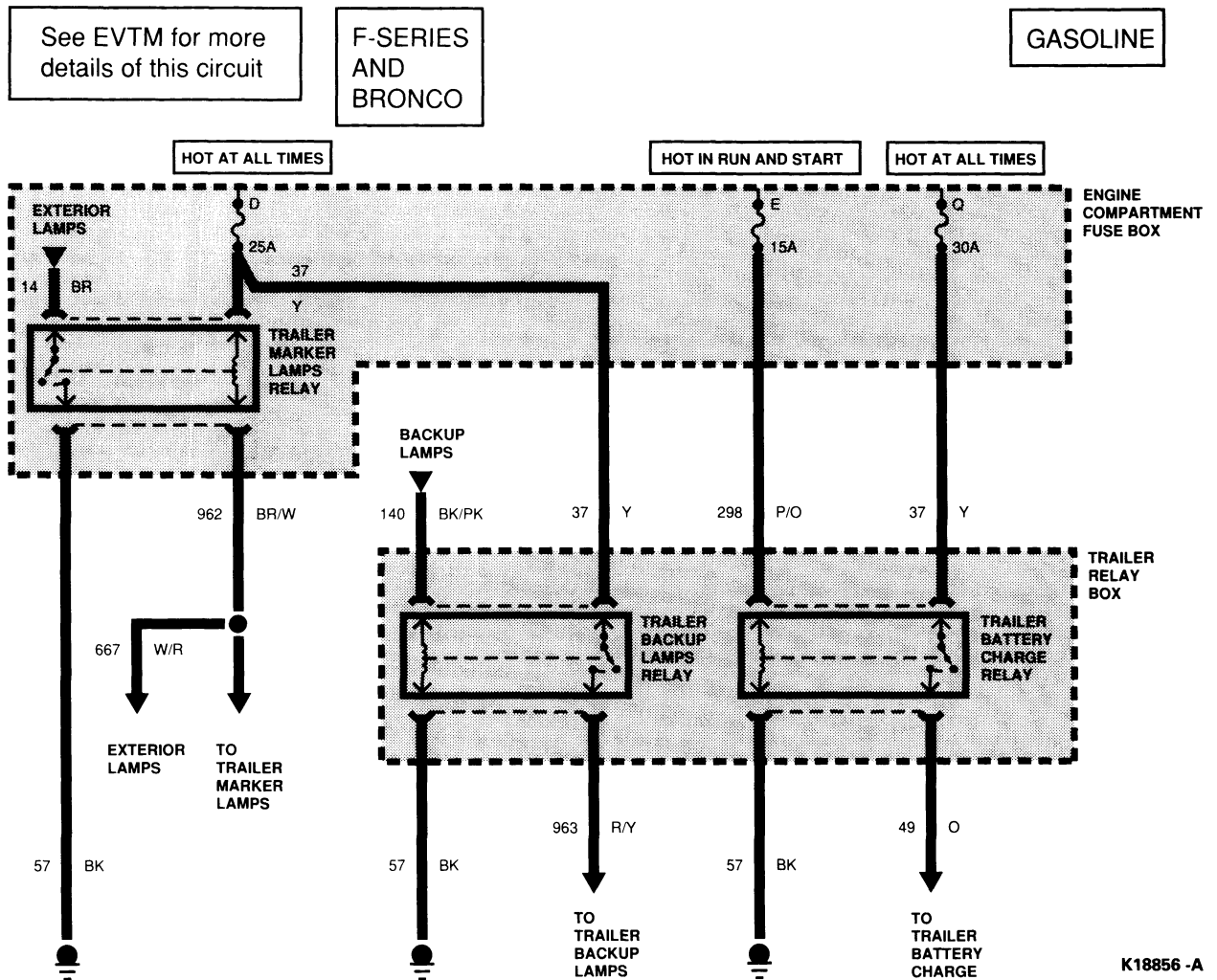
DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)

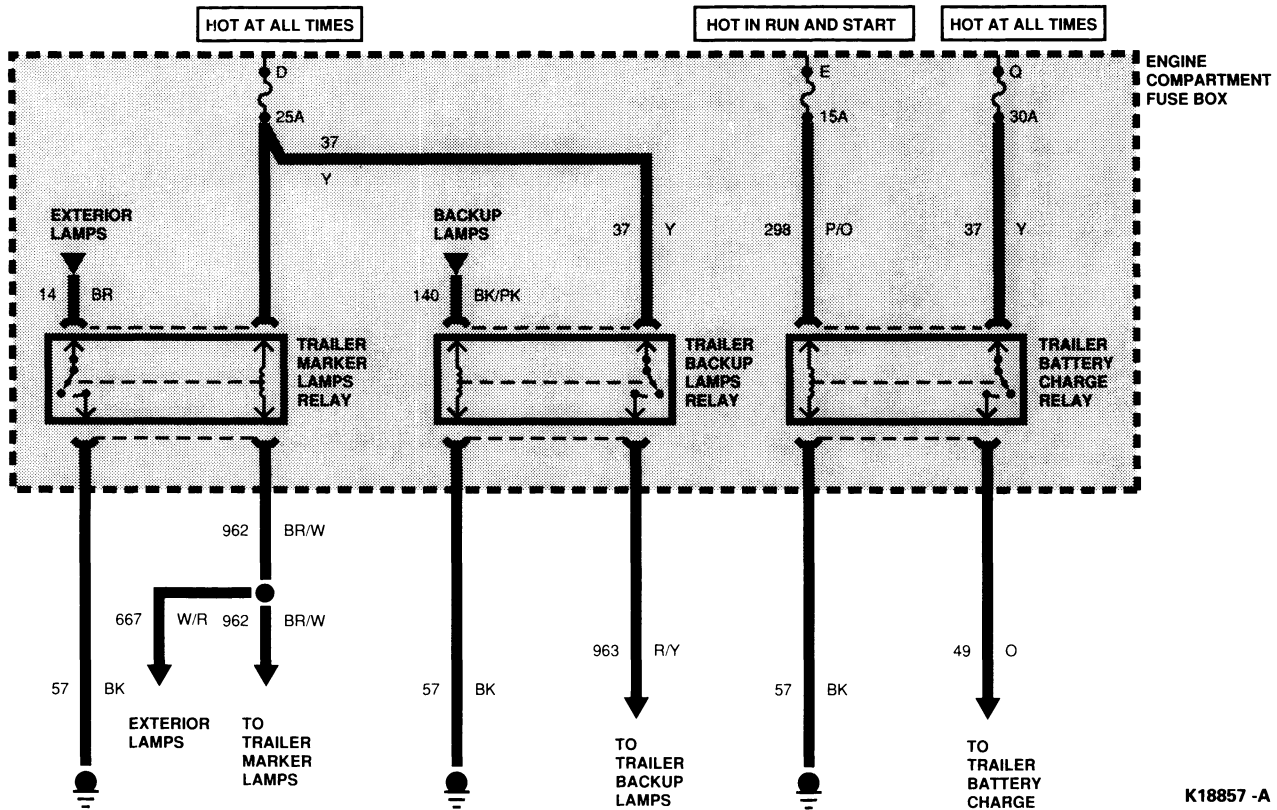


DIAGNOSIS AND TESTING (Continued)

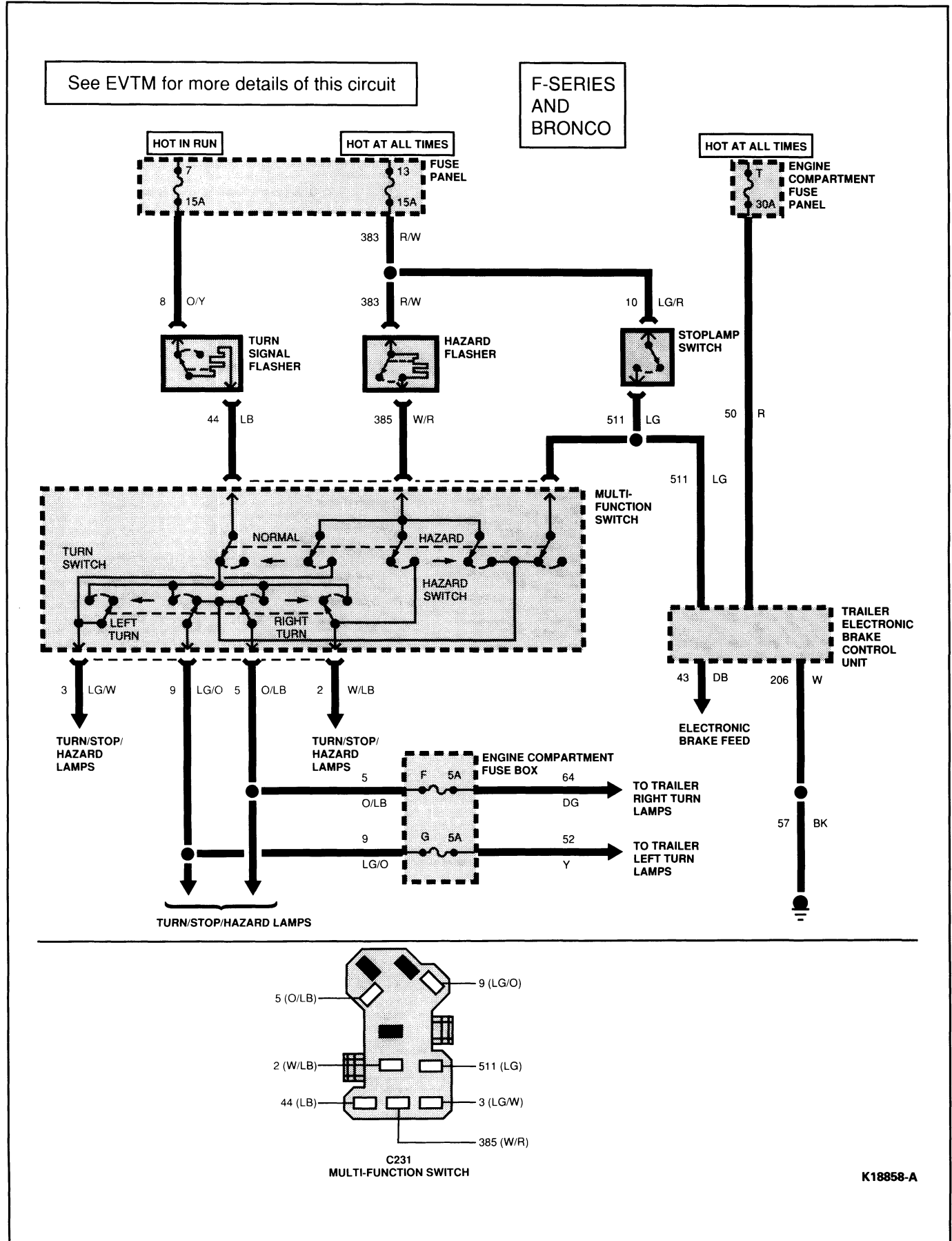
See EVTM for more
details of this circuit

F-SERIES

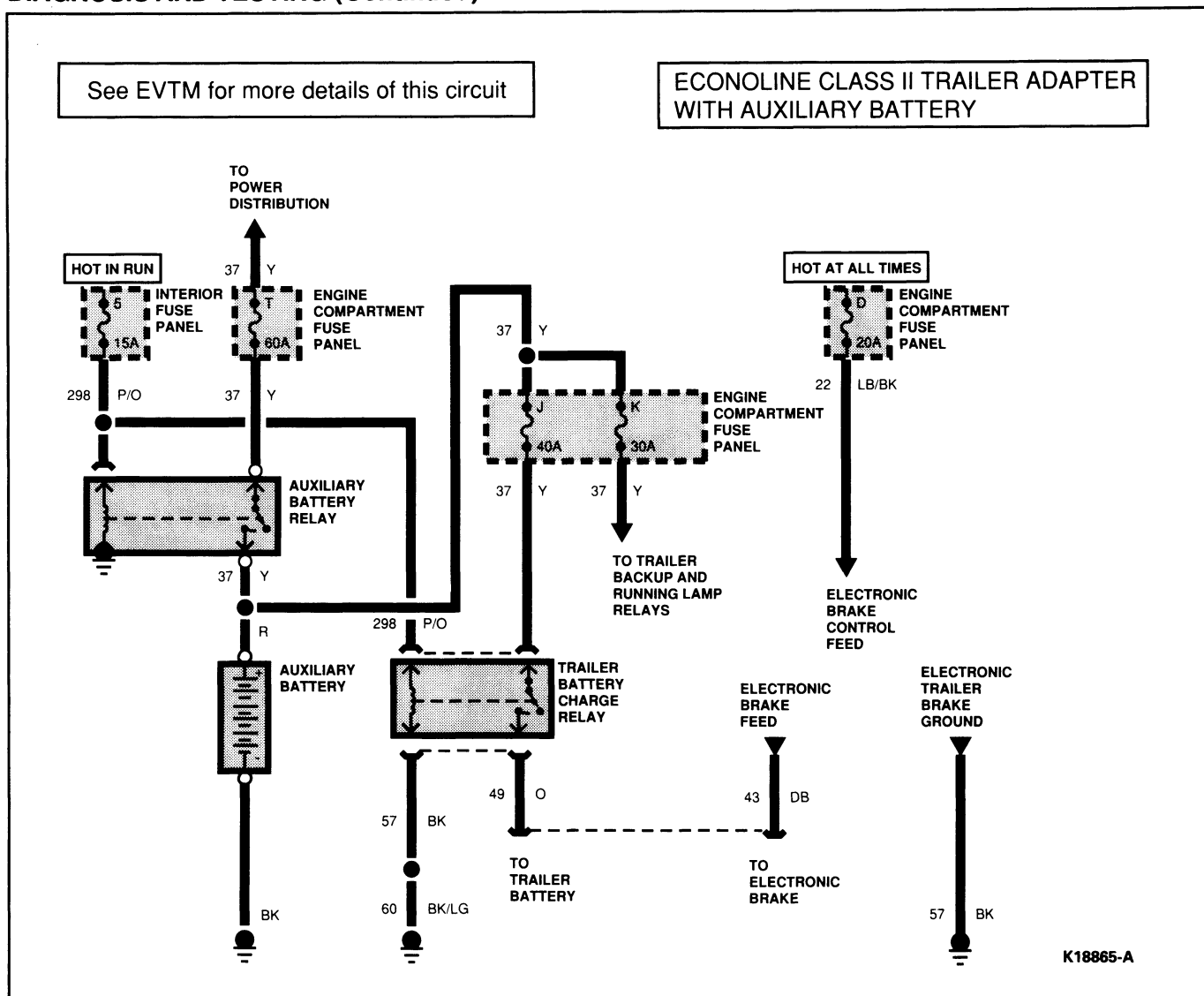
DIESEL



DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)



REMOVAL AND INSTALLATION

Headlamp Bulb and Headlamp Assembly, F-150-250-350, F-Super Duty, E-150-250-350 with Aerodynamic Lamps and Bronco

Removal

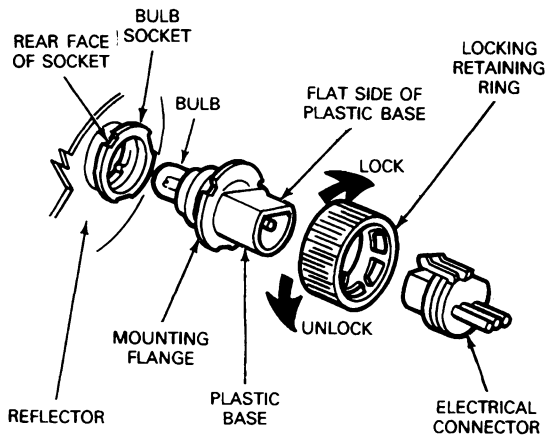
WARNING: THE HALOGEN HEADLAMP BULB CONTAINS GAS UNDER PRESSURE. THE BULB MAY SHATTER IF THE GLASS ENVELOPE IS SCRATCHED OR THE BULB IS DROPPED. HANDLE BULB CAREFULLY. GRASP BULB ONLY BY ITS PLASTIC BASE. AVOID TOUCHING THE GLASS ENVELOPE. KEEP BULB OUT OF REACH OF CHILDREN. ENERGIZE THE BULB ONLY WHEN INSTALLED IN THE HEADLAMP.

- | | |
|---|---|
| <p>Headlamp Bulb and Headlamp Assembly, F-150-250-350, F-Super Duty, E-150-250-350 with Aerodynamic Lamps and Bronco</p> <p>Removal</p> <p>WARNING: THE HALOGEN HEADLAMP BULB CONTAINS GAS UNDER PRESSURE. THE BULB MAY SHATTER IF THE GLASS ENVELOPE IS SCRATCHED OR THE BULB IS DROPPED. HANDLE BULB CAREFULLY. GRASP BULB ONLY BY ITS PLASTIC BASE. AVOID TOUCHING THE GLASS ENVELOPE. KEEP BULB OUT OF REACH OF CHILDREN. ENERGIZE THE BULB ONLY WHEN INSTALLED IN THE HEADLAMP.</p> <ol style="list-style-type: none">1. Check that headlamp switch is in OFF position. | <ol style="list-style-type: none">2. Lift hood and locate bulb installed in rear of headlamp body, all except E-150-250-350, Hi-Series.3. For E-150-250-350, bend back and lift up on two black tabs while holding lamp to vehicle. This will release the lamp from the installed position.4. Remove electrical connector from bulb by grasping wires firmly and snapping connector rearward.5. Remove bulb retaining ring by rotating counterclockwise (when viewed from rear) about one-eighth turn and sliding ring off plastic base. Keep ring as it may be used again to retain new bulb. |
|---|---|

2. Lift hood and locate bulb installed in rear of headlamp body, all except E-150-250-350, Hi-Series.
3. For E-150-250-350, bend back and lift up on two black tabs while holding lamp to vehicle. This will release the lamp from the installed position.
4. Remove electrical connector from bulb by grasping wires firmly and snapping connector rearward.
5. Remove bulb retaining ring by rotating counterclockwise (when viewed from rear) about one-eighth turn and sliding ring off plastic base. Keep ring as it may be used again to retain new bulb.

REMOVAL AND INSTALLATION (Continued)

6. Carefully remove headlamp bulb from socket in reflector by gently pulling straight backward out of socket. Do not rotate bulb during removal.



K11948-1B

Installation

1. With flat side of plastic base of bulb facing upward, insert glass envelope of bulb into socket. Turn base slightly to left or right, if necessary, to align grooves in forward part of plastic base with corresponding locating tabs inside socket. When grooves are aligned, push bulb firmly into socket until mounting flange on base contacts rear face of socket.

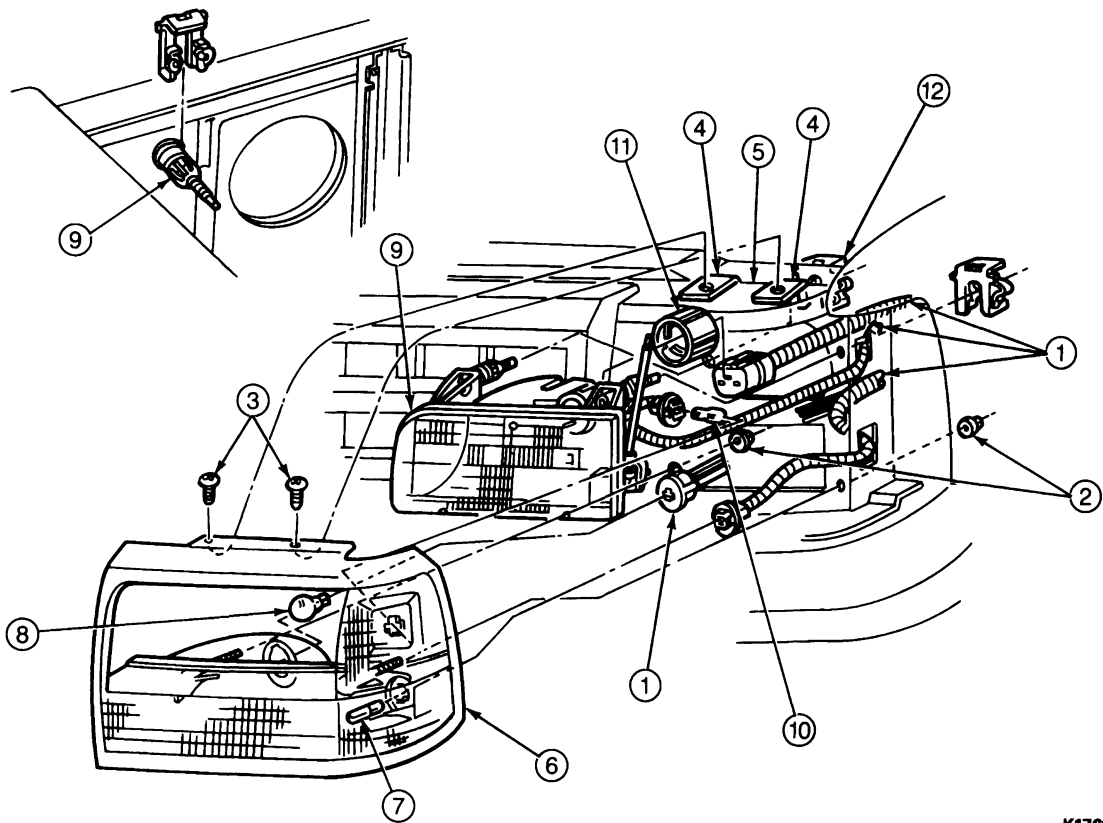
CAUTION: Bulbs #9004 and #9007 look similar but are not interchangeable.

2. Slip bulb retaining ring over rear of plastic base against mounting flange. Lock ring into socket by rotating ring clockwise. A stop will be felt when retaining ring is fully engaged.
3. Push electrical connector into rear of plastic base until it snaps and locks into position.
4. Ford E-150-250-350, Hi Series, position lamp into opening and hold while pushing the two black tabs downward to engage the ends of the adjuster screws. Make sure that a snap is heard to verify that the tabs are engaged.
5. Check lamp to see if it is seated securely. If it is loose, install again and make sure the three adjuster screws are engaged.
6. Turn headlamps on and check for proper operation.

NOTE: A properly aimed headlamp normally need not be re-aimed after installation of this bulb. A burned-out bulb should not be removed from the headlamp reflector until just before a replacement bulb is to be installed. Removal of a bulb for an extended period of time may allow contaminants (dust, moisture, smoke) to enter the headlamp body and affect the performance of the headlamp. When servicing the headlamp bulb, energize the bulb only while it is contained within the headlamp body.

REMOVAL AND INSTALLATION (Continued)

Headlamp Assembly, F-Series and Bronco

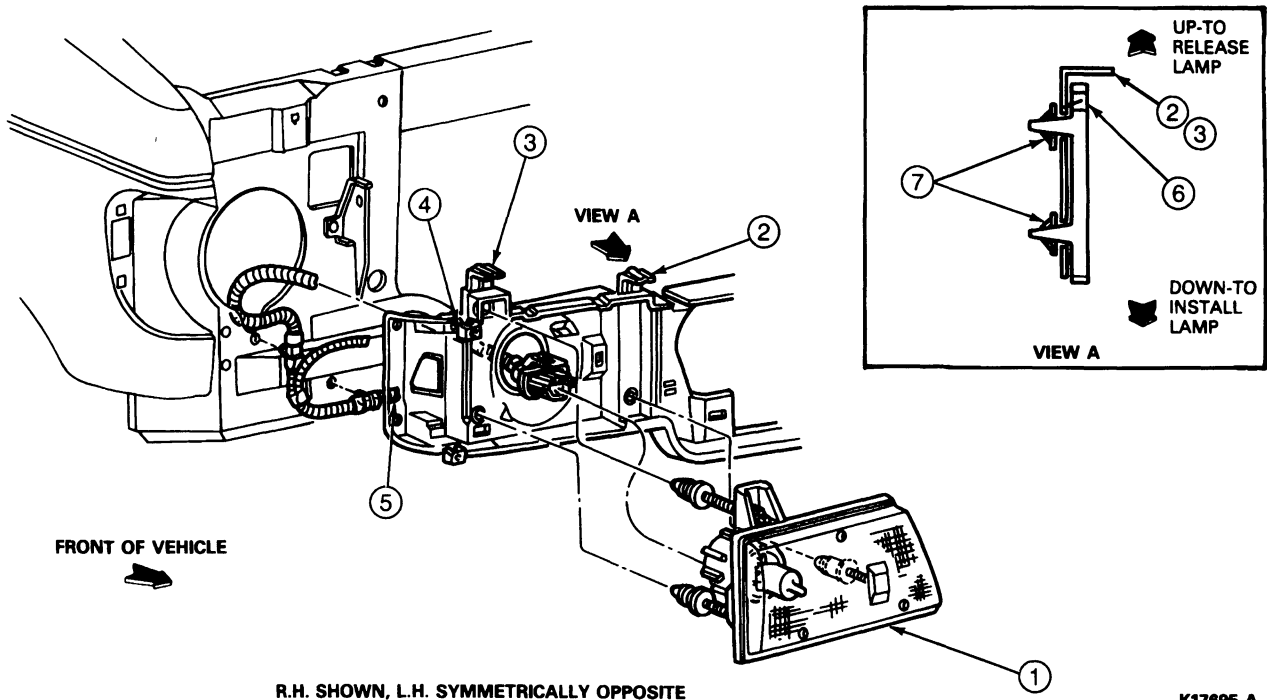


K17693-A

Item	Part Number	Description
1	12A581	Wiring Assembly
2	N621906-S55M	Nut and Washer 4-7 N·m (36-61 In·Lb)
3	N801603-S55	Screw 1.4-2.3 N·m (13-20 In·Lb)
4	N806851-S100	J-Nuts
5	8A164A	Grille Opening Reinforcement

Item	Part Number	Description
6	13043	Headlamp Door
7	13N019	Bulb #916
8	13465	Bulb #3157
9	13005	Headlamp Assembly
10	13465	Bulb #194 NA
11	13N019	Headlamp Bulb Retainer
12	13N020	Headlamp Retainer Clip

(Continued)

REMOVAL AND INSTALLATION (Continued)**Headlamp Assembly, E-150-250-350, HI Series**

K17695-A

Item	Part Number	Description
1	13305 (R.H.) 13306 (L.H.)	Headlamp Assembly
2	13N020	Attaching Bracket — Inboard (Black Tab)

(Continued)

Item	Part Number	Description
3	13N020	Attaching Bracket — Outboard (Black Tab)
4	N806511-S32	Spring Nut
5	14290	Wiring Assembly
6	Ref.	Locating Tab
7	N806882-S	Push Nut

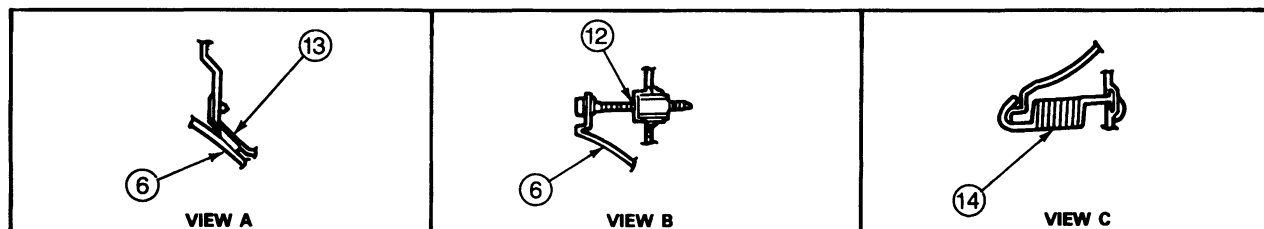
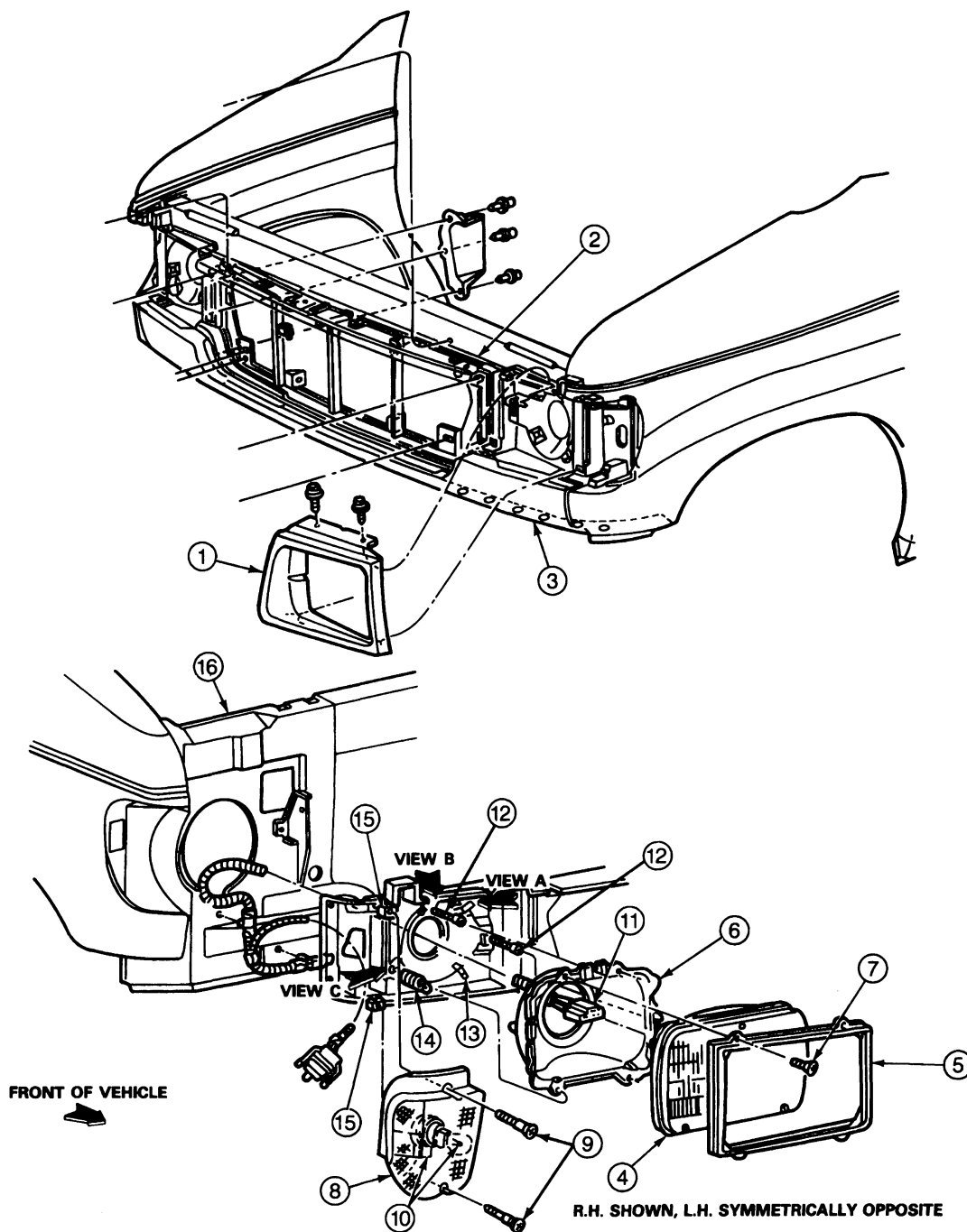
Headlamp Bulb Assembly, E-150-250-350, Lo-Series (Sealed-Beam)**Removal and Installation**

1. Remove the two screws retaining the top of the headlamp door. Pull forward and up to disengage the lower locating tabs.
2. Remove the four retaining screws and remove the retaining ring. Do not disturb the aim adjusting screw settings.

3. Pull the headlamp bulb assembly forward and disconnect the wiring assembly plug from the bulb.
4. For installation follow removal procedures in reverse order. Make sure to adjust the headlamp aim using the Rotunda Headlamp Aiming Kit 107-00001 or equivalent if required.

REMOVAL AND INSTALLATION (Continued)

Headlamp Assembly, E-150-250-350, Lo-Series



K17697-A

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	13052 (R.H.) 13064 (L.H.)	Headlamp Door
2	Ref.	Radiator Grille Opening
3	Ref.	Stone Deflector
4	13007	Bulb Assembly
5	13018	Retaining Ring
6	13047 (R.H.) 13037 (L.H.)	Adjusting Ring
7	390723	Screw 2-3 N·m (18-24 In-Lb)
8	13200 (R.H.) 13201 (L.H.)	Park and Turn Lamp Assembly

(Continued)

Item	Part Number	Description
9	N806505-S49	Screw 1.0-2.0 N·m (9-17 In-Lb)
10	Ref.	Bulb and Connector Assembly
11	—	Connector — To Headlamp Bulb
12	13A093	Adjustment Screw and Nut
13	13B160	Bearing
14	13031	Spring
15	N806511	Spring Nut
16	Ref.	Radiator Support

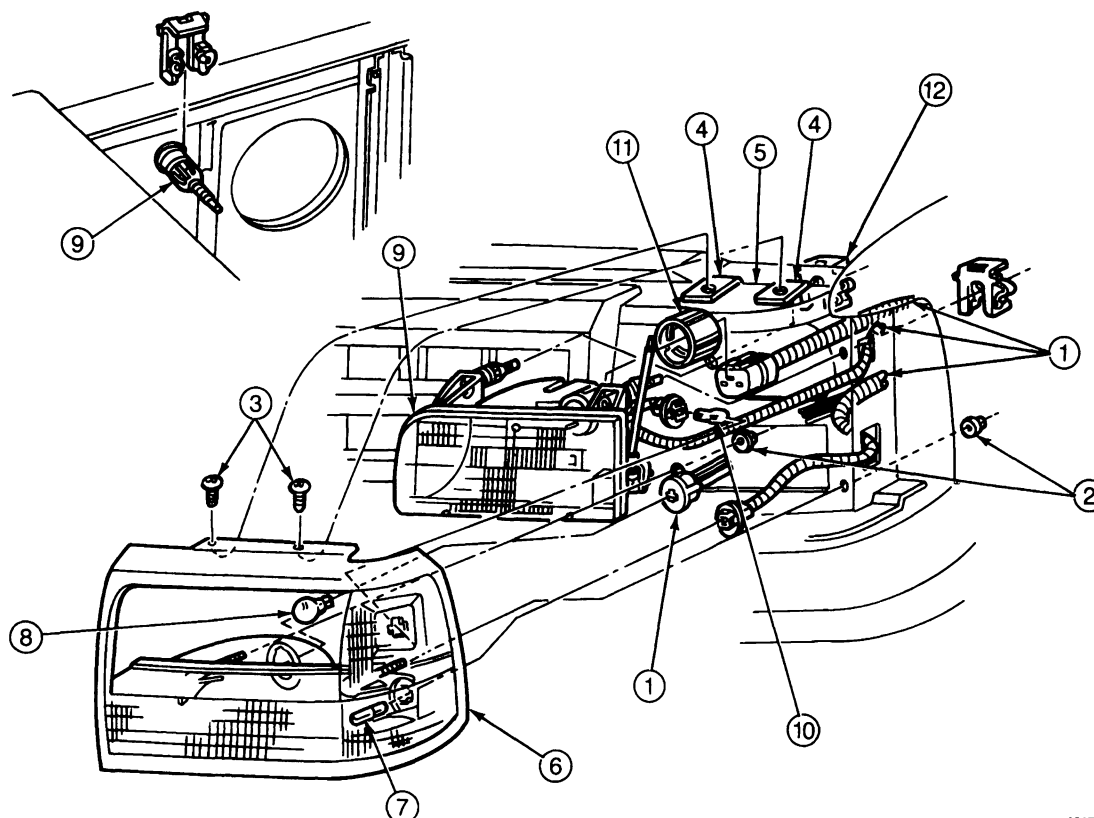
Headlamps, F-Series/Bronco**Removal**

1. Remove two screws and two nuts retaining door assembly.
2. Pull door assembly from vehicle and remove three bulbs and sockets.
3. Disconnect wiring from headlamp bulb.
4. Remove two retainers attaching upper two attachments of headlamp.
5. Turn horizontal adjuster completely out of the adjusting nut.
6. Pull headlamp from vehicle.

Installation

1. Carefully line up horizontal adjuster screw into adjuster nut and turn adjusting shaft to engage adjuster screw.

2. Install upper two retainers on two upper attachments.
3. Connect headlamp bulb wiring.
4. Connect three bulbs and sockets to door assembly.
5. Position door assembly to vehicle and install two screws and two nuts. Tighten screws to 1.4-2.3 N·m (13-20 in-lb). Tighten nuts to 4-7 N·m (36-61 in-lb).
6. Check headlamp aim.

REMOVAL AND INSTALLATION (Continued)**Headlamp Assembly, F-Series and Bronco**

K17693-A

Item	Part Number	Description
1	12A581	Wiring Assembly
2	N621906-S55M	Nut and Washer 4-7 N·m (36-61 in·lb)
3	N801603-S55	Screw 1.4-2.3 N·m (13-20 in·lb)
4	N806851-S100	J-Nuts
5	8A164A	Grille Opening Reinforcement

(Continued)

Item	Part Number	Description
6	13043	Headlamp Door
7	13N019	Bulb #916
8	13465	Bulb #3157
9	13005	Headlamp Assembly
10	13465	Bulb #194 NA
11	13N019	Headlamp Bulb Retainer
12	13N020	Headlamp Retainer Clip

Parking Lamps, F-150-250-350, F-Super Duty and Bronco**Removal and Installation**

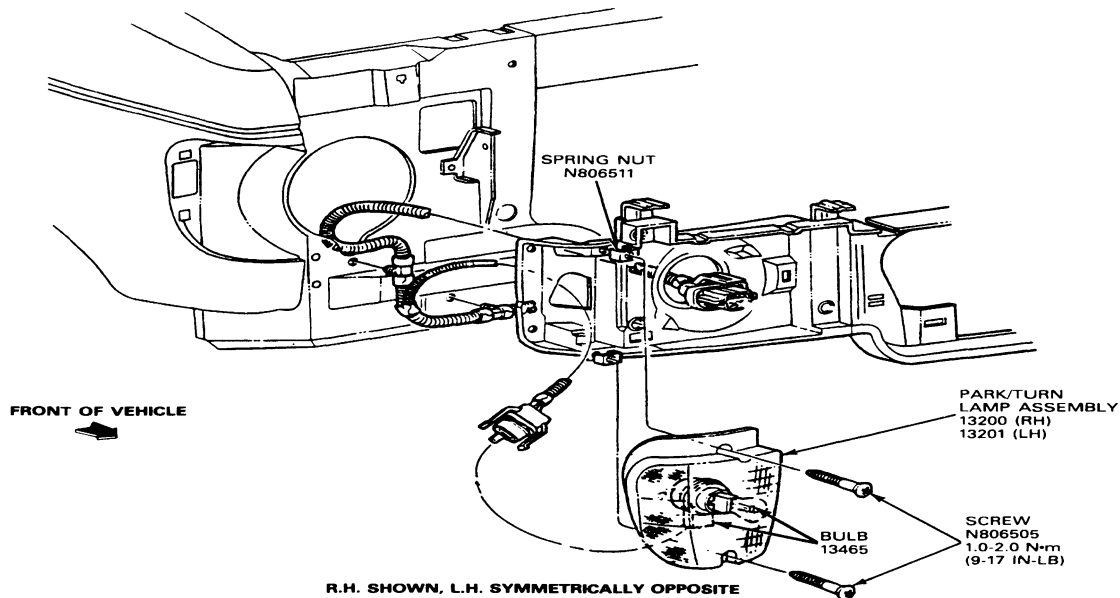
1. Remove headlamp door assembly attaching nuts and screws.
2. Pull assembly away from headlamp and disconnect socket from lamp body.
3. Replace bulb. Reverse procedure to install.
4. Tighten attaching nuts to 4-7 N·m (36-61 in·lb). Tighten attaching screws to 1.4-2.3 N·m (13-20 in·lb).

Parking Lamps, E-150-250-350**Removal and Installation**

1. Remove two screws attaching lamp to body.
2. Pull lamp forward from body and remove bulb and socket.
3. Replace bulb or lamp. Install bulb and socket in lamp.
4. Install two screws and tighten to 1.0-2.0 N·m (9-17 in·lb).

REMOVAL AND INSTALLATION (Continued)

Parking Lamp Assembly, E-150-250-350



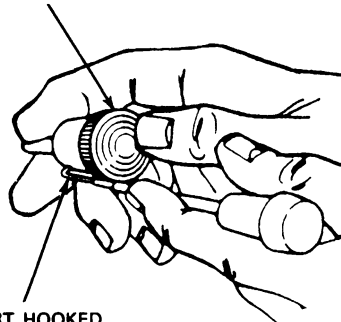
Headlamp Switch

F-150-250-350, F-Super Duty Chassis Cab and Bronco

Removal and Installation

1. Disconnect battery ground cable.
2. On vehicles with tilt column, position steering wheel in full down position.
3. On vehicles with column shift, set parking brake and position shift lever to the lowest position.
4. Unsnap the right and left moulding by carefully prying at the notches on the bottom of the mouldings.
5. Remove the headlight knob by depressing the spring inside of the knob.

HEADLAMP KNOB
AND SHAFT ASSEMBLY

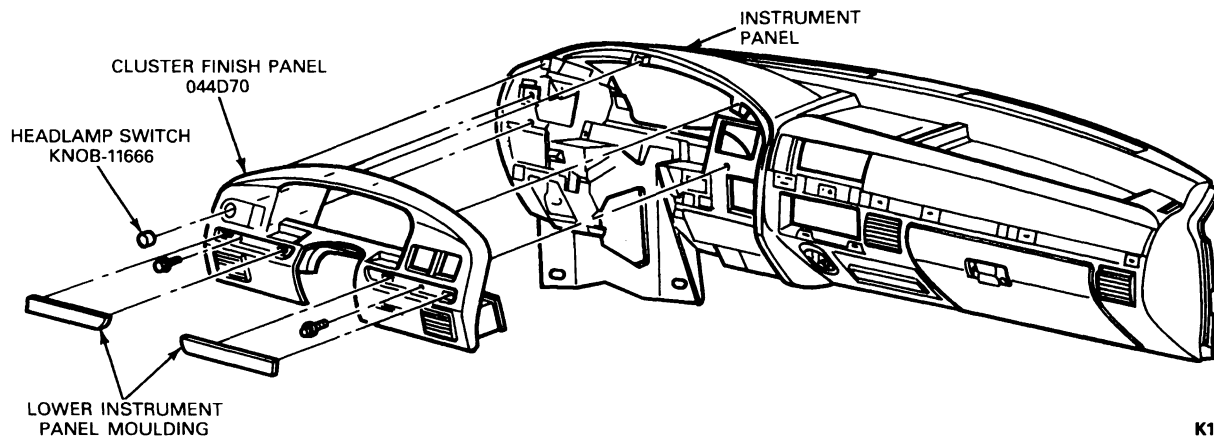


K17679-A

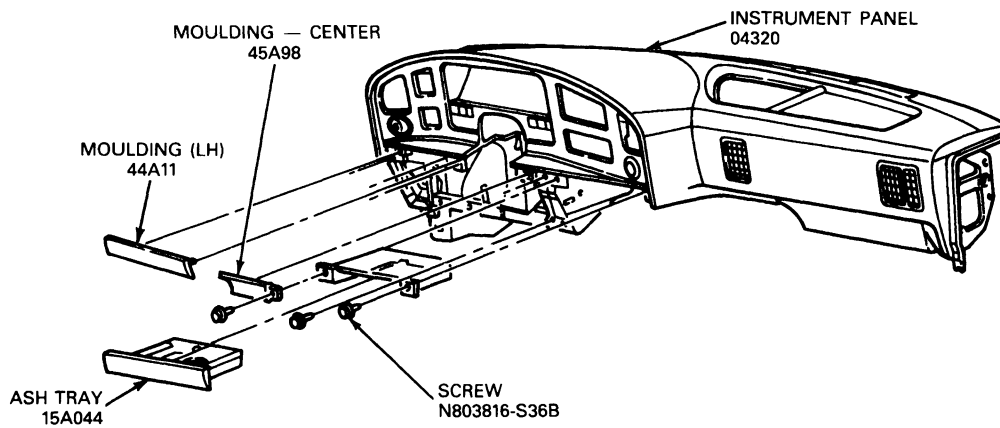
6. Remove the two exposed screws that are under the right and left mouldings.
NOTE: Wiring is connected to the finish panel.
7. Unsnap five retaining clips by pulling the panel rearward starting with the two at the steering column (one each side) and then the three at the top of the panel.
8. Disconnect the wiring from the panel.
9. Remove the switch push rod by inserting a punch or similar tool into the switch access hole while pulling the push rod from the switch. Unscrew the mounting nut. Remove the switch from instrument panel, then remove the wiring connector from the switch.

For installation follow removal procedures in reverse order.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the PCM relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

REMOVAL AND INSTALLATION (Continued)**Instrument Panel, F-Series and Bronco****E-150-250-350****Removal and Installation**

1. Remove the engine cover.
2. Pull out and remove the ashtray drawer.
3. Remove three screws retaining the ashtray drawer retainer and remove the drawer retainer.
4. Remove center and left snap-in moulding on each side of the steering column.

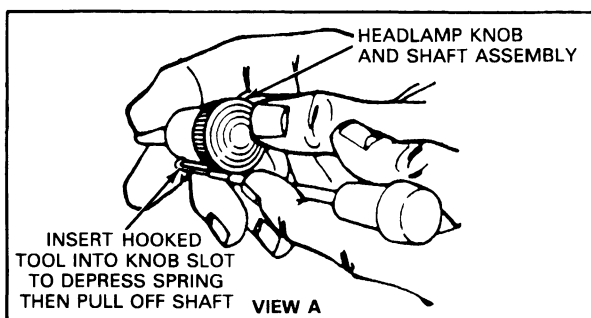
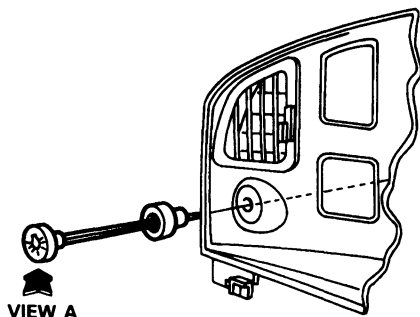
Instrument Panel, E-150-250-350

5. Remove the cigar lighter element.

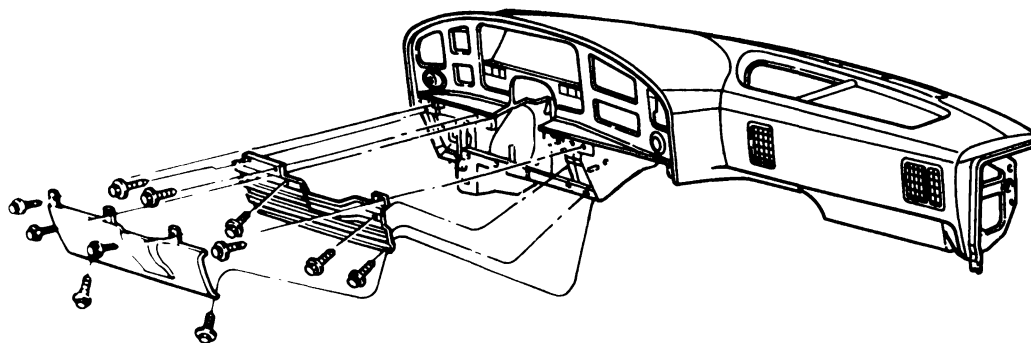
REMOVAL AND INSTALLATION (Continued)

6. Remove headlight switch knob and unscrew the bezel.

7. Remove five screws and steering column opening cover.
8. Remove six screws and steering column opening lower reinforcement.

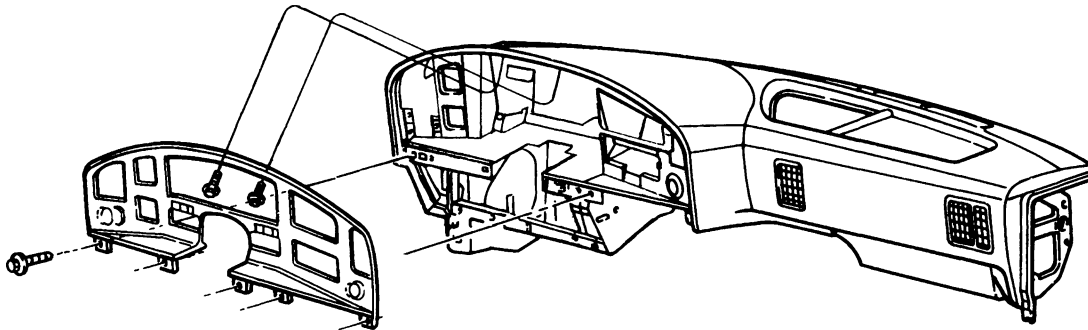


K17706-B

Steering Column Opening Cover and Reinforcement

K17707-A

9. Remove seven screws retaining instrument cluster finish panel.

REMOVAL AND INSTALLATION (Continued)**Instrument Cluster Finish Panel**

K17708-B

10. Pull cluster finish panel away from the instrument panel by unsnapping the snap-in retainers and disconnect all wiring from the finish panel.
11. Remove the headlamp control shaft by pressing the release button on the switch housing with the shaft in the full ON position. Pull the shaft out of the switch. Unscrew the mounting nut or bezel nut. Remove the switch, then remove the wiring connector from the switch.

For installation, follow removal procedures in reverse order.

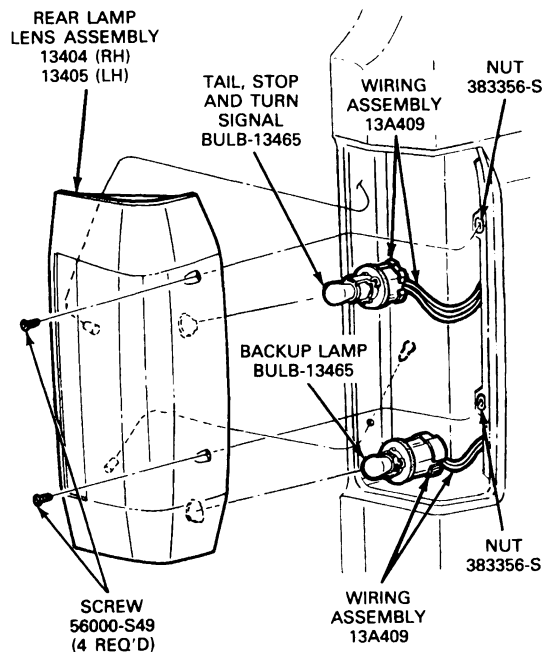
Rear Lamps

F-150-250-350 Styleside Pickup, Bronco and E-150-250-350

Removal and Installation

1. To replace a bulb in the combination tail lamp, stoplamp, reflex and backup lamp, remove the screws that retain the lamp lens assembly to the vehicle and pull lamp lens away from vehicle.
2. Turn the socket with the burned out or broken bulb counterclockwise out of housing.
3. Install lamp lens and retaining screws to vehicle.
4. Remove bulb from the socket by firmly grasping the bulb and pulling straight out.
5. Replace bulb by pushing socket until a snap is heard.
6. Install socket into lamp and turn clockwise until it locks.

NOTE: If lamp body or lens is damaged, replace entire lamp assembly. Lens and body are not serviced separately.

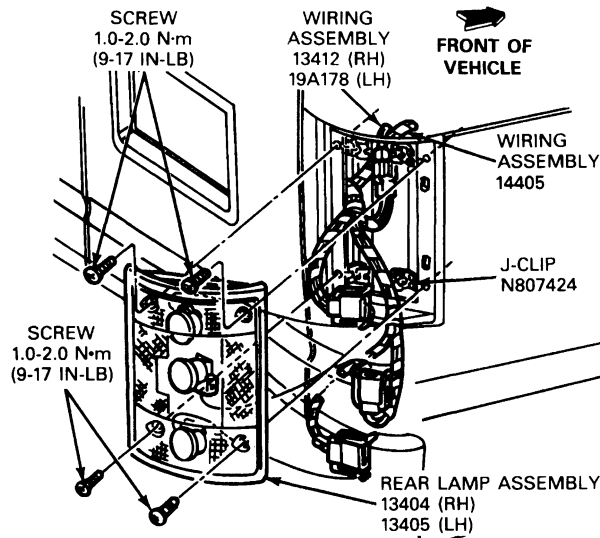
Rear Lamps, F-150-250-350 Style Side and Bronco

**VIEW SHOWING INSTALLATION OF
RH REAR LAMP ASSEMBLY,
LH REAR LAMP ASSEMBLY SYMMETRICALLY OPPOSITE.**

K3961-H

REMOVAL AND INSTALLATION (Continued)

Rear Lamps, E-150-250-350



(R.H. REAR LAMP SHOWN, L.H. SYMMETRICALLY OPPOSITE)

K17709-B

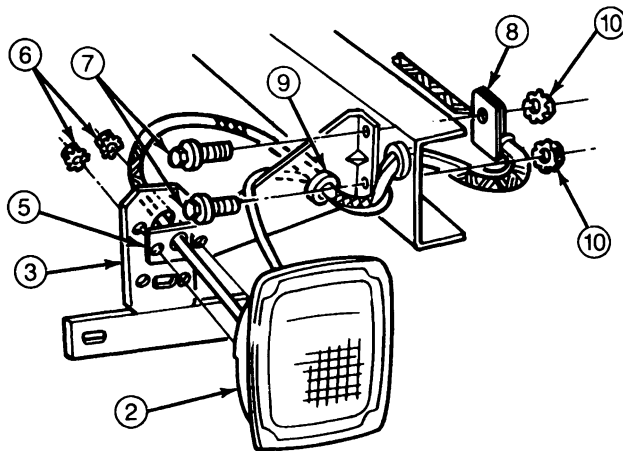
F-150-250-350 4x2 and F-Super Duty Chassis Cab

Removal and Installation

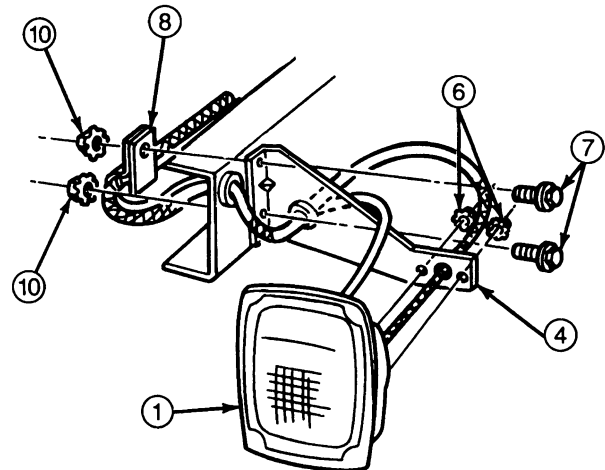
The bulb in the rear lamp body can be replaced by removing the lens retaining screws and pulling lens away from vehicle.

To replace the lamp assembly, remove the two nuts from the mounting studs. Disconnect the two connectors (red-black stripe wire and wire with green insulator) inside the frame side rail. Unhook the wires from the retaining clip and pull the wires out. Insert the studs of the replacement lamp body into the holes of the lamp mounting bracket. Tighten the stud nuts to 16-26 N-m (12-20 ft-lb).

Rear Lamps, F-150-250-350 4x2 and F-Super Duty Chassis Cab



INSTALLATION OF L.H. REAR LAMP ASSY.



INSTALLATION OF R.H. REAR LAMP ASSY.

K17711-A

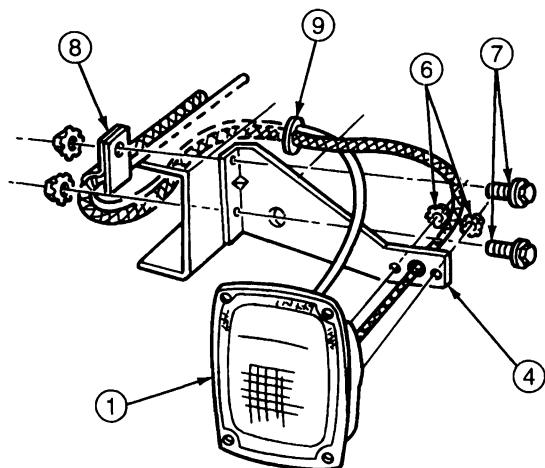
Item	Part Number	Description
1	13404 (RH)	Rear Lamp Assembly
2	13405 (LH)	Rear Lamp Assembly
3	13406	Bracket
4	13470 (RH)	Bracket
5	13471 (LH)	Bracket

(Continued)

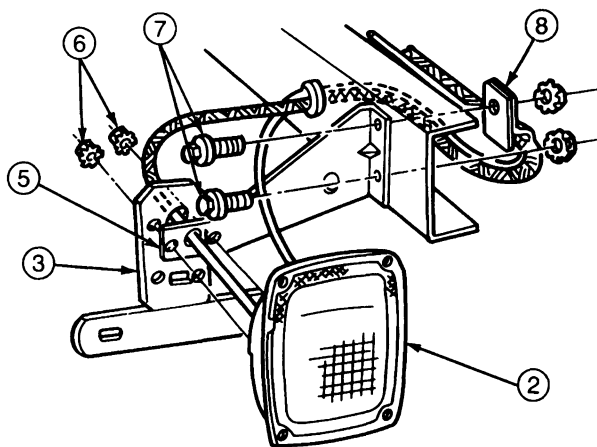
Item	Part Number	Description
6	34659-S36M	Nut and Washer 4-9 N-m (3-7 Ft-Lb)
7	55633-S36	Bolt
8	353473-S36	Clip
9	N805391-S	Grommet
10	34661-S36M	Nut and Washer 16-27 N-m (12-20 Ft-Lb)

REMOVAL AND INSTALLATION (Continued)

Rear Lamps, F-250 4x4 Chassis Cab



INSTALLATION OF R.H. REAR LAMP ASSY.



INSTALLATION OF L.H. REAR LAMP ASSY.

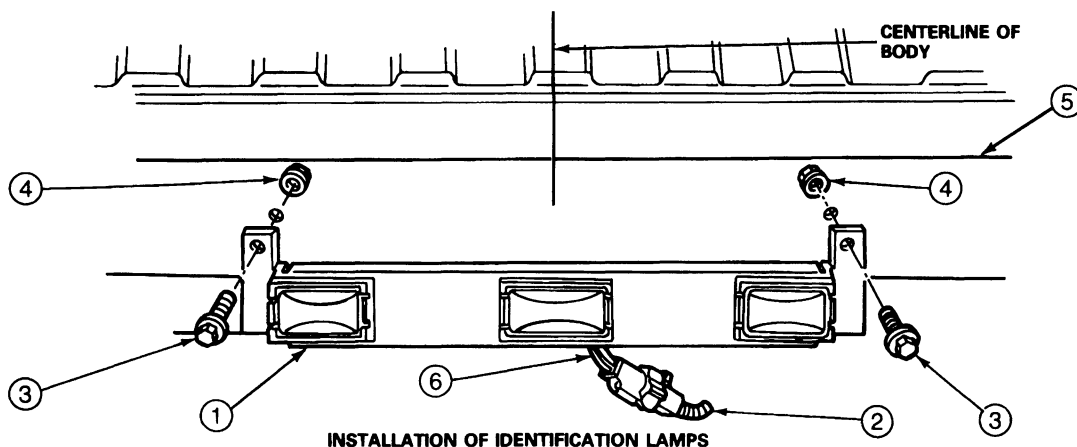
K17713-A

Item	Part Number	Description
1	13404 (RH)	Rear Lamp Assembly
2	13405 (LH)	Rear Lamp Assembly
3	13406	Bracket
4	13470 (RH)	Bracket
5	13471 (LH)	Bracket

(Continued)

Item	Part Number	Description
6	34659-S36M	Nut and Washer 4-9 N·m (3-7 Ft·Lb)
7	55653-S36	Bolt
8	353473-S36	Clip
9	N805391-S	Grommet
10	34661-S36	Nut and Washer 16-27 N·m (12-20 Ft·Lb)

Rear Identification Lamps, F-250-350 with Dual Rear Wheels



INSTALLATION OF IDENTIFICATION LAMPS

K17715-B

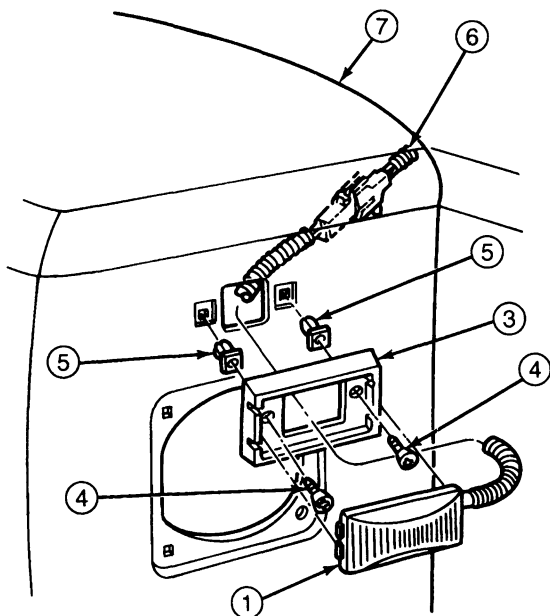
Item	Part Number	Description
1	15425	Marker Lamp and Bracket
2	13A409	Wiring Assembly

(Continued)

Item	Part Number	Description
3	N605892-S2	Bolt
4	N621906-S43M	Nut 9-14 N·m (80-123 In·Lb)
5	Ref.	Pick-Up Box
6	15A411	Wiring Assembly

REMOVAL AND INSTALLATION (Continued)**Rear Marker Lamps, F-350 Styleside with Dual Rear Wheels****Removal and Installation**

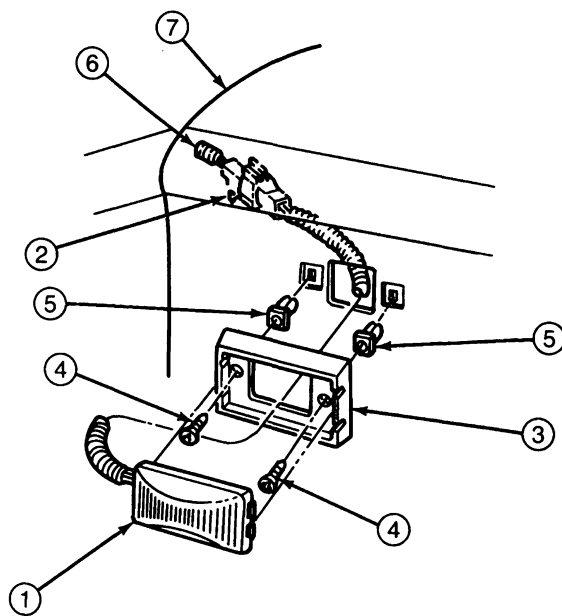
To replace the bulb, unsnap the lens from the bezel assembly. Disconnect the electrical connector from the lens and remove the bulb from the socket.

Rear Marker Lamp, F-350 Styleside and Dual Rear Wheels

VIEW SHOWING INSTALLATION OF L.H. REAR MARKER LAMP.
R.H. REAR MARKER LAMP SYMMETRICALLY OPPOSITE.

Item	Part Number	Description
1	15C400	Lamp and Wiring Assembly
2	Ref.	Locator
3	15B436	Bezel Assembly

(Continued)



VIEW SHOWING INSTALLATION OF L.H. FRONT MARKER LAMP.
R.H. FRONT MARKER LAMP SYMMETRICALLY OPPOSITE.

K17717-A

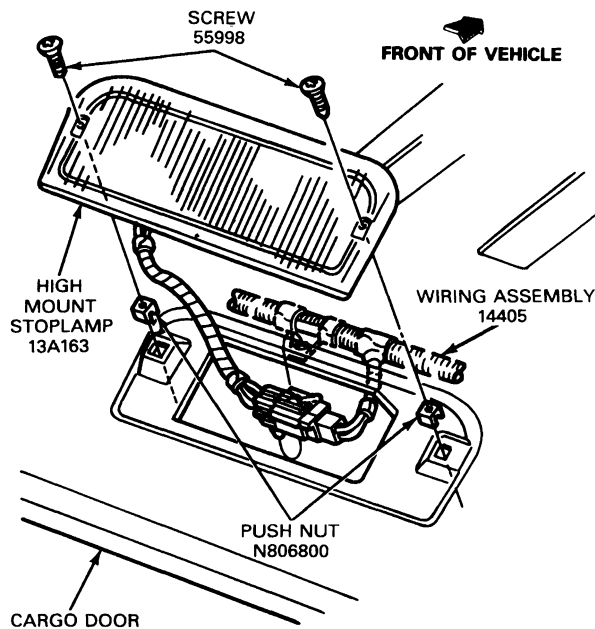
Item	Part Number	Description
4	N610128-S2	Screw
5	383356-S	Nut
6	15A411	Wiring Assembly
7	Ref.	Rear Fender

Hi-Mount Stoplamp**E-150-250-350 Without Cargo Lamp Attached****Removal and Installation**

1. Remove two screws retaining lamp and lift up from vehicle.

2. Twist socket out of lamp to replace bulb.

For installation, follow removal procedures in reverse order.

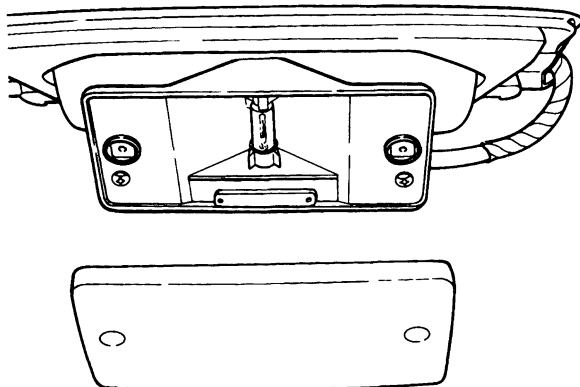
REMOVAL AND INSTALLATION (Continued)**Stoplamp, E-150-250-350 Without Cargo Lamp Attached**

INSTALLATION SHOWING HIGH-MOUNT STOPLAMP ASSEMBLY WITH R.P.O. ACOUSTICAL HEADLINER

K17719-B

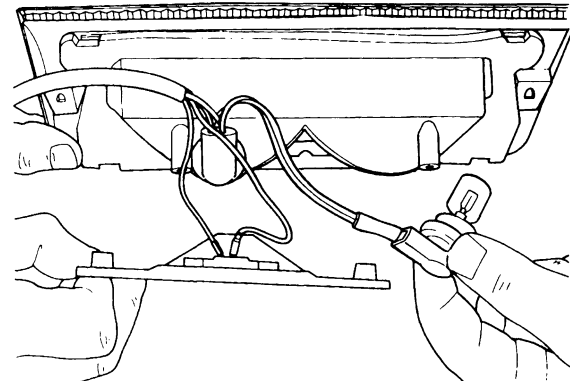
E-150-250-350 with Cargo Lamp Attached**Removal and Installation**

1. Remove two screws retaining Hi-Mount Stoplamp / cargo lamp and lift assembly from vehicle.
2. Remove two screws and cargo lamp lens.

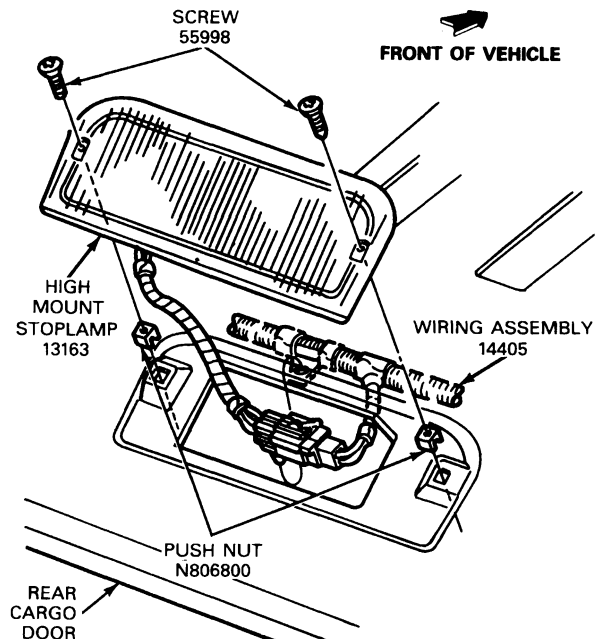


K17483-A

3. Remove two screws attaching cargo lamp to Hi-Mount Stoplamp.
4. Remove bulbs from Hi-Mount Stoplamp and replace.



K17486-A

Stoplamp, E-150-250-350 with Cargo Lamp Attached

HIGH MOUNT STOPLAMP ASSEMBLY WITH BASE VEHICLES OR VEHICLES EQUIPPED WITH HARD HEADLINER

K17721-B

Bronco**Removal and Installation**

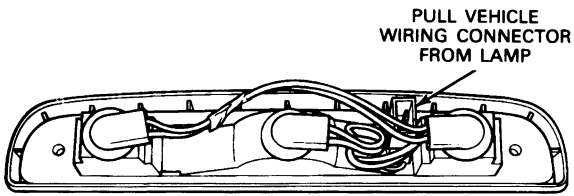
1. Remove two screws retaining the lamp assembly to the top.



K17723-A

REMOVAL AND INSTALLATION (Continued)

2. Pull lamp assembly away from the top.
3. Disconnect lamp wiring connector from vehicle wiring.



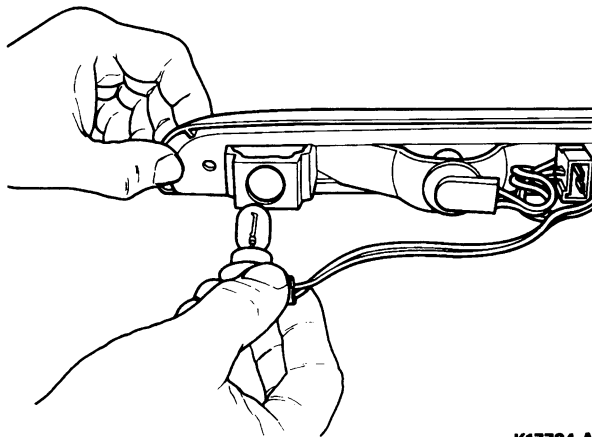
K17725-A

For installation, follow removal procedures in reverse order.

Bulb Replacement, Bronco**Removal and Installation**

1. Follow first two removal steps of Hi-Mount Stoplamp, Bronco.
2. Remove bulb socket(s) from lamp assembly by pulling out of lamp, noting the position of the one removed.

NOTE: The sockets are not twist-locked into lamp.
3. Replace bulb(s) by pulling out of socket. For installation, follow removal procedures in reverse order.



K17724-A

Cargo Lamp Assembly (Exterior), Bronco**Removal and Installation**

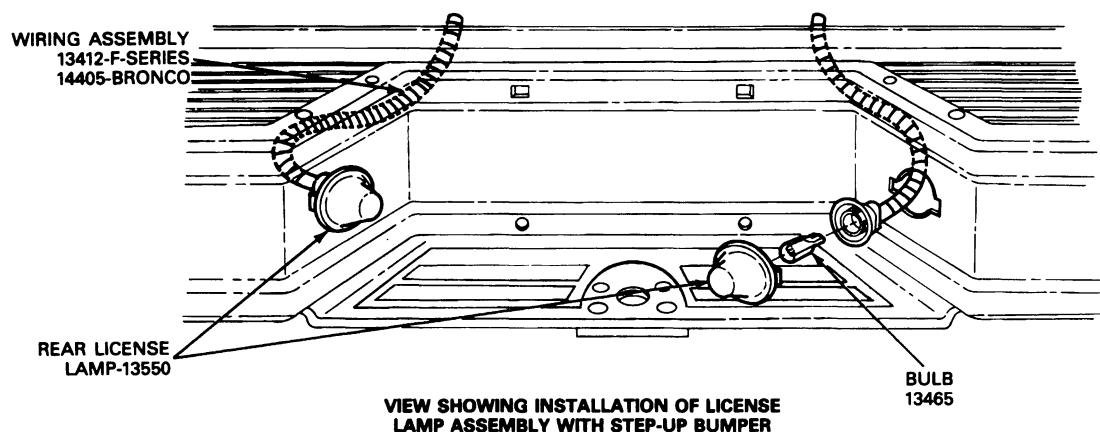
The cargo lamp is part of the Hi-Mount Stoplamp. For bulb replacement and lamp removal and installation procedures, refer to Hi-Mount Stoplamp in the removal and installation portion of this section.

License Plate Lamp**F-150-250-350 with Rear Bumper, Bronco****Bulb****Removal and Installation**

To replace the rear license lamp bulb, rotate socket one-quarter turn from backside of lamp and remove the bulb. To install, reverse removal procedure.

REMOVAL AND INSTALLATION (Continued)**Lamp Assembly****Removal and Installation**

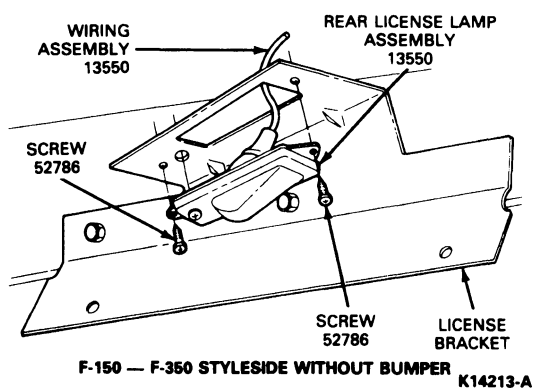
To remove the lamp assembly, push lamp assembly out from behind or pry out from outside. To install, reverse removal procedure.



K3982-D

F-150-250-350 Without Rear Bumper**Bulb, Styleside Only****Removal and Installation**

1. Remove screw retaining rear license lamp cover to assembly.
2. Remove the bulb and replace with a new bulb.
3. Install cover and screw to rear license lamp assembly.

**Lamp Assembly****Removal and Installation**

1. Remove two screws that retain the assembly to license bracket.

2. Disconnect wiring connector.
3. To install, connect wiring connector to lamp assembly. Position lamp assembly to license bracket and install the two retaining screws.

Flareside**Removal and Installation**

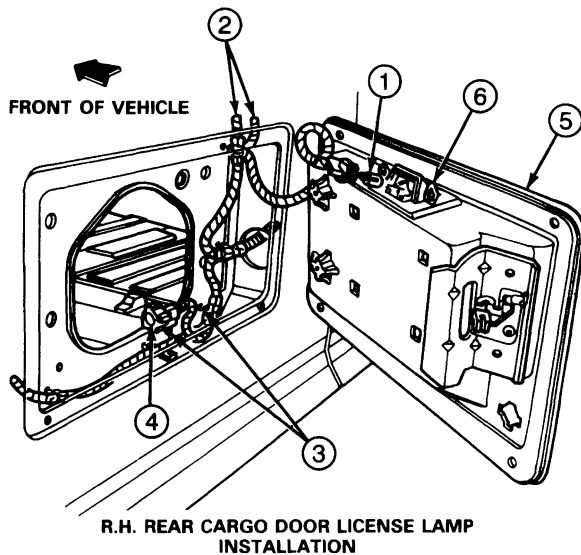
1. Remove two screws that retain the lamp assembly.
2. Remove lamp socket from lamp assembly by rotating socket counterclockwise one-eighth-turn and pull socket from lamp body. Remove bulb by pulling outwards.
3. To install, push bulb into socket.
4. Install lamp and retaining screw.

E 150-250-350**Removal and Installation**

1. To replace the bulb of the E-150-250-350 license plate lamp assembly, remove the two plastic screws retaining the lamp(s).
2. Pull lamp out of license plate housing.
3. Remove the lamp socket from the lamp assembly by twisting counterclockwise.
4. Remove the bulb, install a new bulb and twist the socket into the lamp assembly.

REMOVAL AND INSTALLATION (Continued)

License Plate Lamp, E-150-250-350

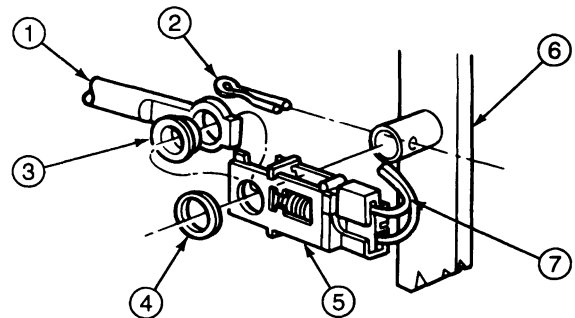


Item	Part Number	Description
1	13730 # 168	Bulb Assembly
2	13412	Wiring Assembly
3	Ref.	Locators
4	Ref.	Door Lock Cylinder Connector
5	Ref.	License Plate Housing
6	N805229-S	Screw / Nut

Stoplamp Switch

Removal and Installation

1. Disconnect wire harness connector from switch.
NOTE: Locking tab must be lifted before connector can be removed.
2. Remove the hairpin retainer. Slide stoplamp switch, push rod, white nylon washer and bushing away from the pedal. Remove washer and then the switch by sliding switch up or down.
NOTE: Since the switch side plate nearest the brake pedal is slotted, it is not necessary to remove the brake master cylinder push rod and black bushing from the brake pedal pin. On vehicles equipped with speed control, the spacer washer is replaced by the dump valve adapter washer assembly.



Item	Part Number	Description
1	2005	Master Cylinder Push Rod
2	380699-S100	Self-Locking Pin
3	2A309	Bushing
4	2B129	Spacer
5	13480	Switch Assembly
6	Ref.	Brake Pedal
7	14A200	Wiring Assembly

3. Position switch so that the U-shaped side is nearest the pedal and directly over / under the pin. Then, slide switch up / down trapping the master cylinder push rod and black bushing between the switch side plates.

Push switch and push rod assembly firmly toward brake pedal arm. Assembly outside white plastic washer to pin. Install hairpin retainer to hold entire assembly.

CAUTION: Do not substitute other types of pin retainers. Use only factory-supplied hairpin retainer.

4. Install connector to the switch.
5. Check stoplamp switch for proper operation.

CAUTION: Stoplamp switch wire harness must have sufficient length to travel with switch during full stroke of pedal. If wire length is too short, reroute or repair harness as required.

Backup Lamp Switch

Manual Transmission

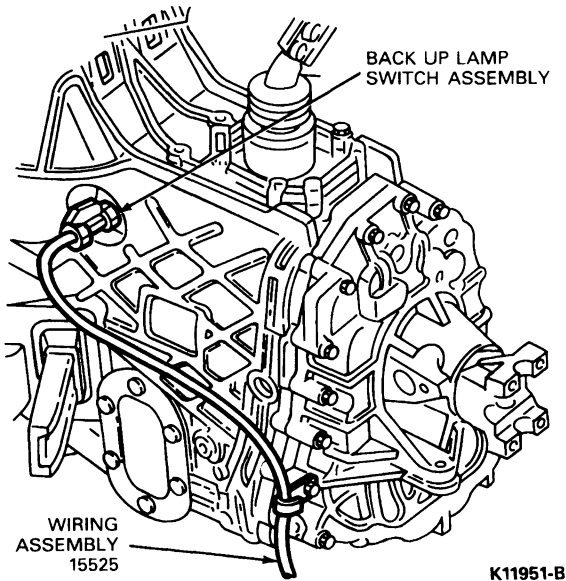
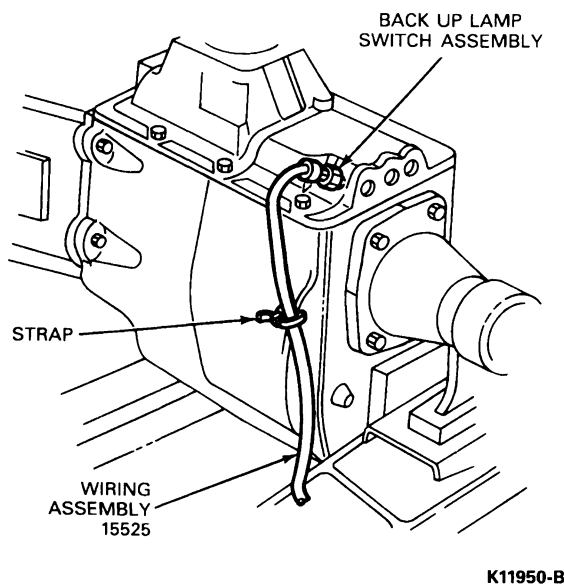
All F-150-250-350, F-Super Duty with 5-Speed Manual Overdrive Transmission or Warner T-18 4-Speed Creeper Transmission

NOTE: The backup lamp switch is mounted on the driver's side of the transmission assembly. It is non-adjustable.

1. Place the transmission selector lever in any position other than Reverse.
2. Disconnect the electrical connector from the switch.

REMOVAL AND INSTALLATION (Continued)

3. Remove the switch from the transmission assembly.
4. To install switch, reverse the above procedure.

Backup Lamp Switch, Typical**Backup Lamp Switch Installed and F-150-250-350 LD****Automatic Transmission**

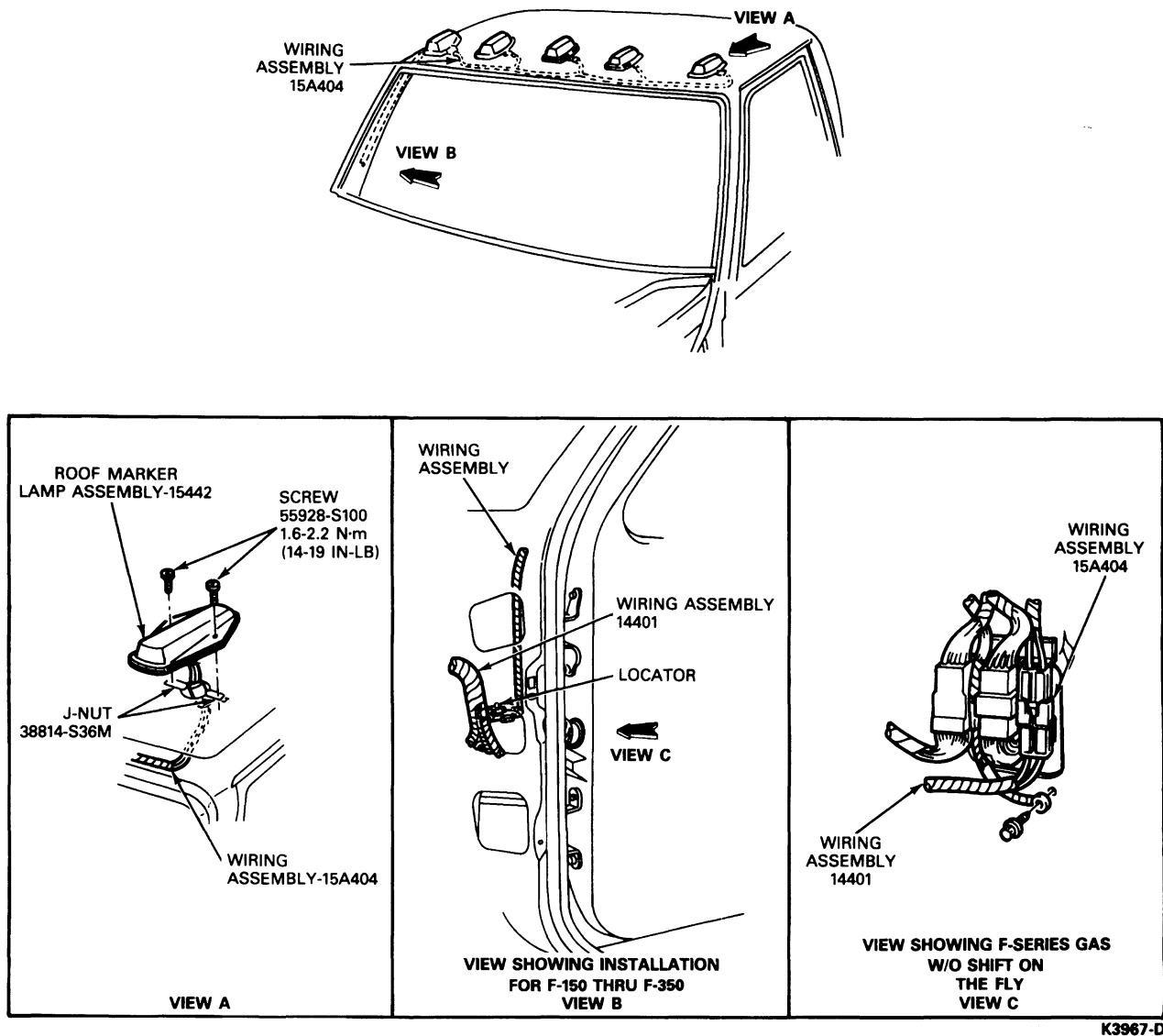
For backup lamp switch removal and installation procedures, refer to the appropriate section in Group 07.

Roof Marker Lamps**Removal and Installation**

1. Remove two screws securing marker to roof and lift lamp enough to see electrical connector.
2. Tape wiring assembly 15A404 to roof of vehicle and disconnect electrical connector.
3. Remove marker lamp from vehicle.
4. Position pad over electrical wires and connect electrical connector.
5. Remove tape from wiring assembly. Position marker lamp to roof.
6. Secure with two screws. Tighten to 0.90-2.25 N·m (8-20 in-lb).

REMOVAL AND INSTALLATION (Continued)

Roof Marker Lamps



Turn Signal/Hazard Warning Flasher Switch, F-150-250-350, F-Super Duty, E-150-250-350 and Bronco

For turn signal/hazard warning flasher switch removal installation procedures refer to Section 11-05.

ADJUSTMENTS

Headlamp Aim

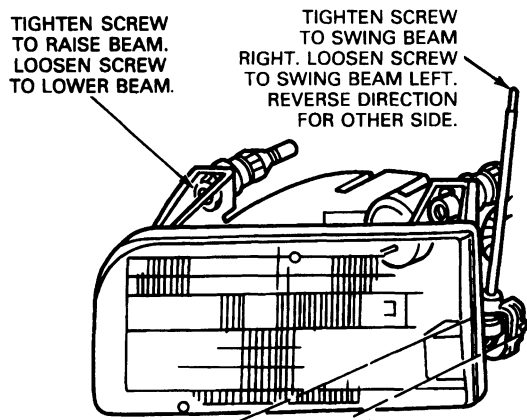
Before making any headlamp adjustments, perform the following preparatory steps:

1. Remove ice or mud from under fenders.
2. Make sure that all tires are inflated to recommended pressures.

NOTE: Sagging springs, faulty wheel alignment or improper tracking of the rear axle may affect headlamp aim.

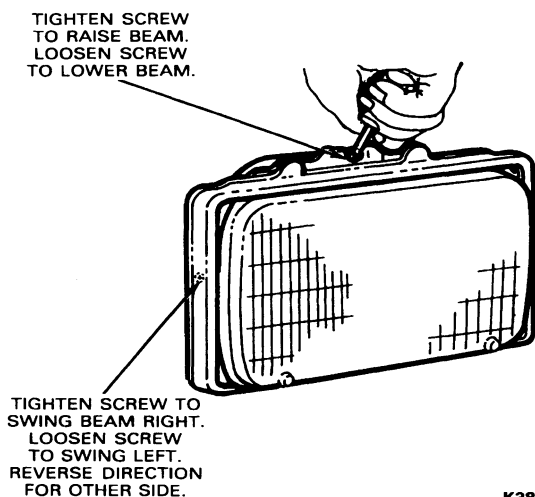
ADJUSTMENTS (Continued)

Headlamp Adjustment Shown Without Headlamp Door or Trim Ring, F-150-250-350, Bronco and E-150-250-350 Hi-Series



K17692-B

Headlamp Adjustment Shown Without Headlamp Door or Trim Ring, E-150-250-350 Lo-Series



K3836-B

3. Make sure there is no load in the vehicle other than the fuel tank half full.
4. Clean lenses and aiming pads.
5. Check for bulb burn-out and proper beam switching.
6. Verify that lamp output is well toward normal new lamp value.
7. Bounce the vehicle and allow to settle.

Perform headlamp aim adjustments with Rotunda Headlamp Aiming Kit 107-00001 or equivalent. To aim the aerodynamically styled headlamps, the adjustable aimer adapters provided in the kit must be used. Adjustment aimer adapter positions are moulded into the bottom edge of the headlamp lens.

Set and lock the adjustable adapters, attach each adapter to its mechanical aimer and aim headlamps per latest instructions in the kit.

The equipment in Rotunda Headlamp Aiming Kit 107-00001 or equivalent can be calibrated to accommodate a slight slope in the floor, making it usable almost anyplace in the garage. However, the area must be reasonably flat.

Each headlamp is adjusted by means of two screws located under the headlamp door or trim ring.

NOTE: Access holes are provided to allow headlamp adjustment without removing the headlamp door.

For sealed-beam lamps, always bring each beam into final position by turning the adjusting screws clockwise so that the headlamp will be held against the tension springs when the operation is completed.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
Screw, Headlamp Retaining Ring, Econoline	2-3	18-24 (In-Lb)
Screw, Front Parking Lamp Assembly Screw, Econoline	1-2	9-17 (In-Lb)
Nut and Washer, Headlamp Door, F-Series and Bronco	4-7	36-61 (In-Lb)
Screw, Headlamp Door, F-Series and Bronco	1.4-2.3	13-20 (In-Lb)
Nut and Washer, Rear Lamp Assembly, F-Series and F-Super Duty Chassis Cab	4-9	3-7
Nut and Washer, Rear Lamp Bracket, F-Series and F-Super Duty	16-26	12-20
Nut, Rear Identification Lamp, F-250-350 with Dual Rear Wheels	9-14	7-10
Screw, Marker Lamp	1-2	9-17 (In-Lb)

SPECIAL SERVICE TOOLS/EQUIPMENT

ROTUNDA EQUIPMENT

Tool Number	Description
107-00001	Headlamp Aiming Kit

SECTION 17-02 Lighting, Interior

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd.)	
Dome and Map Lamp Combination, F-150-250-350, F-Super Duty and Bronco	17-02-5	Econoline Without Headliner	17-02-9
Engine Compartment Lamp	17-02-5	F-150-250-350, F-Super Duty Regular Cab and Crew Cab	17-02-7
Interior Lamps	17-02-1	Courtesy Lamp Switch, Door Jamb	17-02-11
E-150-250-350	17-02-1	Courtesy/Reading Lamp Combination, Econoline	17-02-10
F-150-250-350, F-Super Duty Chassis Cab and Bronco	17-02-3	Dome Lamp	17-02-6
DIAGNOSIS AND TESTING		Bronco	17-02-6
Diagnosis Guide	17-02-5	Econoline, Standard	17-02-7
REMOVAL AND INSTALLATION		F-150-250-350 and F-Super Duty	17-02-6
Cargo Lamp	17-02-7	Engine Compartment Lamp, E-150-250 (Optional)	17-02-12
Bronco, Interior/Headliner-Mounted	17-02-10	SPECIFICATIONS	17-02-12
Econoline With Headliner	17-02-7	VEHICLE APPLICATION	17-02-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab and Bronco Vehicles

DESCRIPTION AND OPERATION

Interior Lamps

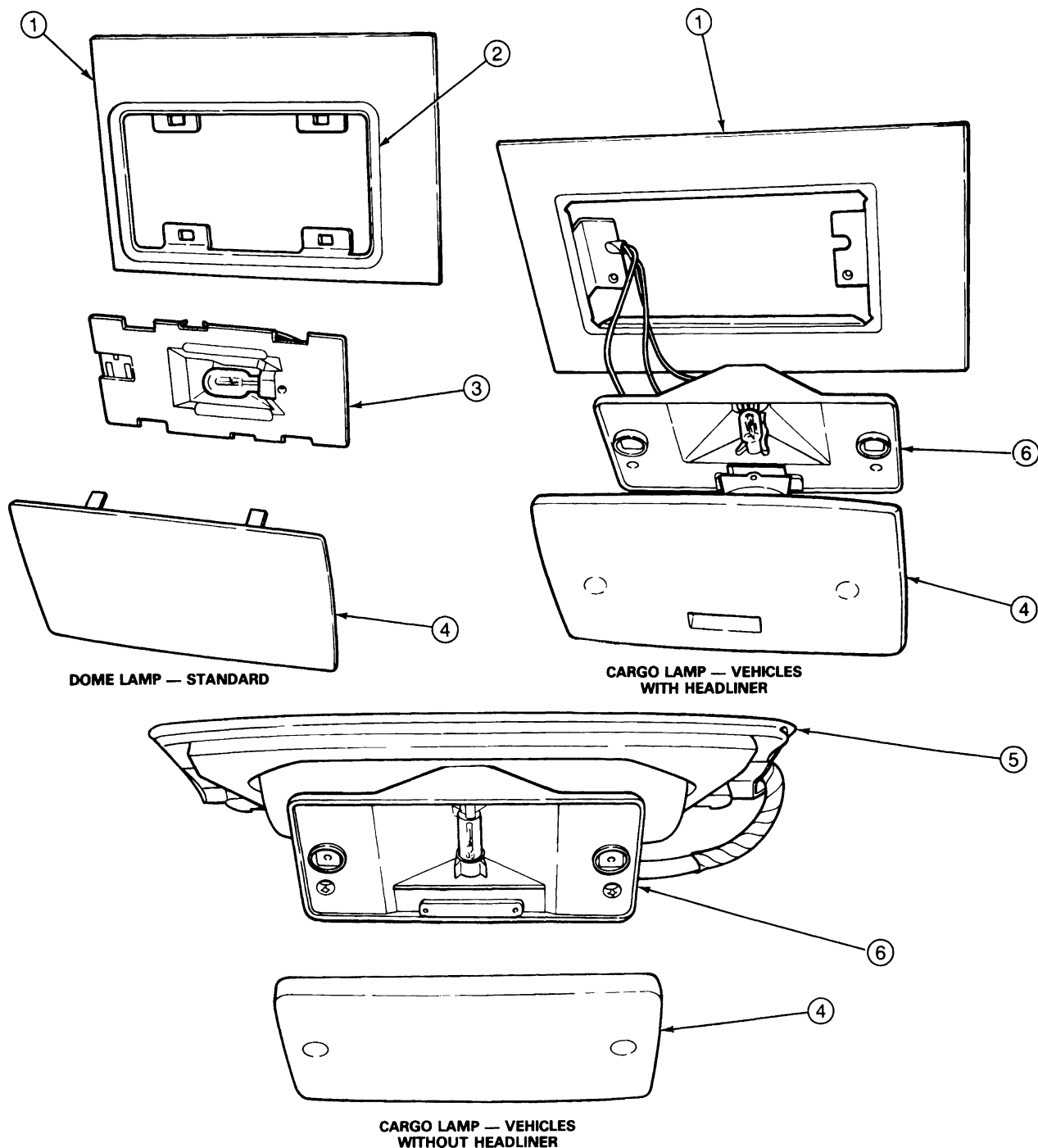
E-150-250-350

The overhead dome lamp, map-dome lamp, and cargo lamp for E-150-250-350 are controlled by the headlamp switch and switches located in the door jambs, if so equipped.

The bulbs are energized when the headlamp switch knob is turned fully counterclockwise and also when the door is opened.

DESCRIPTION AND OPERATION (Continued)

Econoline Dome and Cargo Lamps, Typical



K17477-B

Item	Part Number	Description
1	Ref.	Headliner
2	Ref.	Lamp Body Retainer

(Continued)

Item	Part Number	Description
3	13776	Lamp Body
4	13734	Lens Assembly
5	13613	Hi-Mount Stoplamp
6	13K706	Lamp-Body Assembly

DESCRIPTION AND OPERATION (Continued)

F-150-250-350, F-Super Duty Chassis Cab and Bronco

The overhead dome lamp and map-dome lamp are located above the rear window on F-150-250-350, F-Super Duty Regular Cab and is located above the rear of the front seat on SuperCab and Bronco. The bulbs are energized when the headlamp switch knob is turned fully counterclockwise.

All models of the F-150-250-350, F-Super Duty, Bronco, and Econoline are equipped with door jamb switches which also control the dome lamp.

The cargo lamp on F-150-250-350, F-Super Duty Regular Cab, Crew Cab and SuperCab series is located outside above the rear window and is controlled by turning the headlamp switch fully counterclockwise.

The cargo lamp and switch for Bronco vehicles is located at the rear left side of the cargo area.

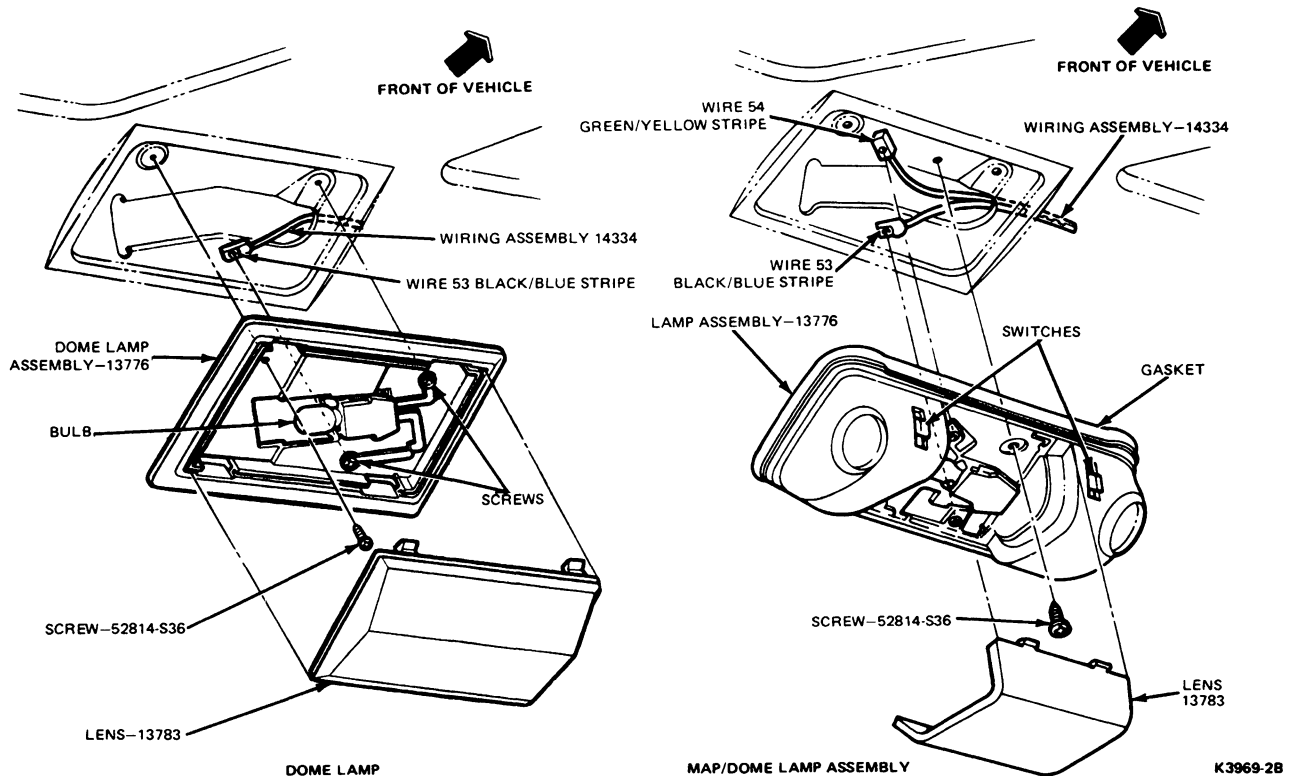
The interior cargo lamp and switch for Bronco vehicles is located in the rear center of the fiberglass top headliner.

The engine compartment lamp is located on the bottom center of the hood and is activated when the hood is raised.

The courtesy lamps for Bronco, F-150-250-350 and F-Super Duty are located under the door armrests on the right and left sides. These lamps are activated by door jamb switches and by turning the headlamp switch fully counterclockwise.

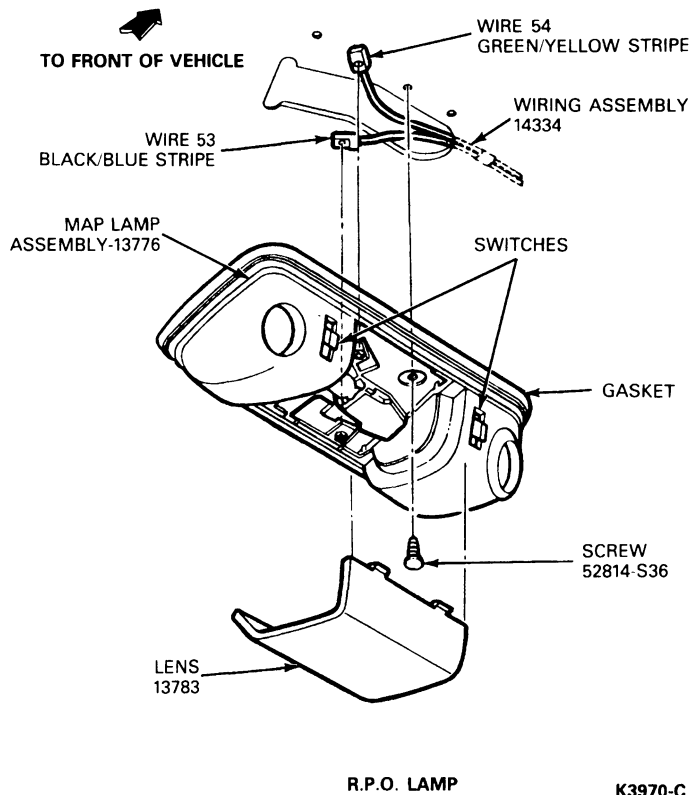
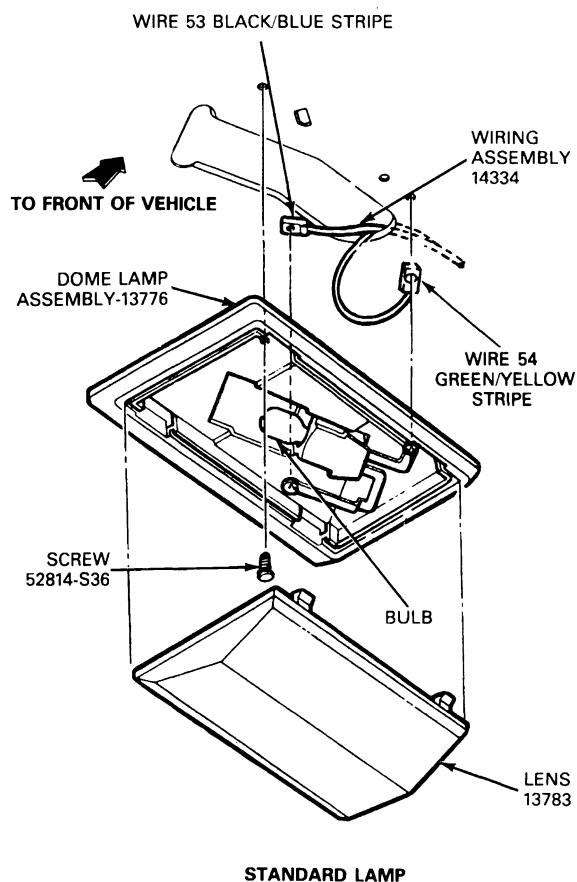
The glove compartment lamp is activated by opening the glove compartment door.

Map/Dome Lamp, F-150-250-350 and F-Super Duty

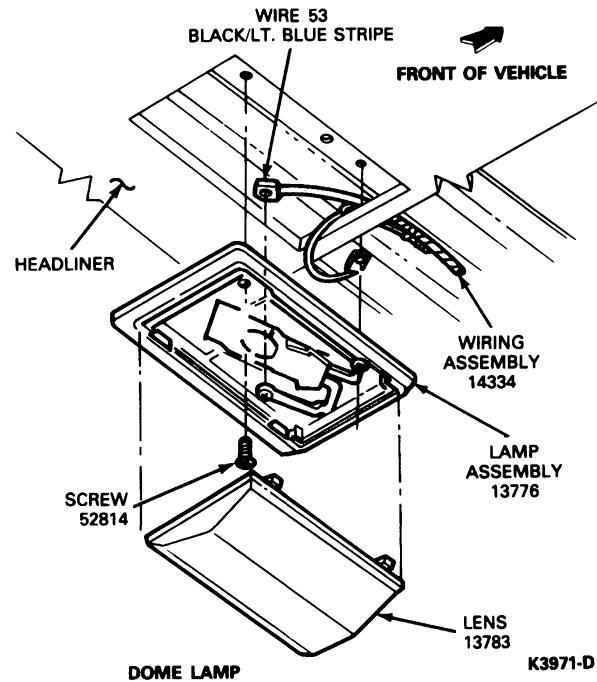
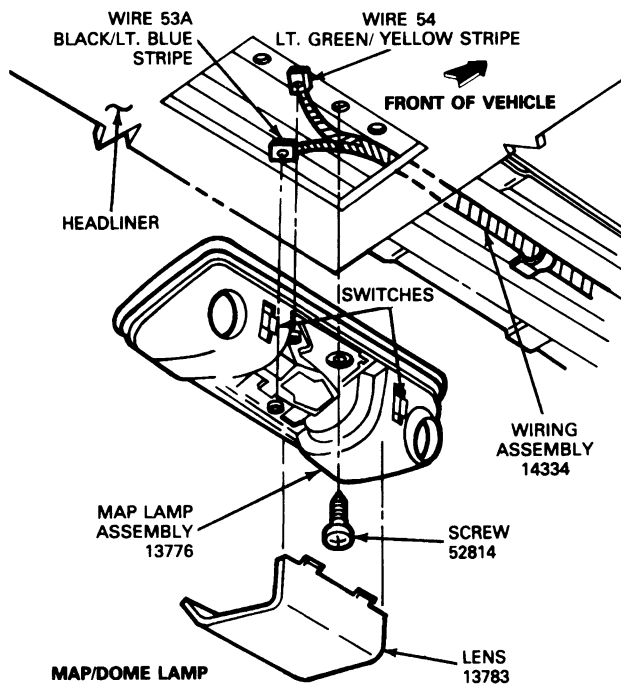


DESCRIPTION AND OPERATION (Continued)

Map/Dome Lamp, Bronco, Without Headliner Shown, Map/Dome Lamp with Headliner Similar



K3970-C

DESCRIPTION AND OPERATION (Continued)**Map Lamp, F-150-250-350, SuperCab, F-Super Duty****Dome and Map Lamp Combination, F-150-250-350, F-Super Duty and Bronco**

The two map lamps are located on each side of the dome lamp housing. The map lamps are operated independently of the dome lamp by two switches located at each map lamp housing. The dome lamp is activated by turning the headlamp switch control knob fully counterclockwise. The dome lamp is also activated by a switch in the pillar when the doors are opened.

Engine Compartment Lamp

F-150-250-350, Bronco and E-150-250 models may be equipped with an optional engine compartment lamp. The lamp is mounted to the hood in the engine compartment.

The engine compartment lamp is activated every time the hood is opened.

A visual inspection is an important part of the lighting system test. Check for wires with frayed or damaged insulation, loose connections and proper harness routing. Refer to the Truck Wiring Diagrams Manual.

Any problems found by the visual inspection should be corrected before performing further tests of the lighting system.

For example, a loose ground strap between the engine and body dash panel may cause an intermittent operation of the lamps and gauges. Inspect and tighten, if necessary, the ground strap attaching screws at the back of the engine and the body dash panel. If a No. 10 screw is required, use Part No. 42367 hex washer head tapping screw.

NOTE: Any screws or bolts used for attaching the engine-to-body ground strap must have an "S36" finish (zinc plate plus dichromate dip).

DIAGNOSIS AND TESTING

Before performing any lighting system tests, make sure the battery is in a fully charged condition and all battery cable connections are clean and tight.

Diagnosis Guide

The following Diagnosis Guide provides steps to take when trying to isolate lighting system problems.

Check for burned out bulbs or fuses before proceeding and replace as necessary.

NOTE: All models use a headlamp switch with a circuit breaker for protection of the headlamps. All other vehicle lamps are protected by a fuse in the fuse panel.

DIAGNOSIS AND TESTING (Continued)

Refer to Testing Guide in Section 17-01, Lighting, Exterior, for headlamp switch diagnosis and testing.

CONDITION	POSSIBLE SOURCE	ACTION
Instrument panel lamp does not light.	<ul style="list-style-type: none"> ● Bulb burned out. ● Fuse burned out. ● Open circuit in wiring, rheostat or printed circuit board. 	<ul style="list-style-type: none"> ● Replace bulb. ● Replace fuse. If fuse blows again, check for short circuit. See Section 18-01. ● Check for a short circuit. Repair as required.
Dome lamp does not come on when door is opened.	<ul style="list-style-type: none"> ● Connector loose ● Blown fuse. ● Bulb burned out. ● Open circuit in wiring. ● Worn or damaged door jamb switch. 	<ul style="list-style-type: none"> ● Secure and / or replace. ● Replace fuse. If fuse blows again, check for short circuit. See Section 18-01. ● Replace bulb. ● Repair as required. ● Replace door jamb switch.
Dome lamp stays on.	<ul style="list-style-type: none"> ● Worn or damaged door jamb switch. ● Worn or damaged main lighting switch. ● Short in wiring. 	<ul style="list-style-type: none"> ● Replace switch. ● Replace main lighting switch. ● Trace and repair wiring.
Poor PRND21 lighting.	<ul style="list-style-type: none"> ● Burned out bulb. ● Weak bulb. ● Wiring. ● Worn or damaged dial. ● Worn or damaged pointer. ● Paint overspray. 	<ul style="list-style-type: none"> ● Replace bulb. ● Replace bulb. ● Check wiring for high resistance. If resistance is high, repair or replace as required. ● Check for total lens illumination. Replace dial if necessary. ● Check for pointer illumination at all dial positions. Replace pointer if necessary. ● Replace dial.
Map lamp does not come on when switch is actuated.	<ul style="list-style-type: none"> ● Bulb burned out. ● Blow fuse. ● Open circuit in wiring. ● Open circuit in wiring. ● Worn or damaged switch in lamp assembly. 	<ul style="list-style-type: none"> ● Replace bulb. ● Replace fuse. ● Repair as required. ● Repair as required. ● Replace lamp assembly.
Map lamp stays on.	<ul style="list-style-type: none"> ● Worn or damaged switch in lamp assembly. 	Replace lamp assembly.

TK17492B

REMOVAL AND INSTALLATION**Dome Lamp****Bronco**

1. Carefully pry the dome lamp lens at the corners from the housing.
2. Remove the two screws retaining the map lamp lens housing to the lamp base and remove the bulbs.
3. To remove the lamp base, remove the four retaining screws.

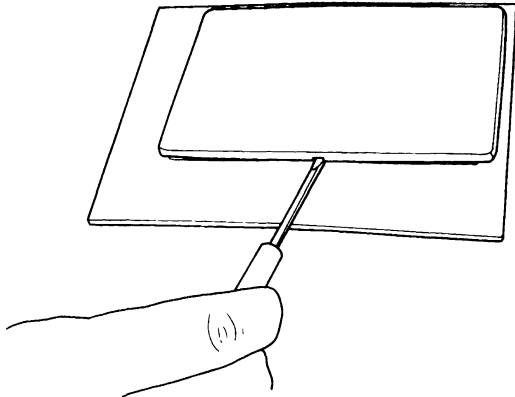
To install, reverse procedure.

F-150-250-350 and F-Super Duty**Removal and Installation**

1. To replace bulb, snap lens out of lamp body and remove bulb from retainers.
 2. To remove lamp body, remove retaining screws.
- To install, position lamp body over screw holes and install retaining screws to 1.8-2.6 N-m (16-23 in-lb). Push on lens to snap into position.

REMOVAL AND INSTALLATION (Continued)**Econoline, Standard****Bulb Replacement****Removal and Installation**

1. Carefully pry the lens assembly from the headliner.



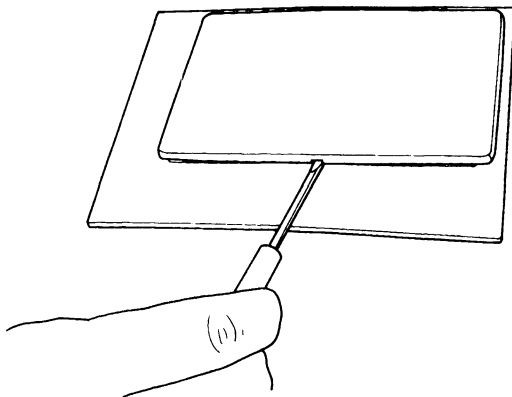
K17479-A

2. Separate the lens from the lamp body.
3. Pull bulb from the socket.

For installation follow removal procedures in reverse order.

Lamp Assembly**Removal and Installation**

1. Disconnect battery ground cable.
2. Carefully pry the lens assembly from the headliner.



K17479-A

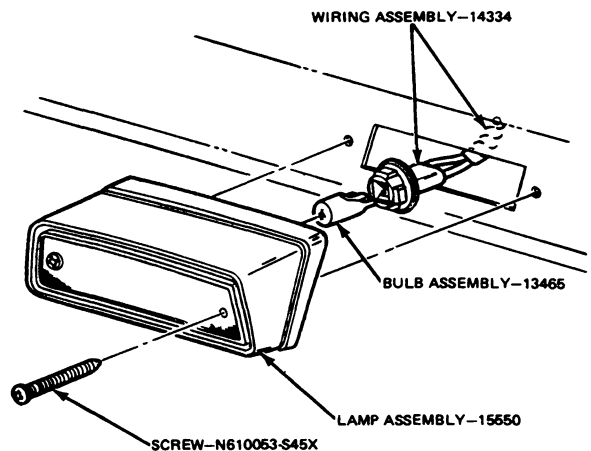
3. Separate the lens from the lamp body.
4. Disconnect the lamp body wiring connector from the vehicle wiring.

For installation follow removal procedures in reverse order. Make sure to assemble lens to lamp body before installing assembly into headliner.

NOTE: If the vehicle is equipped with an EEC processor, when the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the EEC processor relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Cargo Lamp**F-150-250-350, F-Super Duty Regular Cab and Crew Cab**

To remove the cargo lamp assembly on the F-150-250-350 and F-Super Duty series trucks, remove the two lens and door retaining screws and remove the lamp assembly. To install, reverse procedure.

Cargo Lamp, F-150-250-350, F-Super Duty

K3074-1A

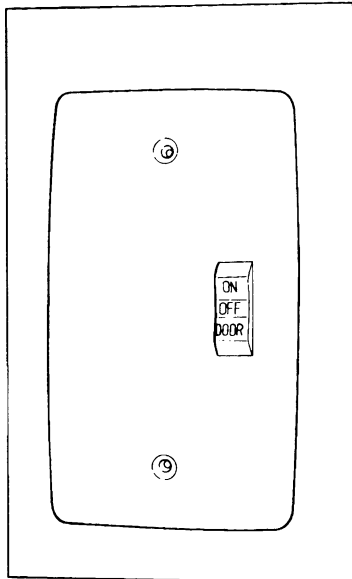
Econoline With Headliner**Bulb Replacement****Removal and Installation**

1. Remove two screws retaining the lens to lamp body and remove lens.

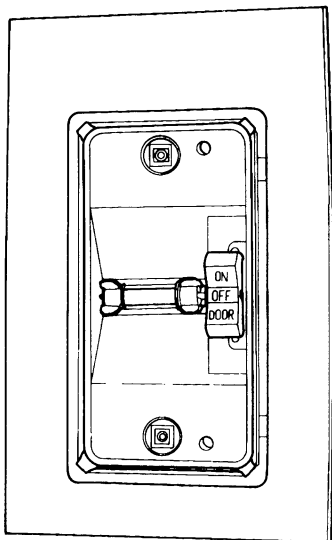
REMOVAL AND INSTALLATION (Continued)

2. Pull bulb from bulb retainer.

For installation follow removal procedures in reverse order.



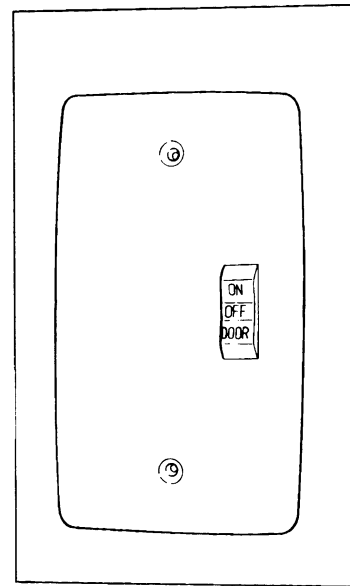
K17480-A



K17481-A

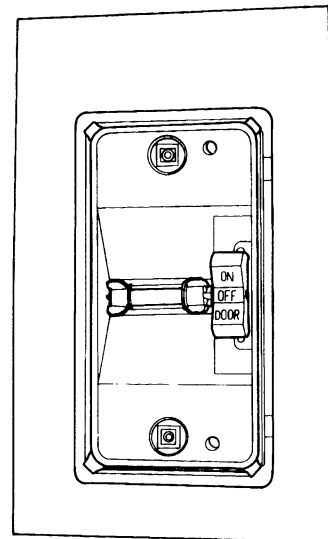
Lamp Assembly**Removal and Installation**

1. Disconnect battery ground cable.
2. Remove two screws retaining the lens to lamp body and remove lens.



K17480-A

3. Remove two screws retaining the lamp body to the headliner.



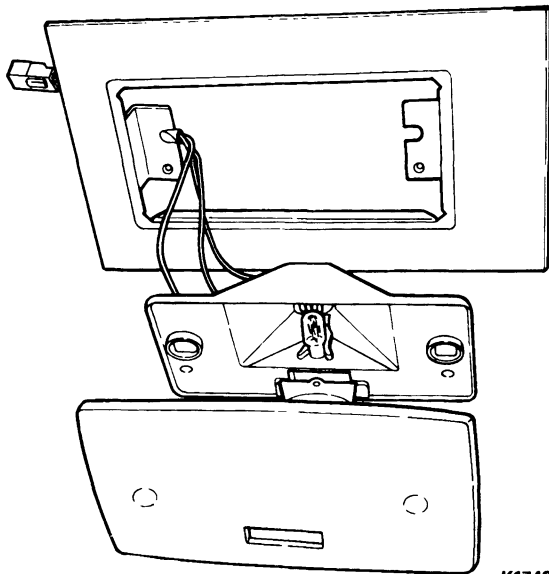
K17481-A

4. Pull lamp body down from the headliner, reach through the opening and disconnect the lamp body wiring from the vehicle wiring.

NOTE: On regular length vehicles with auxiliary air conditioning, the lamp wire leads must be cut to remove the lamp body. The wiring connector is not accessible. Make sure that enough wire is left to splice in the new lamp body.

REMOVAL AND INSTALLATION (Continued)

For installation follow removal procedures in reverse order.



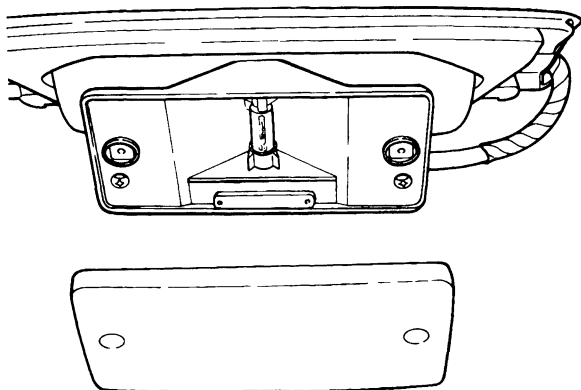
K17482-A

NOTE: If the vehicle is equipped with an EEC processor, when the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the EEC processor relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

Econoline Without Headliner**Bulb Replacement****Removal and Installation**

1. Remove two screws retaining the lens to lamp body and remove lens.
2. Pull bulb from bulb retainer.

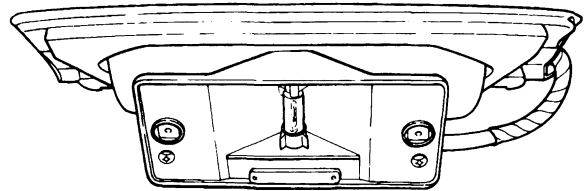
For installation follow removal procedures in reverse order.



K17483-A

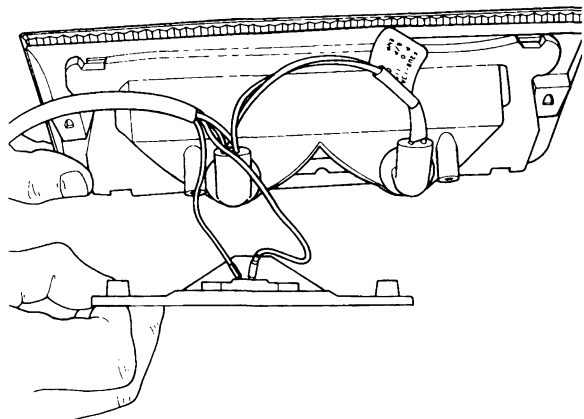
Lamp Assembly**Removal and Installation**

1. Remove two screws retaining the lens to lamp body and remove lens.
2. Remove two screws retaining the lamp body to the Hi-mount stoplamp.



K17484-A

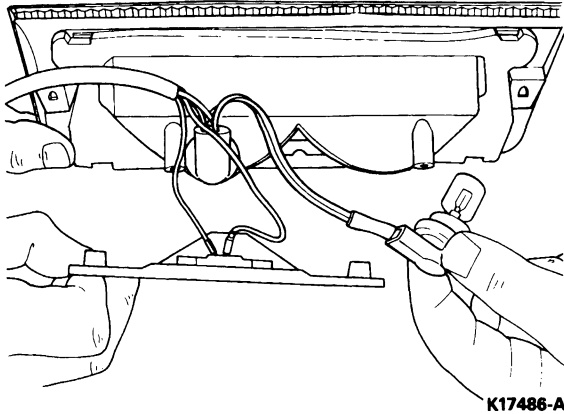
3. Separate the cargo lamp body from the Hi-mount stoplamp.



K17485-A

REMOVAL AND INSTALLATION (Continued)

4. Remove the two bulb sockets from the Hi-mount stoplamp.



5. Disconnect the lamp body wiring connector from the vehicle wiring.

For installation follow removal procedures in reverse order.

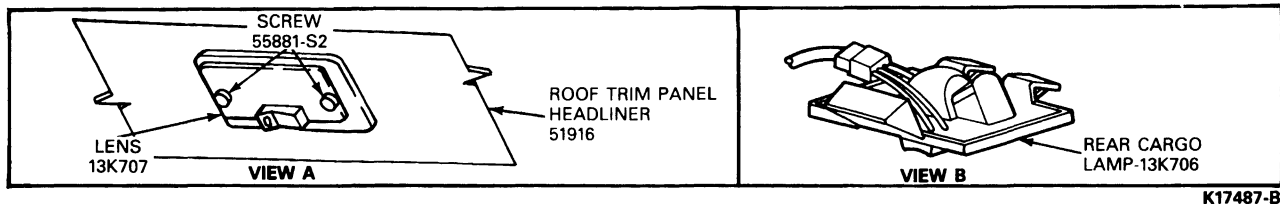
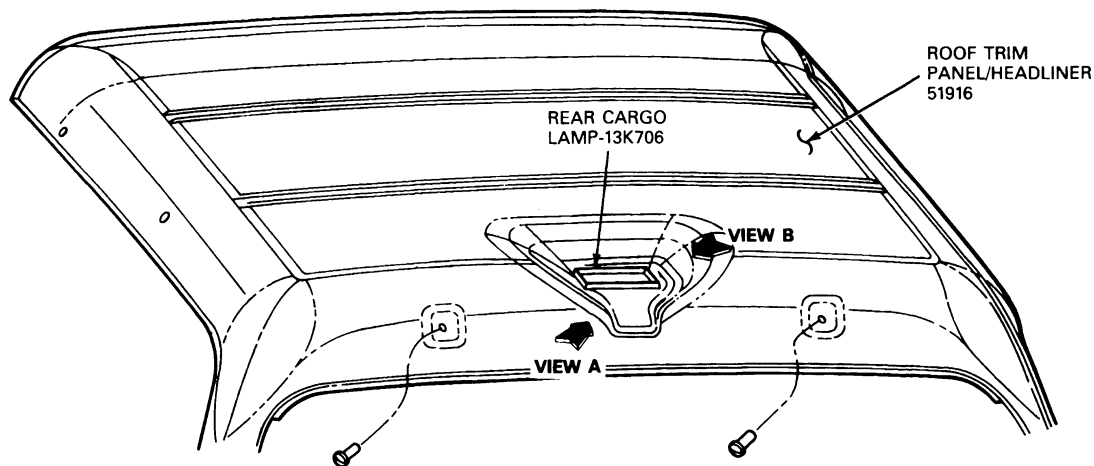
Bronco, Interior / Headliner-Mounted**Bulb Replacement****Removal and Installation**

1. Remove two screws retaining the lens to the lamp assembly.
2. Pull the lens from the lamp assembly.
3. Remove bulb by pulling it out of the lamp.

For installation follow removal procedures in reverse order.

Lamp Assembly**Removal and Installation**

The lamp is glued to the headliner. Remove the headliner and carefully separate the lamp from the headliner. Using an appropriate glue, install the new lamp and install the headliner.

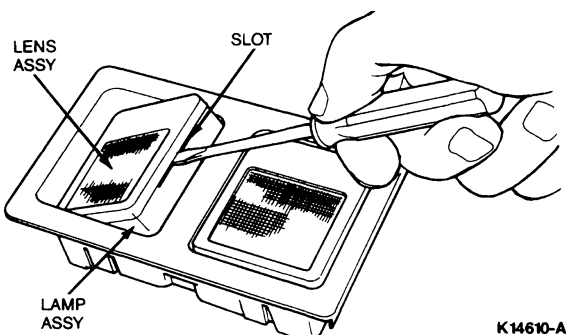
Bronco Cargo Lamp, Interior / Headliner-Mounted**Courtesy / Reading Lamp Combination, Econoline****Bulb Replacement****Removal and Installation**

1. Rotate lens to stop.

2. Insert thin-blade screwdriver in slot on side of lens and twist screwdriver to pop off lens.

REMOVAL AND INSTALLATION (Continued)

3. Remove bulb by pulling it out of bulb retainer. For installation follow removal procedures in reverse order. Note that lens will only fit one way.

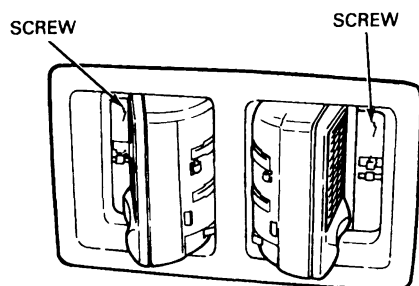


Lamp Assembly

Removal and Installation

1. Rotate both lamp lens to stop, then continue to push until lens goes beyond stop and is in the vertical position.
2. Remove two screws on both ends of lamp.
3. Pull lamp from retainer and disconnect wiring connector.

For installation follow removal procedures in reverse order. Note that the lamp assembly only fits one way to the lamp retainer.



K17489-A

Courtesy Lamp Switch, Door Jamb

Removal

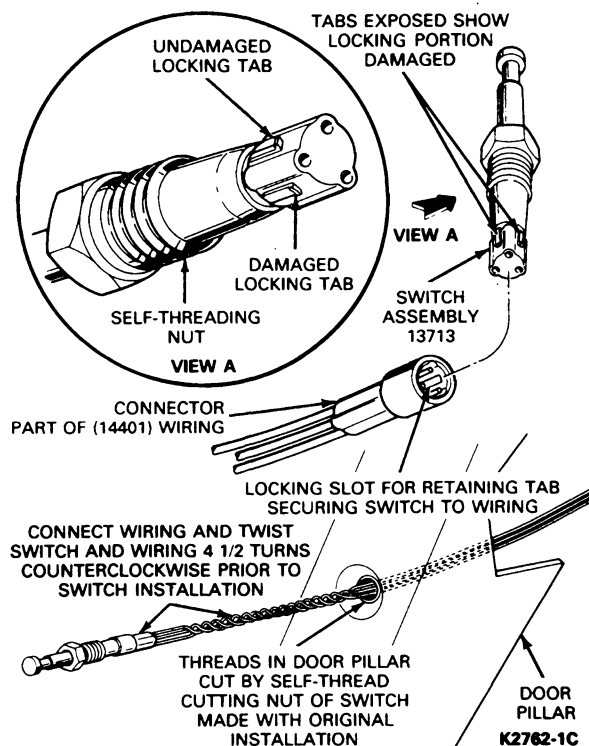
1. Unscrew the hex sleeve nut from the pillar.

2. Extract switch and pull the wiring connector off the switch.
 - a. Retention of courtesy lamp switch to the (14401) wiring connector is by one of three tabs positioned 120 degrees apart on the switch. If, when the switch is disconnected from the wiring connector, the engaged locking tab breaks off, the switch must be rotated 120 degrees to engage a new tab. When all three tabs have been broken, the switch must be replaced.

Installation

1. To install the switch in the pillar, pull the wiring connector and wiring through the switch mounting hole in the pillar and connect the switch to the connector.
2. Twist the wiring and switch 4-1/2 turns counterclockwise, and push the wiring and connector back through the mounting hole.
3. Screw the switch into the pillar until it is seated.
4. Close and open the door to ensure the courtesy lamp is operating properly.

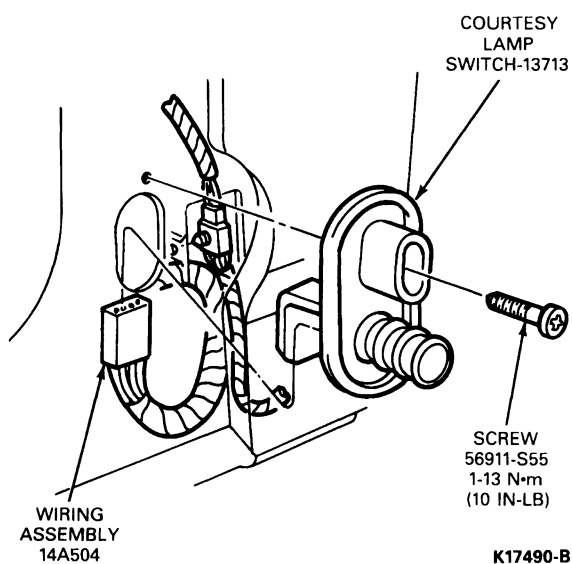
Courtesy Lamp Switch



K2762-1C

REMOVAL AND INSTALLATION (Continued)

Courtesy Lamp Wiring, F-150-250-350 and F-Super Duty Shown, Econoline and Bronco Similar



Engine Compartment Lamp, E-150-250 (Optional)

Bulb replacement requires only removal of the bulb and installation of the new bulb. No lens or door is used on the engine compartment lamp.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	N·m	In-Lb
Screw, Lamp Body	1.8-2.6	16-23
Screw, Lamp Switch	1.3	10

SECTION 17-04 Daytime Running Lamps

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION	
Daytime Running Lamp (DRL) System	17-04-1	Daytime Running Lamp Control Assembly	17-04-3
DIAGNOSIS AND TESTING	17-04-1	SPECIFICATIONS	17-04-4
		VEHICLE APPLICATION	17-04-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty
Chassis Cab and Bronco Vehicles (Canadian Vehicles
Only)

DESCRIPTION

Daytime Running Lamp (DRL) System

The DRL System is designed to turn the high beam headlamps on, with a reduced light output, and without illuminating the high beam indicator lamp in the instrument panel when the following conditions exist.

- The ignition is ON.
- The parking brake is fully released.
- The headlamp system is in OFF position.

DIAGNOSIS AND TESTING

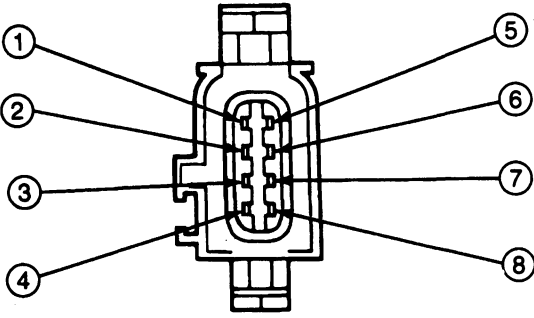
Before performing any lighting systems test, check that the battery is fully charged, battery connections are clean and tight, and burned out fuses and bulbs have been replaced. The DRL system also requires the parking brake switch light to function correctly. Before DRL System analysis and diagnosis may begin, turn ignition off, apply the parking brake and turn off headlamp system.

DAYTIME RUNNING LAMP (DRL) SYSTEM PINPOINT CHART — TEST A

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK HIGH BEAM OPERATION		
	<ul style="list-style-type: none"> ● Key ON. ● Parking brake fully released. ● Headlamp switch in OFF or in Parking Lights position. ● Are the high beams on and indicator not illuminated? 	No	System is functioning properly. No service is required.
		Yes	GO to A2.
A2	CHECK DRL INSTALLATION		
	<ul style="list-style-type: none"> ● Check if DRL module is installed. ● Is DRL module installed? 	Yes	GO to A3.
		No	Install DRL module.
A3	CHECK DRL MODULE CONNECTION		
	<ul style="list-style-type: none"> ● Check DRL harness connection. ● Is module connection OK? 	Yes	GO to A4.
		No	CHECK and SERVICE as required.
A4	CHECK WIRING		
	<ul style="list-style-type: none"> ● Check wiring to low beams for open or shorts? ● Does wiring check OK? 	Yes	CHECK and SERVICE as required.
		No	GO to A5.

DIAGNOSIS AND TESTING (Continued)

DAYTIME RUNNING LAMP (DRL) SYSTEM PINPOINT CHART — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A5	CHECK LIGHTING POWER <ul style="list-style-type: none"> Check voltage at pins 2 and 4. Is 12 volts present at pins 2 and 4 of connector?  <p>WIRING HARNESS CONNECTOR K17368-A</p>	Yes No	<p>GO to A6.</p> <p>CHECK wiring between connector and Underhood Power Distribution Box. SERVICE as required.</p>
A6	CHECK PARKING BRAKE SWITCH <ul style="list-style-type: none"> Check wiring at switch for short to ground. Is wire to the switch grounded? 	Yes No	<p>CHECK wiring at switch for short to ground or shorted parking brake switch. SERVICE or replace as required.</p> <p>GO to A7.</p>
A7	CHECK DRL MODULE <ul style="list-style-type: none"> Replace DRL module with known good module. Key ON. Parking brake fully released. Headlamp switch in OFF or in Parking Lights position. Are high beams ON? 	Yes No	<p>DRL module is damaged. REPLACE module.</p> <p>REPLACE old module. GO to A8.</p>
A8	CHECK HIGH BEAM INDICATOR <ul style="list-style-type: none"> Key ON. Parking brake fully released. Headlamp switch in OFF or in Parking Lights position. High beams off. Is the high beam indicator on? 	Yes No	<p>Damaged DRL module. REPLACE DRL module.</p> <p>GO to A9.</p> <p>NOTE: When using the "flash to pass" mode, the high beam indicator will NOT light.</p>
A9	CHECK FOR FULL HIGH BEAM INTENSITY <ul style="list-style-type: none"> Key ON. Parking brake fully released. Headlamp switch in OFF or in Parking Lights position. Are high beams ON at full intensity? 	Yes No	<p>Damaged DRL module. REPLACE DRL module.</p> <p>GO to A10.</p>
A10	CHECK FOR REDUCED HIGH BEAM INTENSITY <ul style="list-style-type: none"> Key OFF. Parking brake fully released. Headlamp switch in OFF or in Parking Lights position. Are high beams on at reduced intensity? 	Yes No, headlamps are not lit	<p>Damaged ignition switch. SERVICE or replace ignition switch as necessary, or Shorted wiring. CHECK and service as required, or Damaged DRL module. REPLACE DRL module.</p> <p>GO to A11.</p>

DIAGNOSIS AND TESTING (Continued)

DAYTIME RUNNING LAMP (DRL) SYSTEM PINPOINT CHART — TEST A (Continued)

TEST STEP		RESULT	ACTION TO TAKE
A11	CHECK FOR REDUCED HIGH BEAM INTENSITY		
	<ul style="list-style-type: none"> ● Key ON. ● Parking brake applied. ● Headlamp switch in OFF or in Parking Lights. ● Are high beams ON at reduced intensity? 	<p>Yes</p> <p>No, headlamps are lit</p>	<p>Open wiring or poor ground. CHECK wiring and connections between DRL module (pin 6) and parking brake switch, or Damaged parking brake switch. CHECK switch and replace if necessary, or Damaged DRL module. REPLACE DRL module.</p> <p>GO to A12.</p>
A12	CHECK FOR REDUCED HIGH BEAM INTENSITY		
	<ul style="list-style-type: none"> ● Key ON. ● Parking brake applied. ● Headlamp switch in OFF or in Parking Lights position. ● Headlamp switch is ON in LO beam mode. ● Are high beams on at reduced intensity? 	<p>Yes</p> <p>No, low beams are lit, highbeams are not lit</p>	<p>Damaged headlamp switch. REMOVE module. If headlamps are not lit, GO to headlamp switch diagnosis, or Damaged DRL module. REMOVE module. If headlamp low beams are ON, REPLACE module.</p> <p>GO to A13.</p>
A13	CHECK INSTRUMENT PANEL INDICATOR		
	<ul style="list-style-type: none"> ● Key ON. ● Parking brake applied. ● Headlamp switch in OFF or in Parking Lights position. ● Headlamps are ON in HIGH beam mode. ● High beams are ON. ● Is the instrument panel indicator OFF? 	<p>Yes</p> <p>No</p>	<p>Burned out instrument panel bulb. CHECK and REPLACE as required, or Open in wiring. CHECK wiring and connections between DRL module and the indicator light. SERVICE as required.</p> <p>System is functioning properly. No service is required.</p>

REMOVAL AND INSTALLATION

Daytime Running Lamp Control Assembly

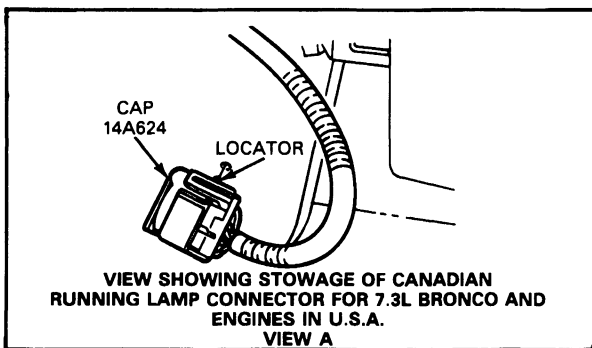
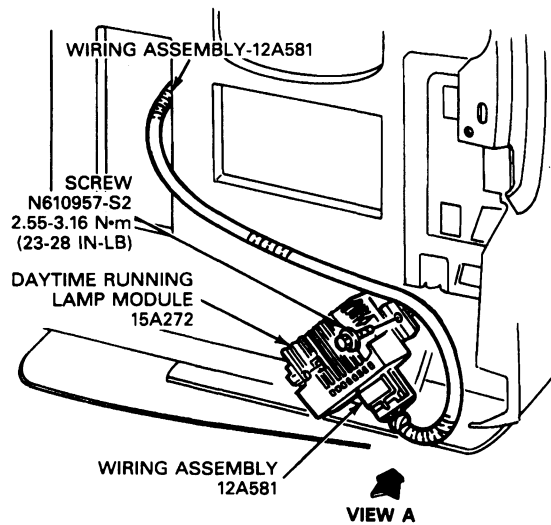
Removal and Installation

1. Remove retaining screw that secures the control assembly to left radiator support.

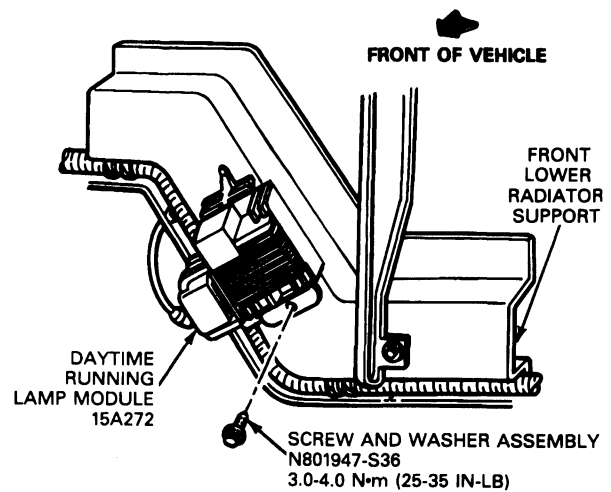
2. Disconnect electrical connector and remove control assembly.

For installation, follow removal procedures in reverse order. Tighten retaining screw to 2.55-3.16 N·m (23-28 in-lb).

REMOVAL AND INSTALLATION (Continued)

Daytime Running Lamp Control Assembly,
F-150-250-350, F-Super Duty and Bronco

K17369-B

Daytime Running Lamp Control Assembly,
E-150-250-350VIEW SHOWING INSTALLATION OF
DAYTIME RUNNING LAMP MODULE
(CANADIAN VEHICLES ONLY)

K17371-B

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N·m	In-Lb
Screw, Retaining	2.55-3.16	23-28
Screw and Washer Assembly (Canadian Vehicles Only)	3.0-4.0	25-35

GROUP

ELECTRICAL
DISTRIBUTION

18
(14000)

SECTION 18-01 Wiring and Circuit Protection

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION	
Fuse Link.....	18-01-4	Fuse Link.....	18-01-5
Fuse Panels.....	18-01-1	Harness Connectors.....	18-01-7
DIAGNOSIS AND TESTING		SPECIAL SERVICE TOOLS.....	18-01-57
Fuse Link Continuity Test.....	18-01-4	SPECIFICATIONS.....	18-01-49
		VEHICLE APPLICATION.....	18-01-1

VEHICLE APPLICATION

E-150-250-350, F-150-250-350, F-Super Duty Chassis Cab, Bronco Commercial Chassis and Motorhome Chassis

DESCRIPTION

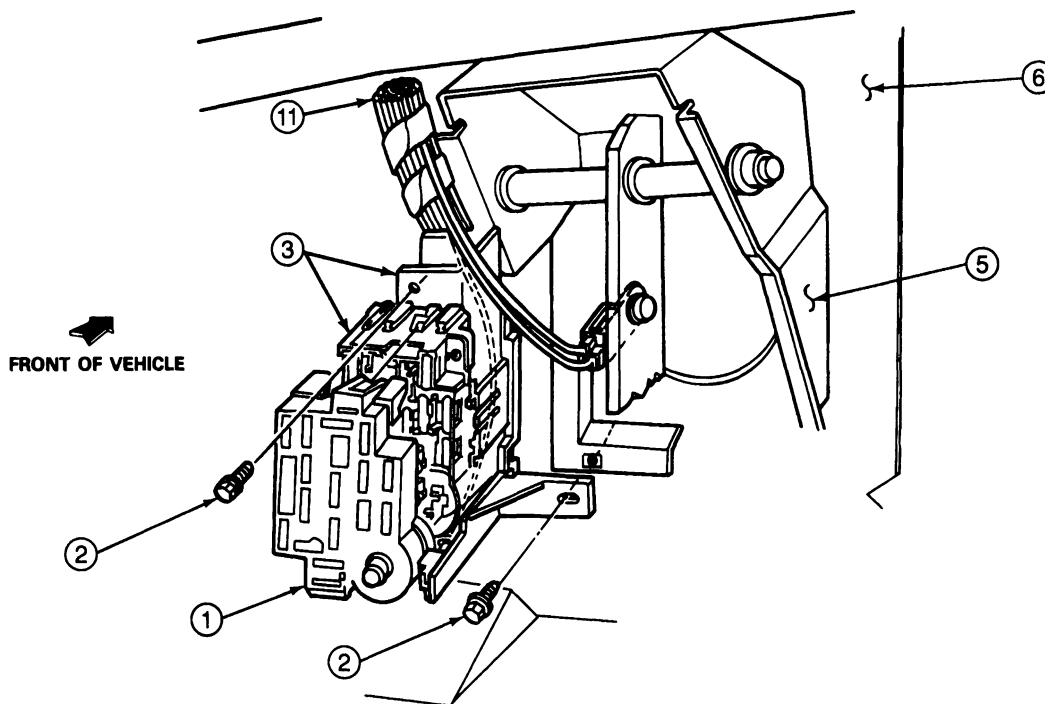
Fuse Panels

Each vehicle has a fuse panel which contains most of the fuses used in the electrical system. The fuse panel for E-150-250-350 is located on a mounting bracket under the instrument panel left of the steering column. The fuse panel for the E-350 Commercial Chassis is located under the instrument panel to the left of the steering column. The fuse panel for the RV Chassis is located on a bracket attached to the brake pedal. The fuse panels for F-150-250-350, F-Super Duty Chassis and Bronco are located on instrument panel behind access door, left of the steering column.

The circuit protection charts in Specifications give the location and values of all the circuits containing fuses or circuit breakers for the various vehicle lines.

DESCRIPTION (Continued)

Fuse Panel, E-150-250-350



K17881-A

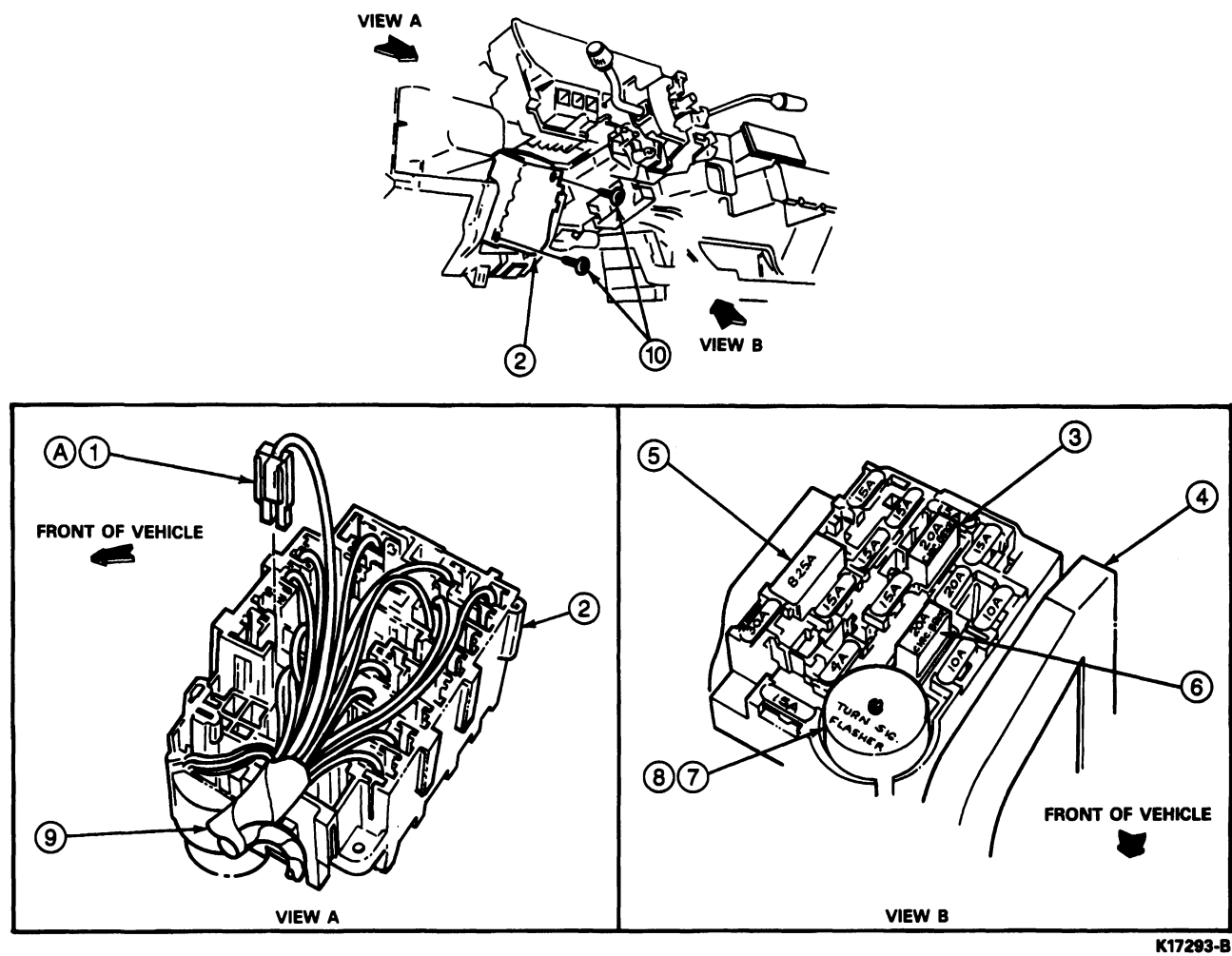
FUSE PANEL, E-150-250-350 (LEGEND)

Item No.	Part Number	Description
1	14A075	Fuse Panel Block Cover
2	N800947-S36	Screw and Washer
3	—	Fuse Panel and Bracket Assembly
5	—	Brake Support Bracket
6	—	Inner Dash Panel Assembly
11	14A200	Wiring Assembly

CK17882-A

DESCRIPTION (Continued)

Fuse Panel, F-150-250-350, F-Super Duty and Bronco



FUSE PANEL, F-150-250-350, F-SUPER DUTY AND BRONCO (LEGEND)

Item No.	Part Number	Description
1	14401	Wiring Assembly — Main
2	14401	Fuse Panel
3	14526	Circuit Breaker (20 Amp)
4	—	Fuse Panel Bracket
5	14526	Circuit Breaker (8.25 Amp)

Item No.	Part Number	Description
6	14526	Circuit Breaker (20 Amp)
7	13350	Turn Signal Flasher Assembly
8	13350	Turn Signal Flasher Assembly
9	14401	Wiring Assembly
10	N803877-S36B	Screw

CK17294-A

DESCRIPTION (Continued)

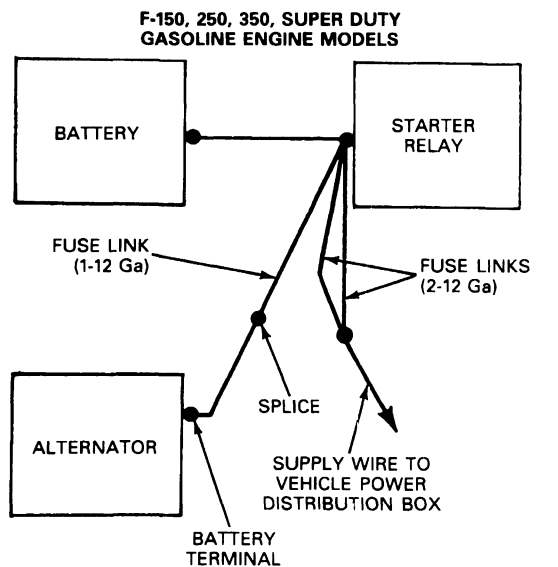
Fuse Link

The fuse link is a short length of special, Hypalon (high temperature) insulated wire, integral with the engine compartment wiring harness and should not be confused with standard wire. It is several wire gauges smaller than the circuit which it protects.

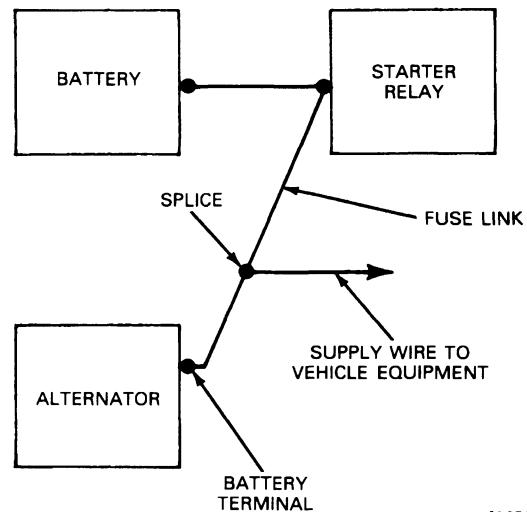
CAUTION: Under no circumstances should a fuse link replacement repair be made using a length of standard wire cut from bulk stock or from another wiring harness.

The higher melting temperature properties and additional thickness of the Hypalon insulation will usually allow the undersized internal fuse wire to melt and disintegrate within the Hypalon casing with little damage to the high temperature insulation other than discoloration and / or bubbling of the insulation surface. In extreme cases of excessive circuit current the insulation may separate after the fuse wire has disintegrated. However, the bare wire will seldom be exposed. When it becomes difficult to determine if the fuse link is burned open, perform a continuity test. When heavy current flows, such as when a booster battery is connected incorrectly or when a short to ground occurs in the wiring harness, the fuse link burns out and protects the generator (alternator) and / or wiring.

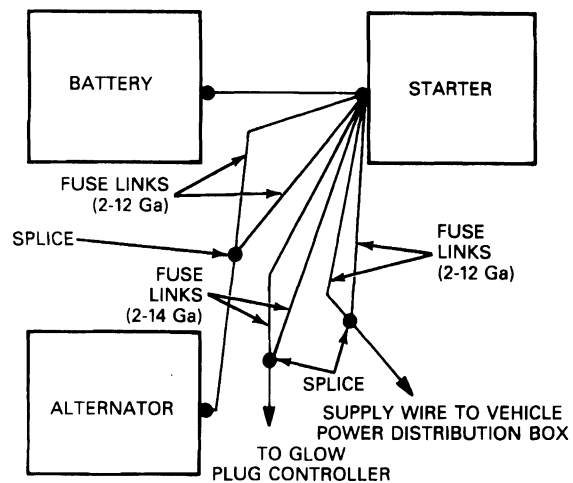
Production fuse links have color coded insulation on the wire or on the terminal insulator. Color identification of the insulation or connector is blue — 20 gauge wire, brown — 18 gauge wire, black — 16 gauge wire, green — 14 gauge wire, or grey — 12 gauge wire. The illustration shows typical fuse link installations.

F-150-250-350, F-Super Duty Gasoline Engine Models

K19625-A

Light Truck with Charge Indicator Light

J1432-J

F-250-350, F-Super Duty Diesel Engine Models

K19629-A

DIAGNOSIS AND TESTING**Fuse Link Continuity Test**

1. Make certain battery is OK, then turn headlamps or any accessory on. If the headlamps or an accessory do not operate, a fuse link is probably burned out.

DIAGNOSIS AND TESTING (Continued)

2. Where there are two fuse links, repeat Step 1 to test the fuse link that protects the vehicle equipment.
To test the fuse link that protects the alternator, make certain the battery is OK, then check with a voltmeter or 12-volt test lamp for voltage at the BAT terminal of the generator (alternator). No voltage indicates the generator (alternator) fuse link is probably burned out.

REMOVAL AND INSTALLATION**Fuse Link****Removal and Installation**

NOTE: The E-350 Commercial Chassis Vehicles use many of the same electronic components as the Econoline E-350 Van. These components, however, are located in different locations and the removal and installation procedures are different.

If it becomes necessary to replace a fuse link in a wiring assembly, make sure the replacement fuse link is a duplicate of the one removed with respect to gauge, length and insulation. Original Ford replacement fuse links have insulation that is flameproof. Do not fabricate a fuse link from ordinary wire because the insulation may not be flameproof.

If a circuit protected by a fusible link becomes inoperative, inspect for a blown fuse link. If the fuse link wire insulation is burned or opened, disconnect the feed wire part of the wiring and cut out the damaged portion as close as possible behind the splice in the harness. If the damaged fuse link is between two splices (weld points in the harness), cut out the damaged portion as close as possible to the weld points.

To service any blown fuse link use the following procedure:

1. Determine which circuit is damaged, its location and the cause of the open fuse link. If the damaged fuse link is one of three fed by a common No. 10 or 12 gauge feed wire, determine the specific affected circuit.
2. Disconnect the battery ground cable.
NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.
3. Cut the damaged fuse link from the wiring harness and discard it. If the fuse link is one of three circuits fed by a single feed wire, cut it out of the harness at each splice end and discard it.

4. Identify and procure the proper fuse link and butt connectors for attaching the fuse link to the harness.
5. Strip wires 7.6 mm (0.3 inch) and insert into proper gauge wire connector.
6. Crimp and heat splice insulation until tubing shrinks and adhesive flows from each end of connector.
7. To service a two-link group when only one link has blown and other link is not damaged:
 - a. Cut out blown link (two places).
 - b. Position correct eyelet type service fusible link, bare butt connector and insulation tubing.
 - c. Crimp connector and heat insulation until tubing shrinks and adhesive flows from each end of connector.
8. To replace any fuse link on a single circuit in a harness, cut out the damaged portion, strip approximately 12.7mm (1 / 2 inch) of insulation from the two wire ends and attach the appropriate replacement fuse link to the stripped wire ends with two proper size butt connectors.
9. If the damaged fuse link is between two splices (weld points in the harness), cut out the damaged portion as close to the weld points as possible.
10. To repair any fuse link which has an eyelet terminal on one end such as the charging circuit, cut off the open fuse link behind the weld, strip approximately 12.7mm (1 / 2 inch) of insulation from the cut end and attach the appropriate new eyelet fuse link to the cut stripped wire with an appropriate size butt connector.
11. Connect negative battery cable to battery and test the system for proper operation.

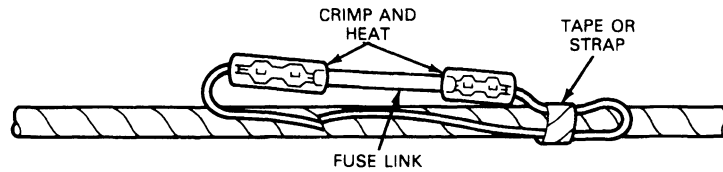
NOTE: Do not mistake a resistor wire for a fuse link. The resistor wire is generally longer and has print stating, "Resistor — don't cut or splice."

NOTE: When attaching a single No. 16, 18 or 20 gauge fuse link to a heavy gauge wire, always double the stripped wire end of the fuse link before inserting and crimping it into the butt connector for positive wire retention.

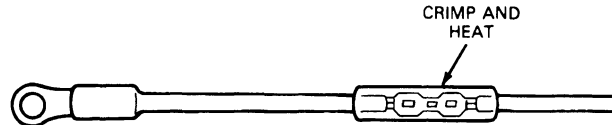
NOTE: Always attempt to make replacement link as close in length as original damaged link.

REMOVAL AND INSTALLATION (Continued)

Fuse Link Repair Procedure



TYPICAL REPAIR FOR ANY IN-LINE FUSE LINK USING THE SPECIFIED GAUGE FUSE LINK FOR THE SPECIFIC CIRCUIT



TYPICAL REPAIR USING THE EYELET TERMINAL FUSE LINK OF THE SPECIFIED GAUGE FOR ATTACHMENT TO A CIRCUIT WIRE END

FUSE LINK AND BUTT CONNECTOR SERVICE PROCEDURES

J1704-2H

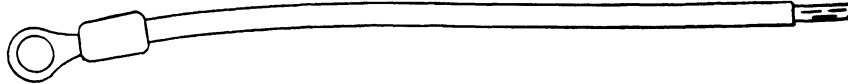
Fuse Link Identification

FUSE LINK AND BUTT CONNECTOR IDENTIFICATION WIRING ASSEMBLY — FUSE LINK (WITH INSULATION STRIPPED BOTH ENDS)



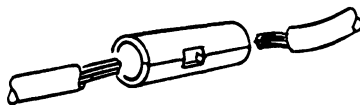
D3AZ-14A526-H	NO. 14 GA. WIRE — 9.00" ± .50 LENGTH (GREEN INSULATION)
D3AZ-14A526-J	NO. 16 GA. WIRE — 9.00" ± .50 LENGTH (ORANGE INSULATION) AS REQ'D
D3AZ-14A526-L	NO. 18 GA. WIRE — 9.00" ± .50 LENGTH (RED INSULATION) AS REQ'D
D3AZ-14A526-M	NO. 20 GA. WIRE — 9.00" ± .50 LENGTH (BLUE INSULATION) AS REQ'D

WIRING ASSEMBLY — FUSE LINK (WITH EYELET TERMINAL AND ONE END STRIPPED)



E9AZ-14526-A	NO. 12 GA. WIRE — 9.00" ± .50 LENGTH (GRAY INSULATION) AS REQ'D
D3AZ-14A526-D	NO. 14 GA. WIRE — 9.00" ± .50 LENGTH (GREEN INSULATION) AS REQ'D
D3AZ-14A526-E	NO. 16 GA. WIRE — 9.00" ± .50 LENGTH (ORANGE INSULATION) AS REQ'D
D3AZ-14A526-F	NO. 18 GA. WIRE — 9.00" ± .50 LENGTH (RED INSULATION) AS REQ'D
D3AZ-14A526-G	NO. 20 GA. WIRE — 9.00" ± .50 LENGTH (BLUE INSULATION) AS REQ'D

BUTT CONNECTOR — WIRING SPLICE

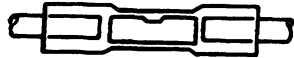


D3AZ-14488-Y	FOR NOS. 10 AND 12 GA. WIRE (LOAD CIRCUIT) AS REQ'D
D3AZ-14488-Z	FOR NOS. 14 AND 16 GA. WIRE (LOAD CIRCUIT) AS REQ'D

J1707-2F

REMOVAL AND INSTALLATION (Continued)

Butt Connector Service Procedure and Identification



1. STRIP WIRES 7.6mm (0.3 IN.)
INSERT INTO CRIMP BARREL



2. CRIMP USING CRIMP TOOL FOR
PREINSULATED CRIMPS

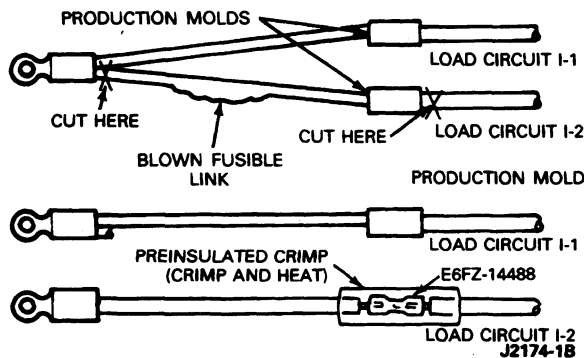


3. HEAT SPLICE WITH HEAT GUN UNTIL
TUBING SHRINKS AND ADHESIVE FLOWS
FROM EACH END.

PART NUMBER	PART NAME
E6FZ-14488-A	Butt Connector Gauge: 18-22, Color: Red
E6FZ-14488-B	Butt Connector Gauge: 14-16, Color: Blue
E6FZ-14488-C	Butt Connector Gauge: 10-12, Color: Yellow

J4334-1A

Fusible Link Service Procedure



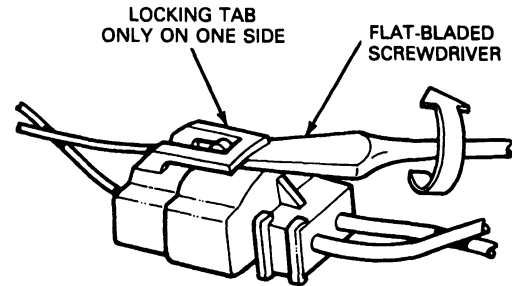
Harness Connectors

Removal and Installation

The various connector disengagement procedures should be used when disconnecting the various types of connectors.

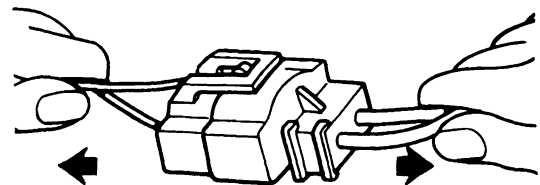
Using a Screwdriver

1. Insert a flat-bladed screwdriver under the locking tab and twist.
2. Turn connector over and repeat procedure on opposite side of connector.



K19268-A

3. Grasp the wires with both hands and pull the connector apart.

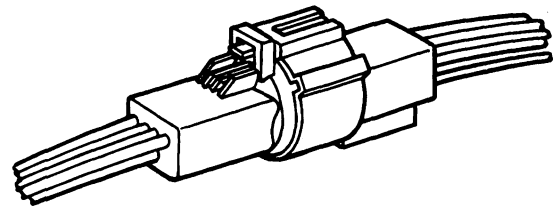


K19267-A

By Hand

CAUTION: Removal of connector by pulling wire will damage connector's locking mechanism, resulting in a loose fitting connection when installed.

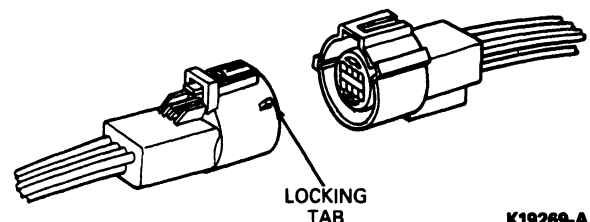
1. Grasp each end of connector body.



K19268-A

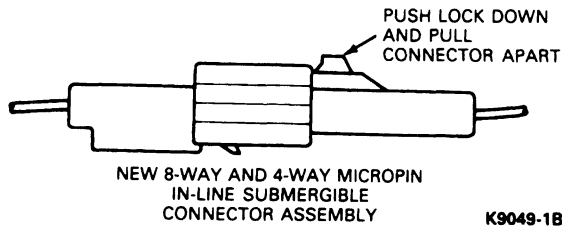
2. While holding connector body, use thumb pressure to depress locking tab and pull connector apart.

NOTE: Wiggling the parts will make separation easier.



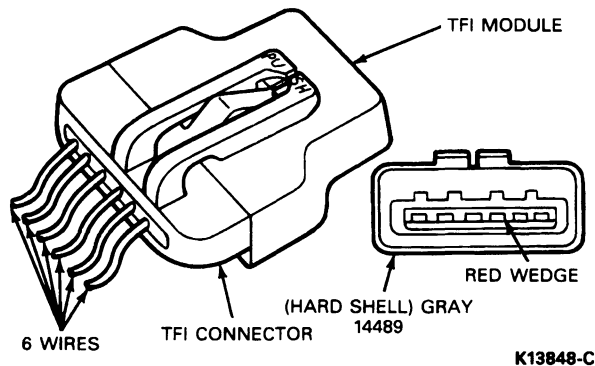
K19269-A

REMOVAL AND INSTALLATION (Continued)



TFI CONNETTOR DISENGAGEMENT PROCEDURE

1. GRASP CONNECTOR BY POSITIONING THUMB ON LOCKING TAB MARKED "PUSH".
2. WHILE DEPRESSING LOCKING TAB DOWNWARD, PULL BACKWARD ON CONNECTOR AND DISENGAGE. (NOTE: "WIGGLING" THE CONNECTOR WILL MAKE SEPARATION EASIER).



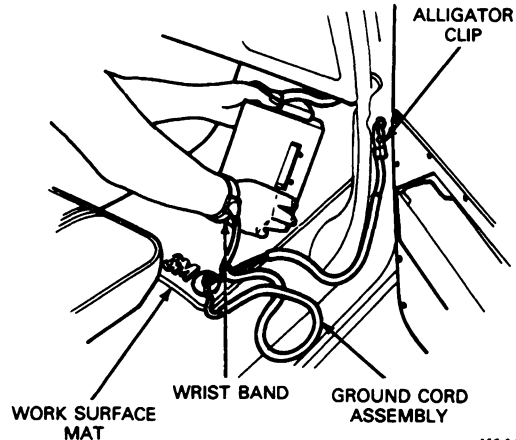
Service Precautions

Electronic modules such as instrument clusters, powertrain controls and radios incorporate the latest technology. Some of the components used in these modules are sensitive to static electricity damage at voltage levels far below what the human body can sense. While a person cannot feel or hear the "snap" of a static discharge until the charge level is about 3000 volts, some of the electronic module components can be damaged or weakened by as little as 100 volts.

Use the following safeguards to avoid static electrical damage.

1. Leave the electronic modules in their original packaging until ready to install in vehicles.
2. Avoid touching module connector pins.
3. Avoid laying modules on nonconductive surfaces.
4. As an added safeguard, use a 3M Static Protection Kit (3M part number 18293). This kit contains special wrist straps, a 15-inch by 24-inch flexible conductive mat, grounding cords and full instructions. It is available through local 3M Suppliers.

3M Static Protection Kit



STATIC CHARGE GENERATION VALUES

Activity	Relative Humidity	
	Low (10-20%)	High (65-80%)
Walking across carpet	35,000	1,500
Walking over vinyl floor	12,000	250
Working at bench	6,000	100
Sliding across vehicle seat	25,000	1,000

CK14478-1A

Removal and Installation

1. Disconnect battery ground cable.

NOTE: On vehicles equipped with EEC, when the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the Powertrain Control Module (PCM) relearns its adaptive strategy. The vehicle may need to be driven 10 miles or more to relearn the strategy.

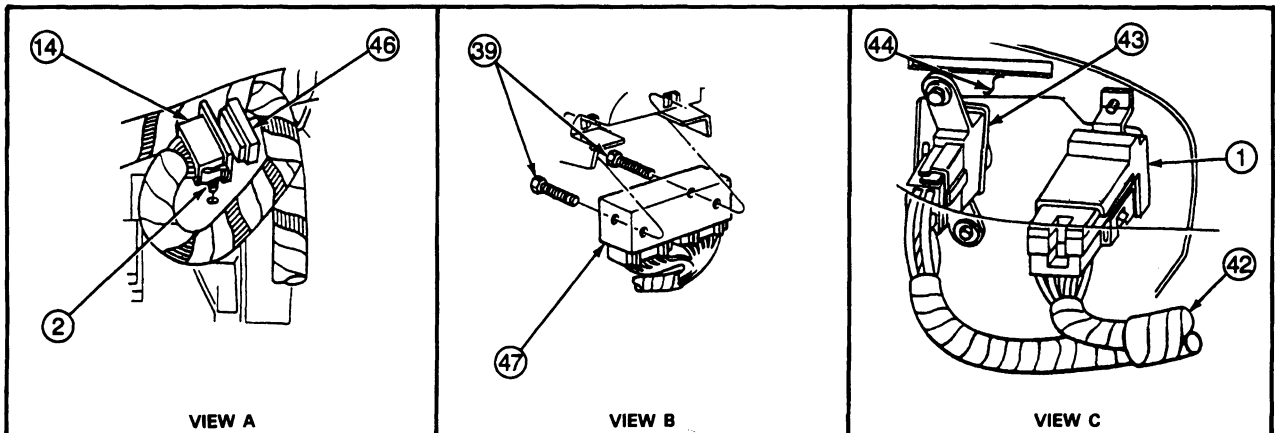
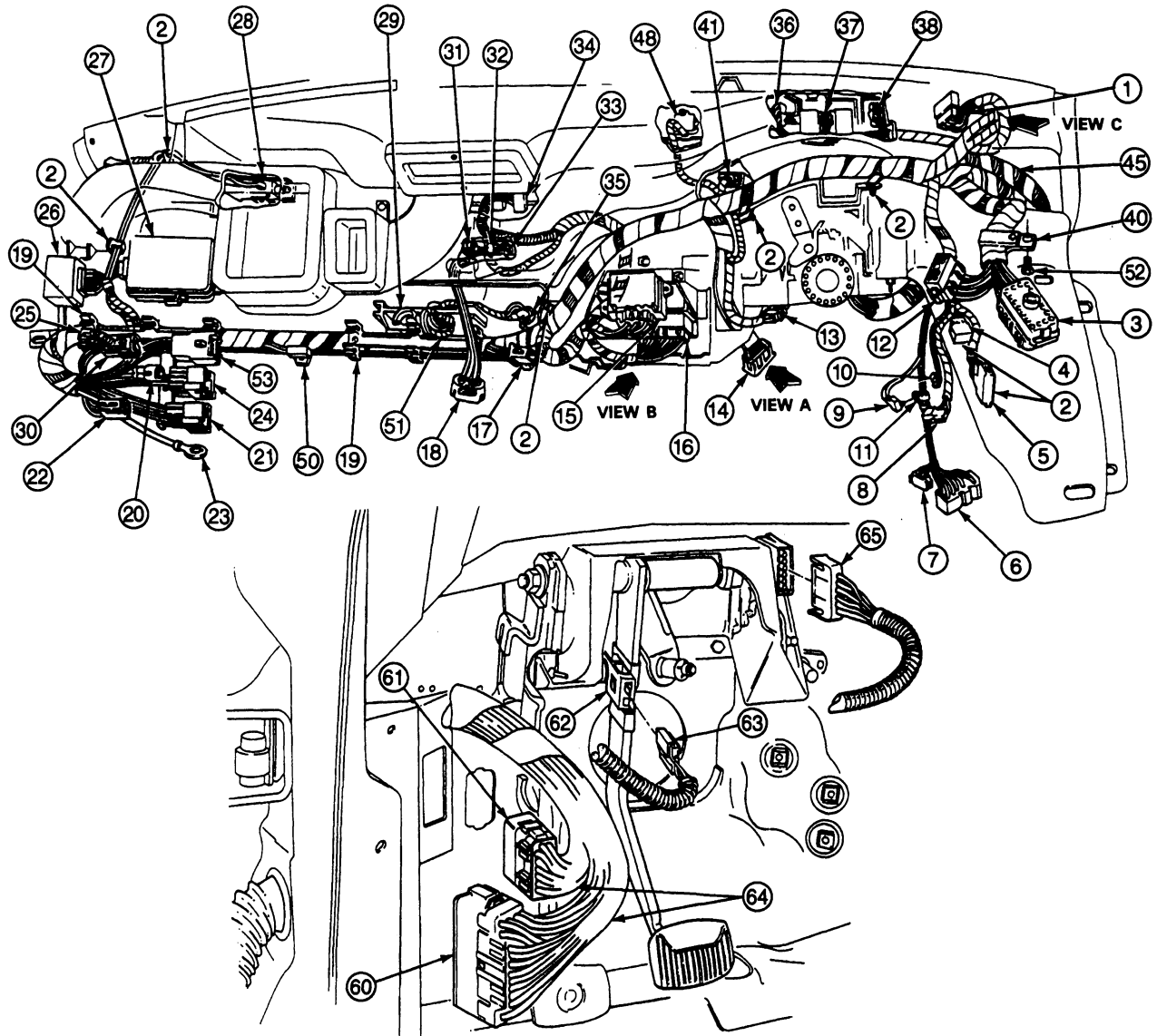
NOTE: Refer to Sections 01-05A and 01-05B if it is necessary to remove any trim panels to gain access to the harness.

2. Disconnect all wiring harness connectors.
3. Disengage harness from all locators, straps and /or clips as necessary, including ground wire eyelets. Remove harness from vehicle.

For installation, follow removal procedure in reverse order.

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Wiring Installation, F-150-250-350, F-Super Duty Chassis Cab and Bronco (Gas Engines)



K17295-A

REMOVAL AND INSTALLATION (Continued)

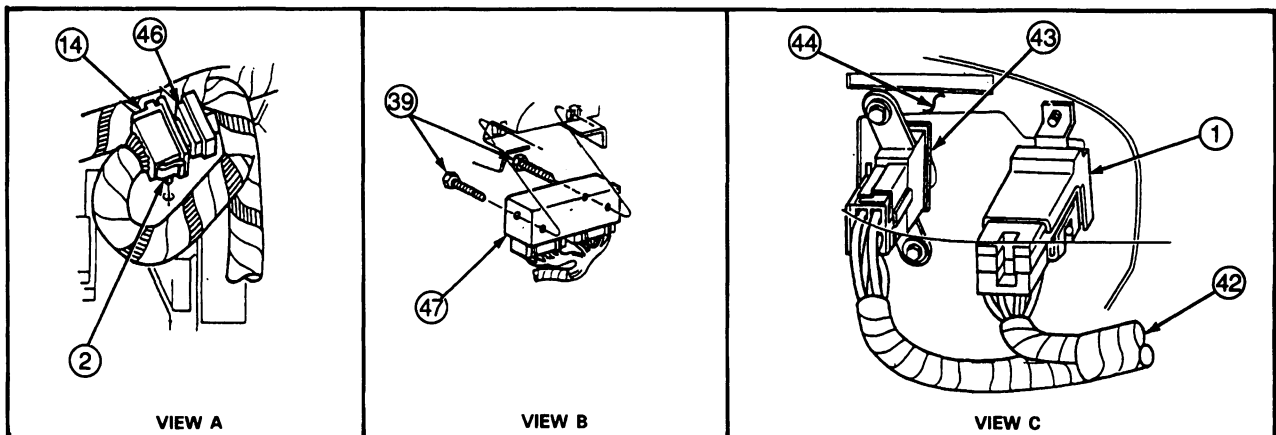
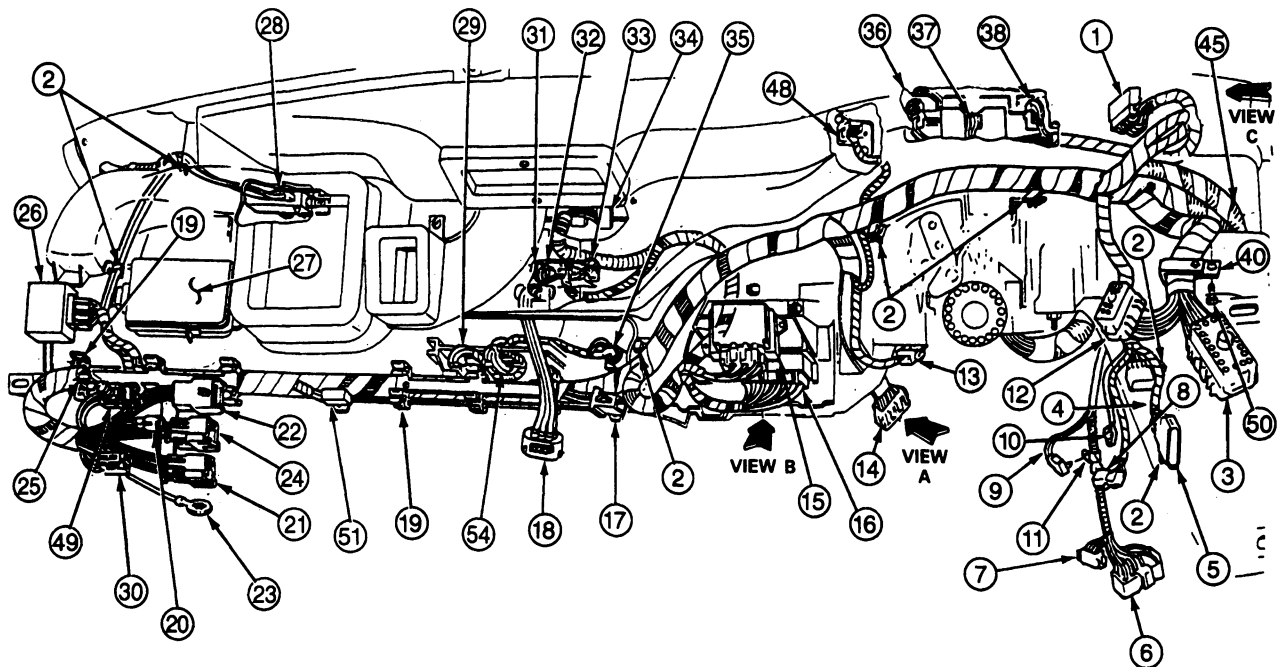
Item	Part Number	Description
1	—	To Headlamp Switch
2	13A506	Locator, Position in Hole Provided
3	14A464	To 12A581 for Continuation
4	14A459	To 14504
5	14A459	To 14504
6	—	To Multi-Function Switch
7	—	To Multi-Function Switch
8	—	To Stoplamp Switch
9	—	E4OD Pigtail
10	—	To Park Signal Lamp Switch
11	13A506	Clip P.I.A. To 14401
12	14A464	To 14405
13	14489	To 9C899
14	—	To Clutch Interlock Switch
15	—	To Warning Buzzer Chime
16	—	To Speed Control Amplifier
17	—	To Trailer Brake Controller
18	—	Vacuum Hose Clip
19	14A099	Shield
20	—	To Right Courtesy Lamp Switch
21	14A459	To 18A586
22	—	To Inertia Switch
23	14463	To Ground
24	14A459	To 14630
25	—	To Brake Anti-Lock Module Keep Alive Circuit
26	—	To Wiper Control Module
27	—	To Rear Brake Anti-Lock Module (F-150-250-350 Only)
28	—	To Glovebox Lamp

(Continued)

Item	Part Number	Description
29	—	Cigar Lighter
30	14A459	To Clearance Lamp F-Series Only For Continuation
31	—	To Heater Mode Switch
32	—	To A/C Illumination
33	—	To A/C Blower Switch
34	—	To Radio
35	—	To Power Point
36	—	To Cluster
37	—	To PSOM
38	—	To Cluster
39	N803876-S36B	Screw
40	14A282	Retainer Assembly
41	—	To 14A262 Electric Defrost
42	14401	Wiring Assembly
43	—	To Fuel Tank Selector Switch
44	—	Instrument Panel
45	14401	To Fusebox
46	14B155	Cap
47	14A163	Retainer Assembly
48	—	Shift On The Fly Switch
49	—	Bracket
50	—	PSOM Test Circuit
51	—	To Ashtray
52	N606678-S2	Screw
53	14A459	To 7A786
54	19A123	Retainer Assembly
55	19A123	Retainer Assembly
60	14A464	To Bulkhead
61	14A464	To Bulkhead
62	—	To Stoplamp Switch
63	—	To Stoplamp Switch
64	14401	Wiring Assembly
65	—	To Clutch Interlock Switch

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Wiring Installation, F-150-250-350, F-Super Duty Chassis Cab (Diesel Engine)



K17297-A

Item	Part Number	Description
1	—	To Headlamp Switch
2	13A506	Locator Position in Hole Provided
3	14A464	To 12A581
4	14A459	To 14A504
5	14A459	To 14A504
6	—	To Multi-Function Switch
7	—	To Multi-Function Switch
8	—	To Stoplamp Switch
9	—	E4OD Pigtail
10	—	To Park Signal Lamp Switch
11	13A506	Clip PIA To 14401
12	14A464	To 14405

(Continued)

Item	Part Number	Description
13	14489	To 9C899
14	—	To Clutch Interlock Switch
15	—	To Warning Buzzer Chime
16	—	To Speed Control Amplifier
17	—	To Trailer Brake Controller
18	—	Vacuum
19	14A099	Shield
20	—	To Right Courtesy Lamp Switch
21	14A459	To 18A856
22	14A459	To 7A786
23	14463	To Ground
24	14A459	To 14630

(Continued)

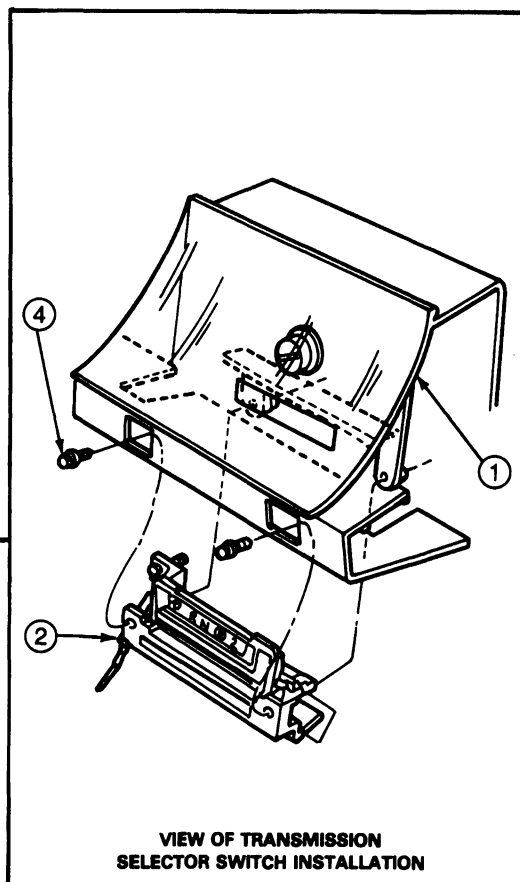
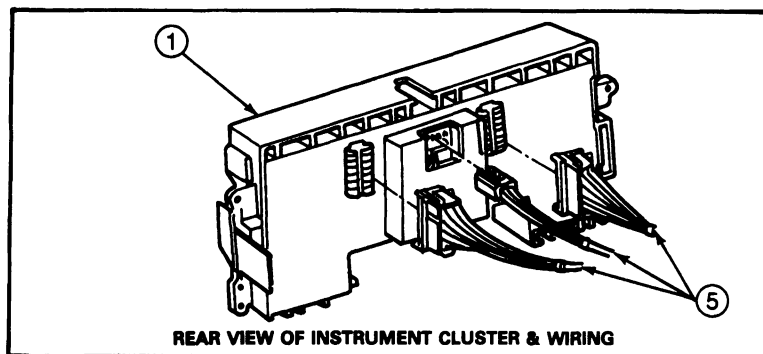
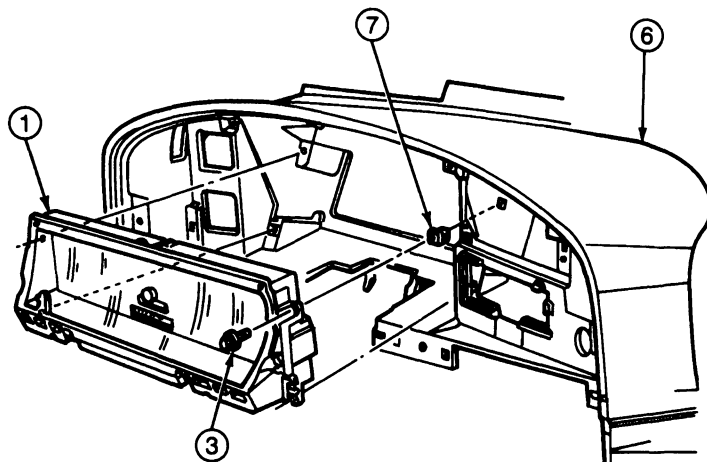
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
25	—	To Brake Anti-Lock Module
		Keep Alive Circuit
26	17D539	Wiper Control Module
27	—	To Rear Brake Anti-Lock
		Module (F-150-250-350
		Only)
28	—	To Glovebox Lamp
29	—	Cigar Lighter
30	—	To Inertia Switch
31	—	To Heater Mode Switch
32	—	To A/C Illumination
33	—	To A/C Blower Switch
34	—	To Radio
35	—	To Power Point
36	—	To Cluster
37	—	To PSOM
38	—	To Cluster

(Continued)

Item	Part Number	Description
39	N803876-S36B	Screw
40	14A282	Retainer Assembly
41	—	Bracket
42	14401	Wiring Assembly
43	—	Fuel Tank Selector Switch
44	—	Instrument Panel
45	14401	To Fuse Box
46	14B155	Cap
47	14A163B	Retainer Assembly
48	14489	To 3x3 Warning Module
49	14A459	To Clearance Lamp F-Series
		Only
50	N606678-S2	Screw
51	—	PSOM Test Circuit
52	19A123	Retainer Assembly
53	19A123	Retainer Assembly
54	—	To Ash Tray

Instrument Cluster and Wiring, E-Series



K17299-A

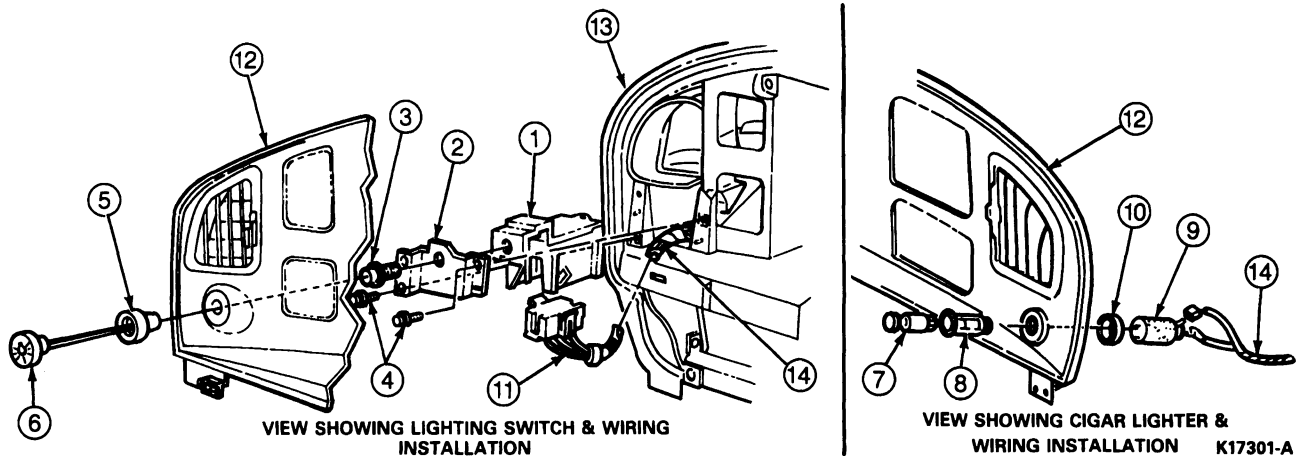
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	10849	Cluster Assembly
2	7B053	Transmission Selector Switch Assembly
3	N803876-S36B	Screw

(Continued)

Item	Part Number	Description
4	N800705-S2	Screw
5	14401	Wiring Assembly
6	—	Instrument Panel Assembly
7	—	Nut

Lighting Switch and Cigar Lighter Installation



LIGHTING SWITCH AND CIGAR LIGHTER INSTALLATION (LEGEND)

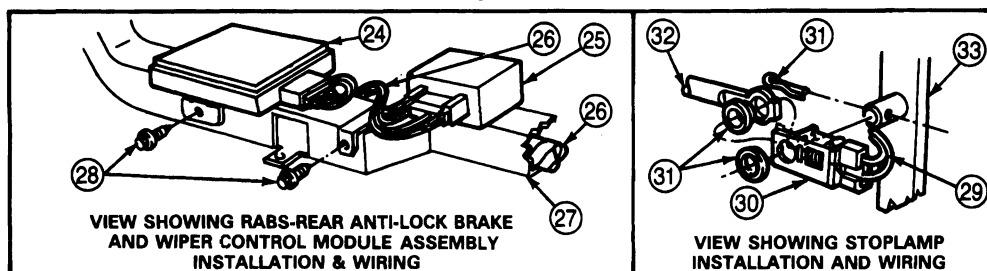
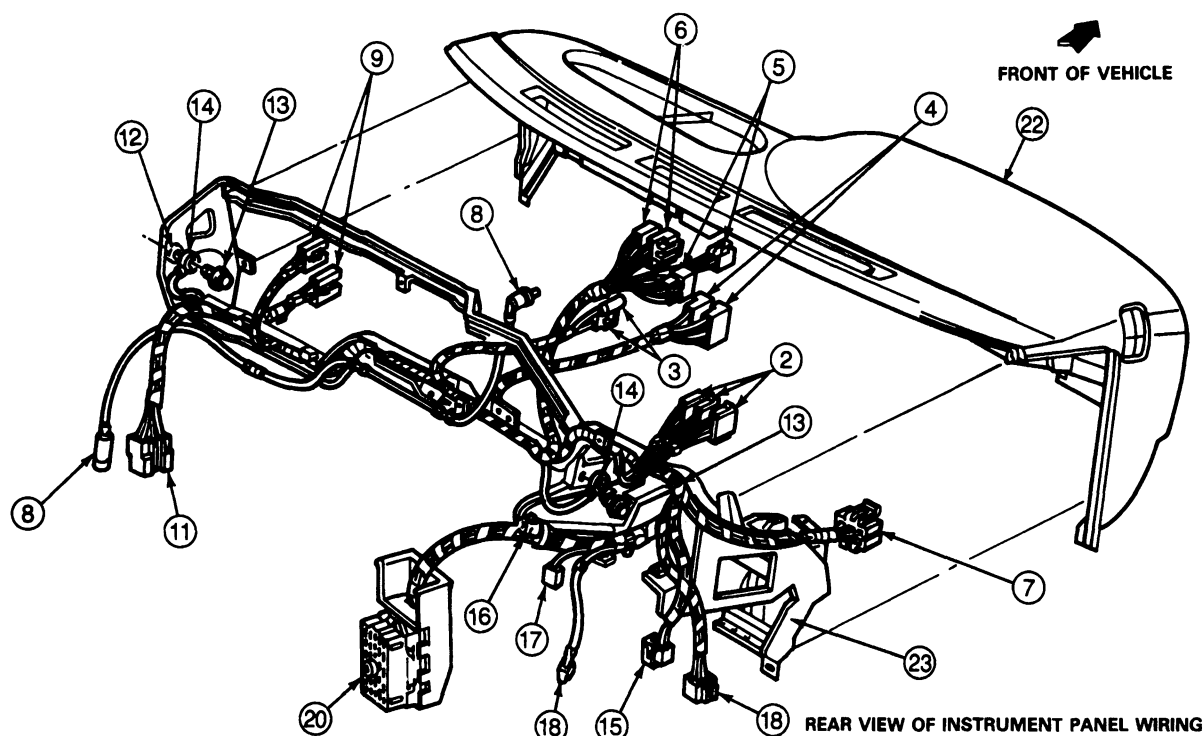
Item No.	Part Number	Description
1	11654	Headlamp Switch Assembly
2	15057	Light Switch Bracket Assembly
3	11650	Nut
4	N803876-S36B	Screw 2.1-2.9 N·m (19-25 In-Lb)
5	11A656	Bezel
6	11689	Knob and Shaft Assembly
7	11502	Knob and Element Assembly

Item No.	Part Number	Description
8	15055	Socket and Retainer Assembly
9	19N236	Socket Power Assembly
10	—	Bezel
11	14401	Wiring Assembly
12	—	Finish Panel
13	—	Instrument Panel
14	14401	Wiring Assembly

CK17302-A

REMOVAL AND INSTALLATION (Continued)

Instrument Panel Wiring



K17303-B

Item	Part Number	Description
2	—	To Cluster Assembly
3	—	To Cigar Lighter Assembly
4	—	To Radio Receiver Assembly
5	—	To A/C and Auxiliary Blower Switch Assembly
6	—	To Illumination A/C and Heater Control and A/C Module Switch Assembly
7	—	To Lighting Switch Assembly
8	—	Antenna Lead in Cable
9	—	To Wiper Control Module and RABS Module Assembly
10	—	Place Locator in Holes Provided
11	—	To 14A200 Wiring Assembly
12	—	Existing Weld Nut
13	N805375	Ground Screws
14	—	Ground Leads

(Continued)

Item	Part Number	Description
15	—	To Anti-Theft Light Indicator
16	—	To Modified Vehicle Accessory
17	—	To PSOM Test
18	—	To Parking Brake Switch Assembly
19	—	To Diesel Warning Lamp
20	12A581	Connector
22	—	Instrument Panel
23	—	Instrument Panel Steels
24	—	Rear Anti-Lock Brake Module Assembly
25	—	Wiper Control Module
26	14401	Wiring Assembly
27	—	Front of Instrument Panel Steels
28	—	Screw and Washer Assembly
29	14A200	Wiring Assembly

(Continued)

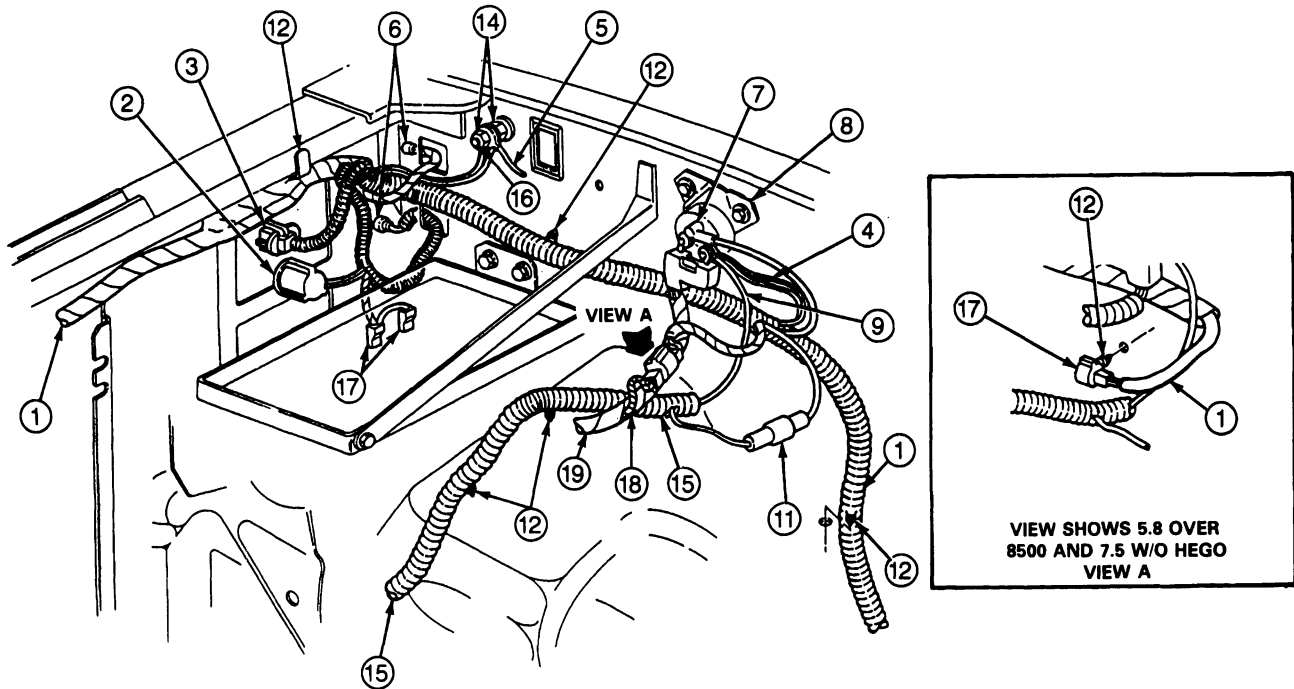
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
30	13480	Stoplamp Switch Assembly
31	—	Chassis Parts

(Continued)

Item	Part Number	Description
32	—	Part of Master Cylinder
33	—	Brake Pedal Assembly

Fender Apron, Right, F-150-250-350, F-Super Duty Chassis Cab and Bronco with 4.9L, 5.0L, 5.8L and 7.5L Engines



K17305-A

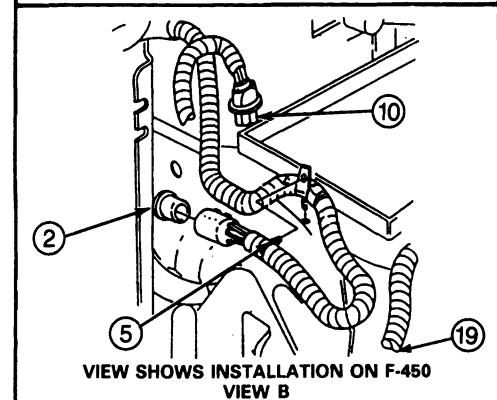
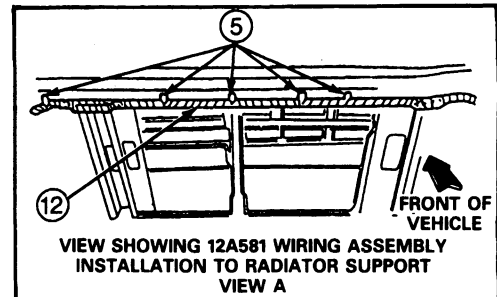
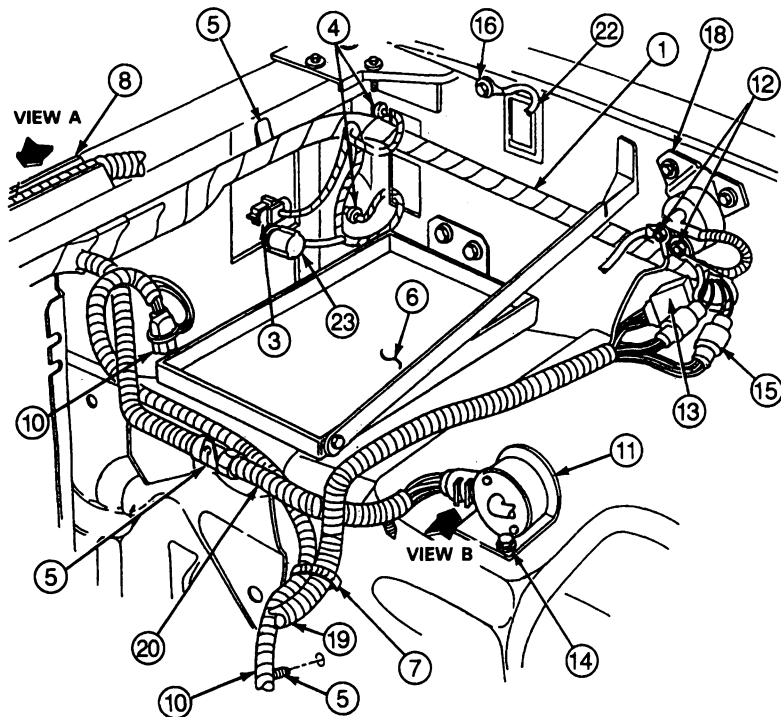
Item	Part Number	Description
1	12A581	Wiring Assembly
2	—	To Right Park and Turn Lamp
3	—	To Right Headlamp
4	—	To Starter Motor Relay
5	—	To Ground
6	—	To Right Park
7	—	To Starter Motor Relay Start Terminal
8	11450	Starter Motor Relay Assembly

(Continued)

Item	Part Number	Description
9	14305	To Starter Motor Relay
11	—	To 14350
12	—	Place Locator in Hole Provided
14	N621906-S36	Nut
15	14350	Wiring Assembly
16	N806182-S36	Stud
17	—	Cap
18	12A690	Hego Assembly — All Gas Engines Except 5.8L Over 8500 and 7.5L
19	14B060	Wiring Assembly

REMOVAL AND INSTALLATION (Continued)

Fender Apron, Right, F-250-350, F-Super Duty Chassis Cab with 7.3L Diesel Engine



K17307-A

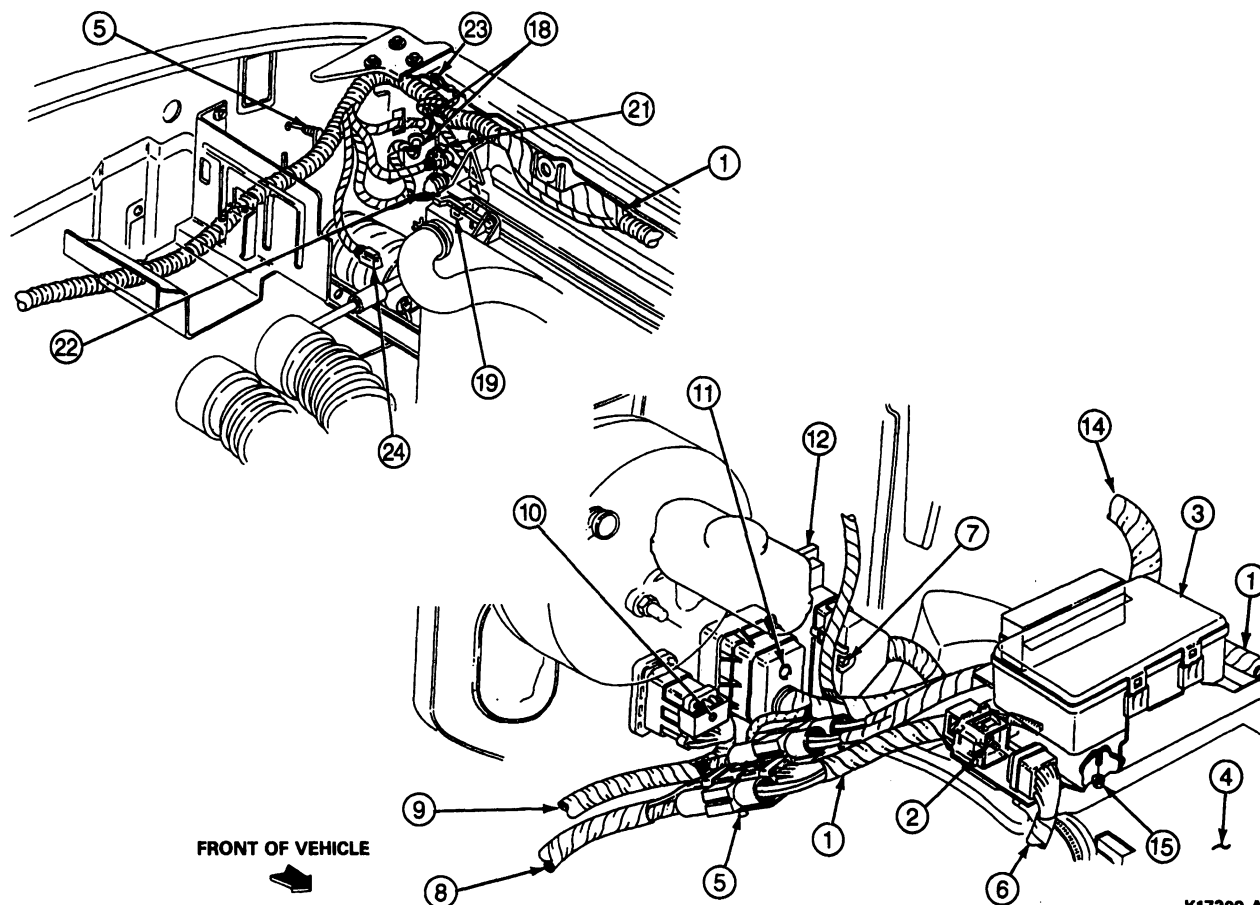
Item	Part Number	Description
1	12A581	Wiring Assembly
2	14A457	Cap — F-Super Duty Only
3	—	To Headlamp
4	—	To Right-Hand Park Lamps
5	—	Locator Position in Hole Provided
6	—	Battery Tray
7	—	Bundle Strap
8	14A099	Trough
10	6B018	Wiring Assembly

(Continued)

Item	Part Number	Description
11	—	Low Vacuum Warning Switch and Bracket Assembly
12	—	Existing Screw
13	10316	Voltage Regulator
14	N803991-S36	Screw
15	—	Connector — E4OD Only
16	N805375-S36MG	Screw 7-17 N·m (5.2-12 Ft·Lb)
18	—	Starter Motor Relay
19	14305	Wiring Assembly
20	14301	Cable Assembly
22	—	To Ground
23	—	To Right Park

REMOVAL AND INSTALLATION (Continued)

Fender Apron, Left, F-150-250-350, F-Super Duty and Bronco with 4.9L, 5.0L, 5.8L and 7.5L Chassis Cab Engines

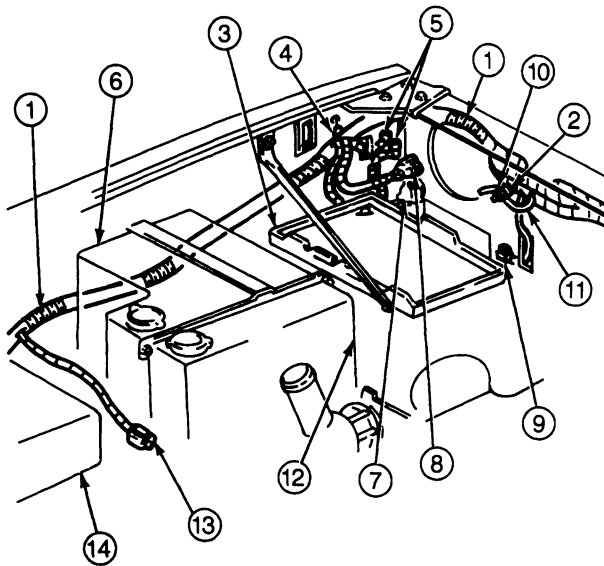


K17309-A

Item	Part Number	Description
1	12A581	Wiring Assembly
2	12A581	Wiring 42 Way Bolt 4.5-6.8 N-m (40-60 In-Lb)
3	—	Power Network Box
4	—	Air Cleaner
5	—	Position Locator in Hole Provided
6	9D930	Wiring Assembly
7	12A581	Wiring Assembly EEC Connector Bolt 4.5-6.8 N-m (40-60 In-Lb)
8	15525	Wiring Assembly
9	14405	Wiring Assembly

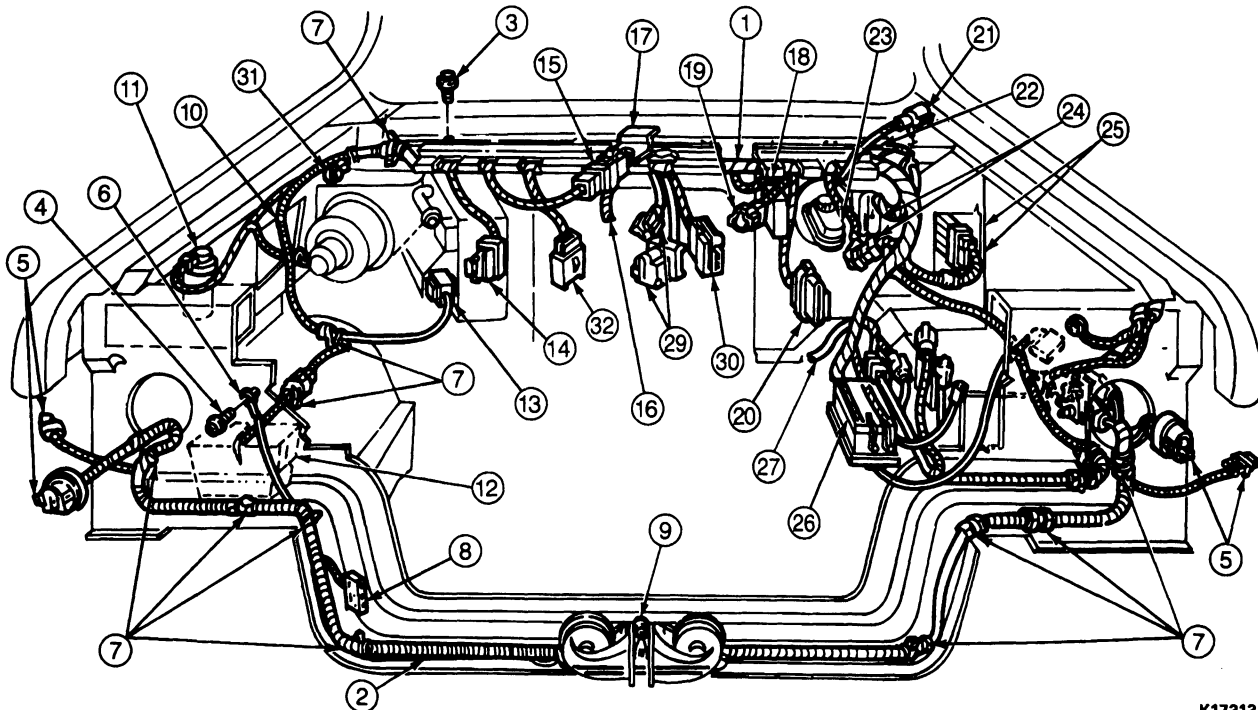
(Continued)

Item	Part Number	Description
10	14405	Wiring Assembly Bulkhead 24 Way Bolt 4.5-6.8 N-m (40-60 In-Lb)
11	12A581	Wiring Assembly Bulkhead 76 Way Bolt 4.5-6.8 N-m (40-60 In-Lb)
12	—	EEC Module
14	—	To TFI Module
15	N621907-S102	Nut 4.5-6.8 N-m (40-60 In-Lb)
18	—	To Left Parking Lights
19	—	To Canadian Running Lamp Module
21	—	To Left Headlamp
22	—	To Left Turn and Park
23	N805375-S36MG	Screw 7-11 N-m (5.2-8 Ft-Lb)
24	—	To Windshield Washer Pump

REMOVAL AND INSTALLATION (Continued)**Fender Apron, Left, F-250-350, F-Super Duty Chassis Cab with 7.3L Diesel Engine without E4OD Transmission**

Item	Part Number	Description
1	12A581	Wiring Assembly
2	N806182-S36	Stud
3	—	Battery Tray
4	—	Locator Position in Hole Provided
5	—	To Left Park
6	—	Coolant Reservoir
7	—	To Left Park and Turn
8	—	To Left Headlamp
9	—	To Canadian Running Lamp Module
10	N621906-S36	Nut
11	—	To Ground
12	—	Windshield Washer
13	—	To Windshield Washer Motor
14	—	Power Network Box

K17311-A

Engine Compartment Wiring, E-Series

K17313-A

REMOVAL AND INSTALLATION (Continued)

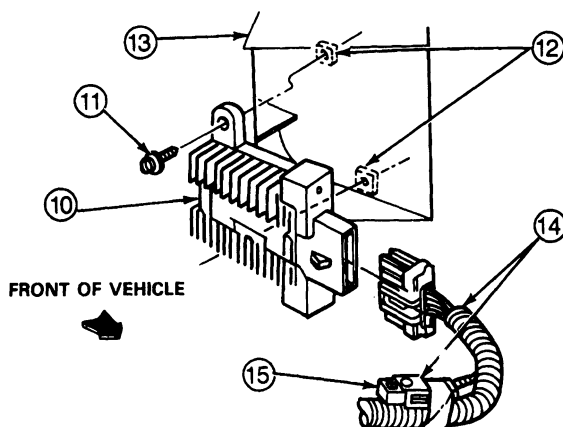
ENGINE COMPARTMENT WIRING, E-SERIES (LEGEND)

Item No.	Part Number	Description
1	12A581	Wiring Assembly
2	14290	Wiring Assembly
3	55907-S2	Screw and Washer Assembly
4	N804057-S2	Ground Screw
5	—	Headlamp and Park/Turn Signal
6	—	Ground Lead
7	—	Locator, Place in Hole Provided
8	—	To Daytime Running Lamp Module
9	—	Horn and Bracket
10	—	To Blower Motor
11	—	To A/C Pressure Switch Assembly
12	—	Windshield Washer Reservoir
13	—	To Blower Motor Resistor
14	—	To Map Sensor Assembly
15	—	42-Way Connector
16	9D930	Wiring Assembly

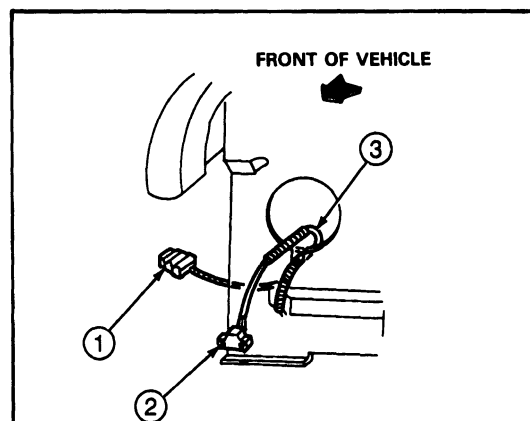
Item No.	Part Number	Description
17	—	Bracket
18	—	To EEC Module
19	—	To 14105 Wiring Assembly
20	—	To Speed Control Module
21	—	To Hood Lamp Assembly
22	—	To Windshield Washer Motor
23	—	To Brake Warning Switch
24	—	76-Way Connector
25	—	TFI Module Assembly
26	—	High Current Fuse Panel Assembly
27	—	To 14406 Wiring Assembly
29	—	To 9D910 Wiring Assembly
30	—	To A/C Compressor Clutch
31	—	RABS Test Connector
32	—	To Engine Wiring

CK17314-A

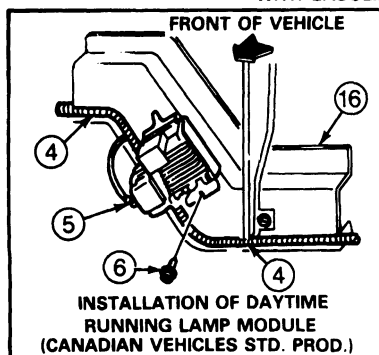
Front End Wiring, Low Series, Headlamps, Turn Signals, Horns, Daytime Running Lamp and Ignition Control Module Installation and Wiring



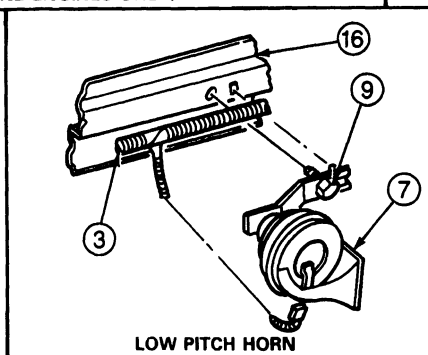
T.F.I. MODULE ASSY. SHORTING BAR & WIRING INSTALLATION
(USED ONLY FOR VEHICLES EQUIPPED WITH GASOLINE ENGINES ONLY)



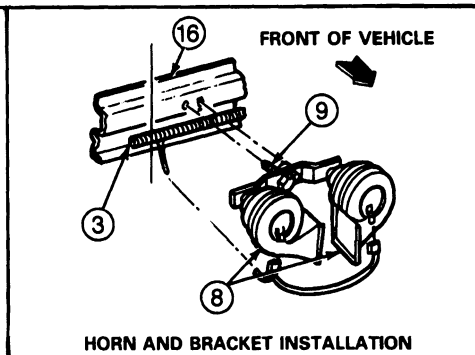
LOW SERIES HEADLAMP CONNECTORS & WIRING
(R.H. SHOWN, L.H. SYMMETRICALLY OPPOSITE)



INSTALLATION OF DAYTIME RUNNING LAMP MODULE
(CANADIAN VEHICLES STD. PROD.)



LOW PITCH HORN



HORN AND BRACKET INSTALLATION

K17315-A

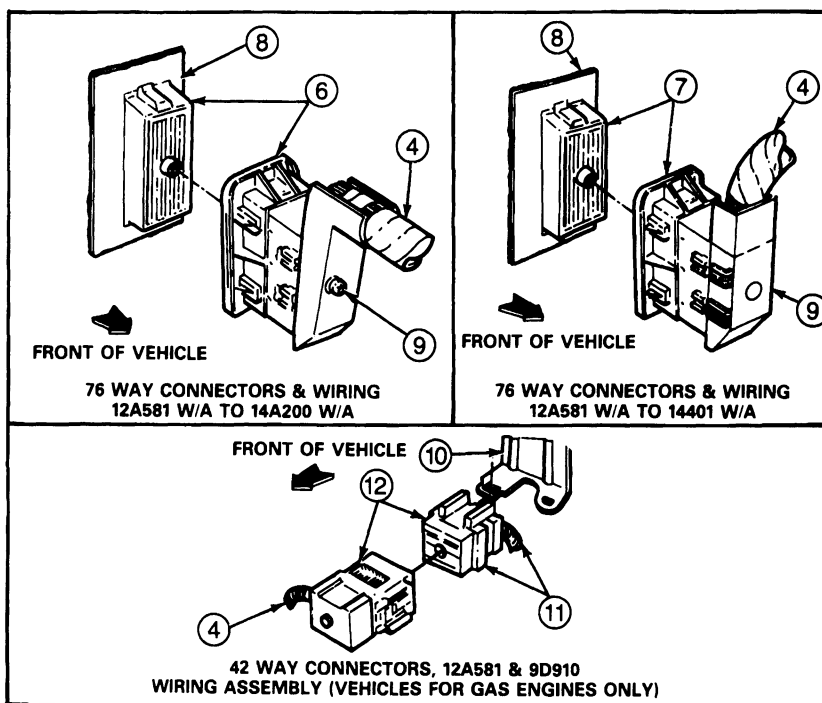
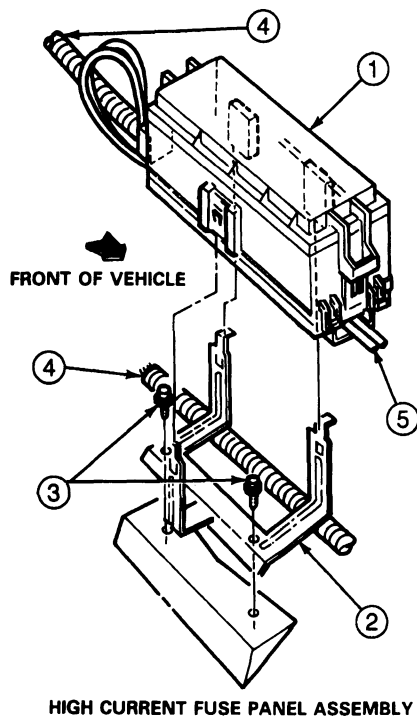
REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	—	Turn Signal Assembly
2	—	To Headlamp Assembly
3	14290	Wiring Assembly
4	—	Install Locator in Hole Provided
5	15A272	Control Module and Bracket
6	N801947-S36	Screw and Washer Assembly
7	13802	Low Horn

(Continued)

Item	Part Number	Description
8	13A803	Horn and Bracket
9	N801939-S39	Captive Screw
10	12B582	TFI Module
11	N605892-S39	Bolt
12	—	Existing Weld Nut
13	—	Inner Front Dash Panel
14	—	Shorting Bar
15	14624	Connector
16	—	Front Lower Radiator Support

Engine Compartment Wiring



K17317-A

ENGINE COMPARTMENT WIRING (LEGEND)

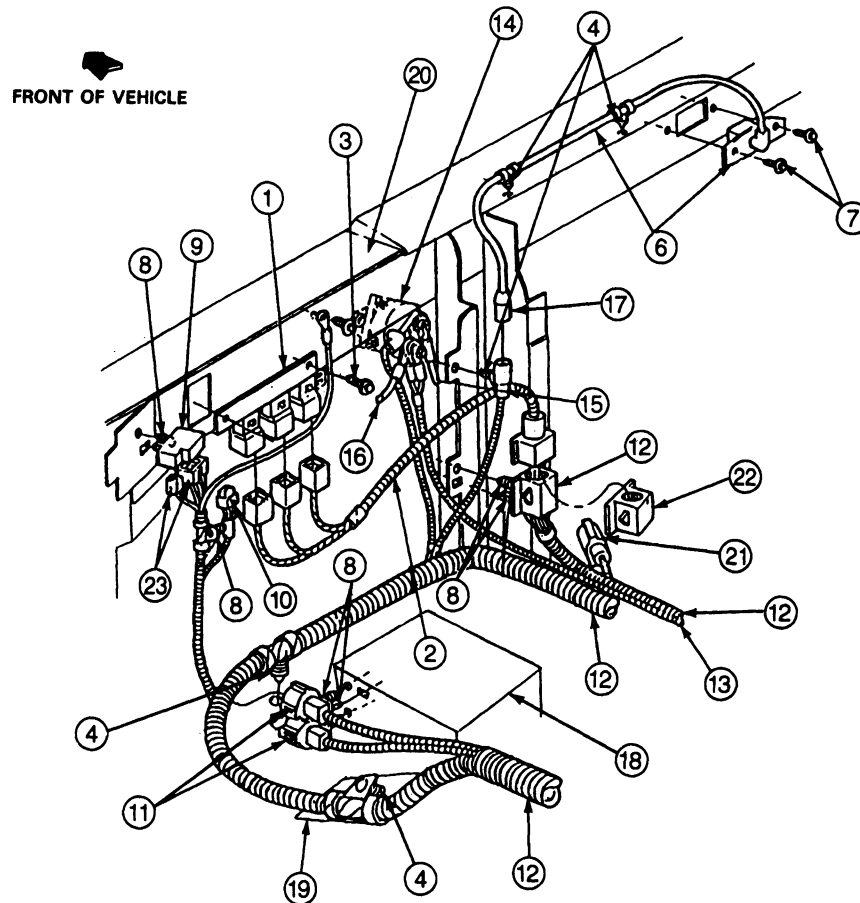
Item No.	Part Number	Description
1	12A581	High Current Fuse Panel
2	14536	Bracket
3	N606675-S55	Screw and Washer Assembly
4	12A581	Wiring Assembly
5	—	To Starting Motor Relay
6	—	76-Way Connector
7	—	76-Way Connector

Item No.	Part Number	Description
8	—	Dash Panel
9	—	Locking Connector Screw
10	—	Existing Dash Panel Bracket
11	—	42-Way Connector and Wiring
12	—	42-Way Connector (Engine to Dash Panel)

CK17318-A

REMOVAL AND INSTALLATION (Continued)

Engine Compartment Wiring, Engine Control Sensor and Trailer Tow



K17319-A

ENGINE COMPARTMENT WIRING, ENGINE CONTROL SENSOR AND TRAILER TOW (LEGEND)

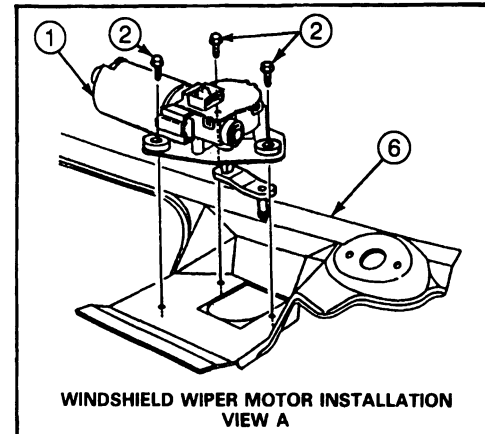
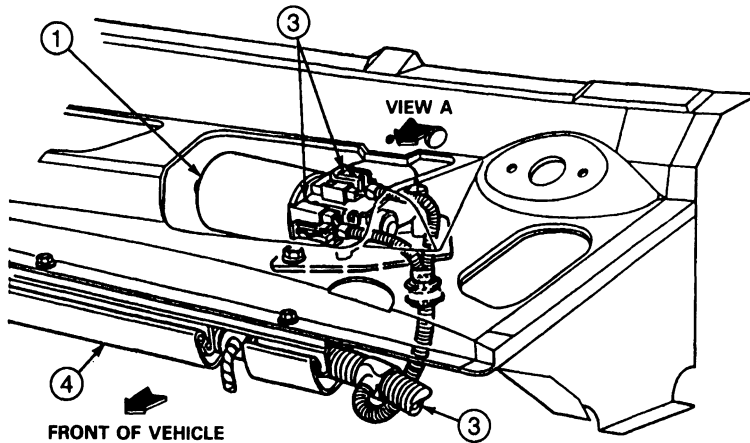
Item No.	Part Number	Description
1	14A301	Bracket and Relay Assembly
2	14A341	Outlet and Wiring Assembly
3	N611151-S2	Screw
4	—	Place Locators in Holes Provided
5	N805375-S	Ground Screw
6	14A688	Air Bag Sensor and Wiring Assembly
7	N806327-S190	Screw and Washer Assembly
8	—	Place Lector in Hole Provided
9	14A593	V.I.P. Cover
10	—	RABS Test Connector
11	—	To 14A290 Wiring Assembly
12	12A581	Wiring Assembly
13	12A581	Wiring Assembly

Item No.	Part Number	Description
14	—	Starting Motor Relay
15	—	Relay Cable Assembly to Engine
16	14305	Wiring Assembly
17	—	Connector to Air Bag Sensor Wiring Assembly
18	—	Left Battery Tray
19	—	Part of Fender Apron
20	—	Radiator Support
21	—	Auxiliary Battery Connector
22	15B484	Marker Lamp Jumper used when not equipped with R.P.O. Trailer Tow
23	—	Connectors, Part of 12A581 Wiring Assembly

CK17320-A

REMOVAL AND INSTALLATION (Continued)

Windshield Wiper Motor Assembly and Wiring



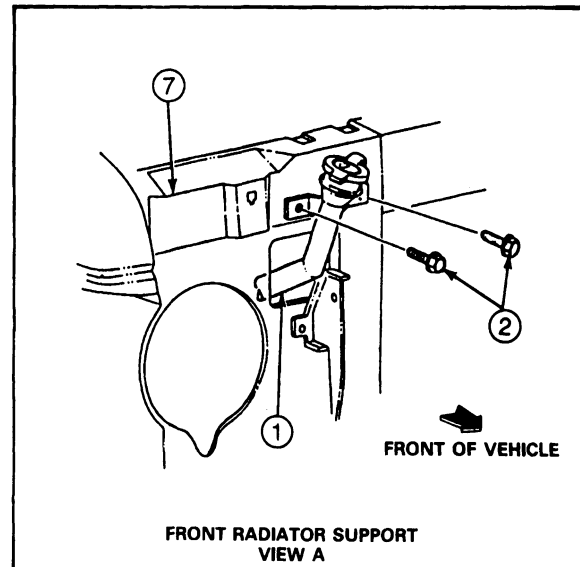
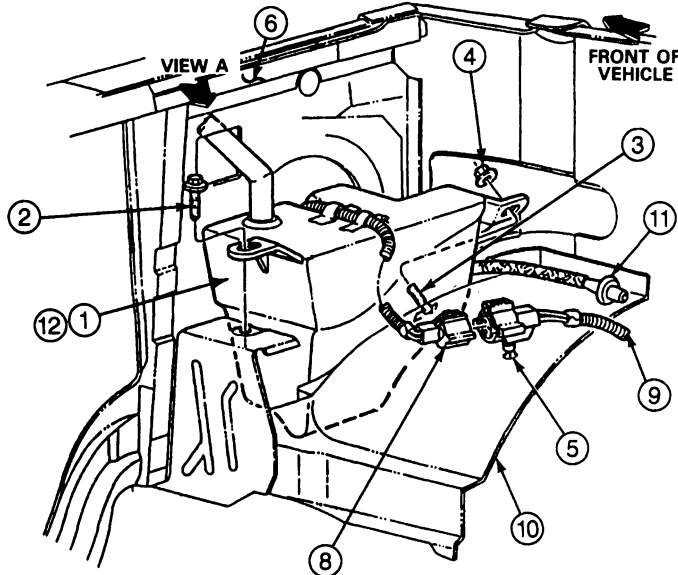
K17321-A

WINDSHIELD WIPER MOTOR ASSEMBLY AND WIRING (LEGEND)

Item No.	Part Number	Description
1	17504	Wiper Motor Assembly
2	N610962-S190	Screw 7-9 N-m (60-85 In-Lb)
3	—	Connectors, Part of 12A581 Wiring Assembly
4	—	Shield, Part of 12A581 Wiring Assembly
6	—	Top Cowl

CK17322-A

Windshield Washer Reservoir, Gas and Diesel Engines



K17323-A

REMOVAL AND INSTALLATION (Continued)

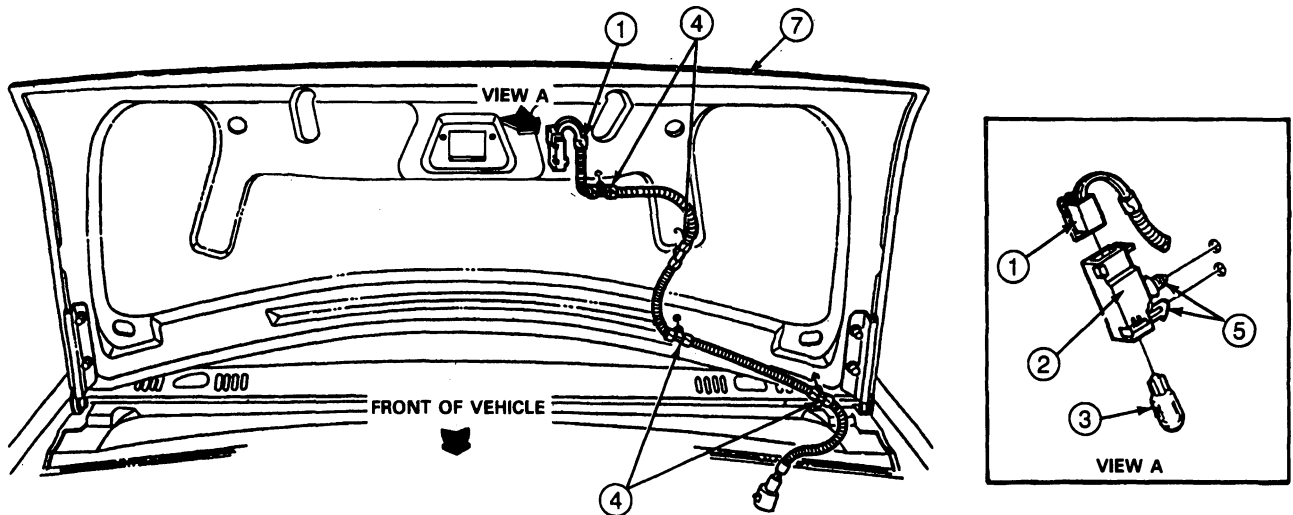
WINDSHIELD WASHER RESERVOIR, GAS AND DIESEL ENGINES (LEGEND)

Item No.	Part Number	Description
1	17B613	Windshield Washer Reservoir and Motor Assembly
2	N800369-S2	Screw 4.1-6.7 N·m (3.0-5.0 Ft-Lb)
3	N804057-S2	Bolt and Retainer Assembly
4	N621905-M6	Nut and Washer Assembly
5	—	Place Locator in Hole Provided

Item No.	Part Number	Description
6	—	Front Inner Radiator Support (Right)
7	—	Front Outer Radiator Support (Right)
8	—	Wiring and Connector
9	12A581	Wiring Assembly
10	—	Fender Apron
12	ESB-M8B15-B	Windshield Washer Anti-Freeze Solution

CK17324-A

Engine Compartment Lamp and Wiring, All Vans / Wagons, Custom Wagon XL Van, Base Van



K17325-A

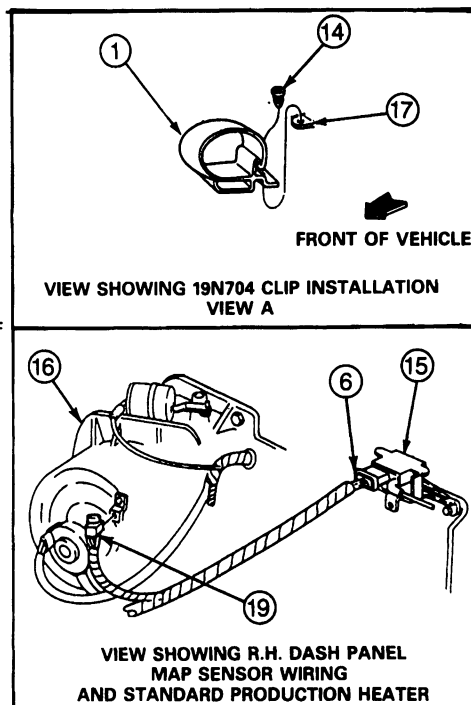
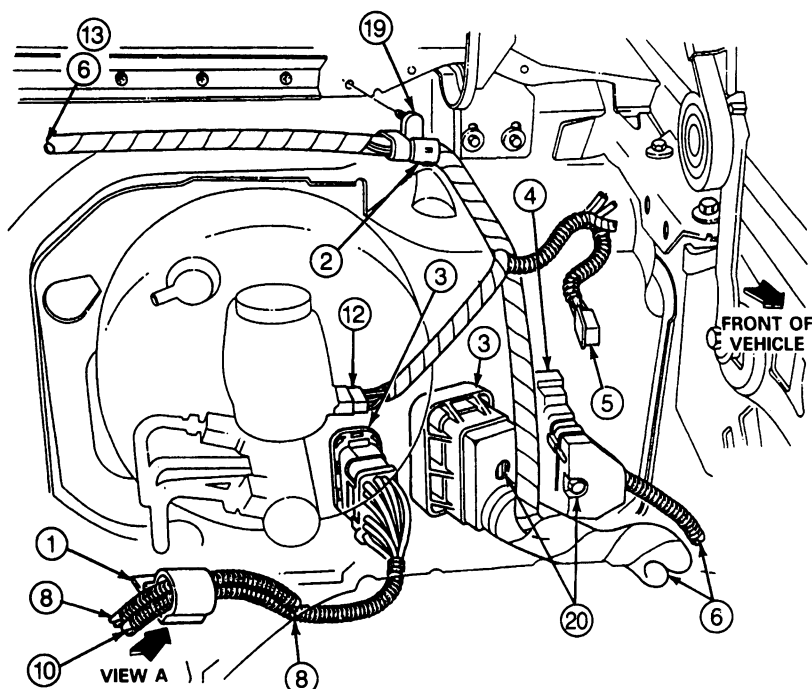
ENGINE COMPARTMENT LAMP AND WIRING, ALL VANS/WAGONS, CUSTOM WAGON XL VAN, BASE VAN (LEGEND)

Item No.	Part Number	Description
1	15A702	Engine Compartment Lamp Feed
2	15702	Lamp Assembly Engine Compartment
3	13465	Bulb
4	—	Place Locators in Holes Provided
5	—	Place Locator and Retainer in Provided Holes
7	—	Front Hood Assembly

CK17326-A

REMOVAL AND INSTALLATION (Continued)

Dash Panel Wiring, F-Series and Bronco with Gasoline Engines and 7.3L Diesel with E4OD Transmission



K17327-A

DASH PANEL WIRING, F-SERIES AND BRONCO WITH GASOLINE ENGINES AND 7.3L DIESEL WITH E4OD TRANSMISSION (LEGEND)

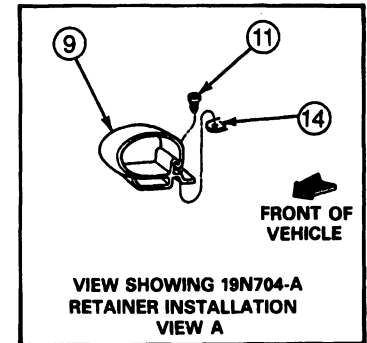
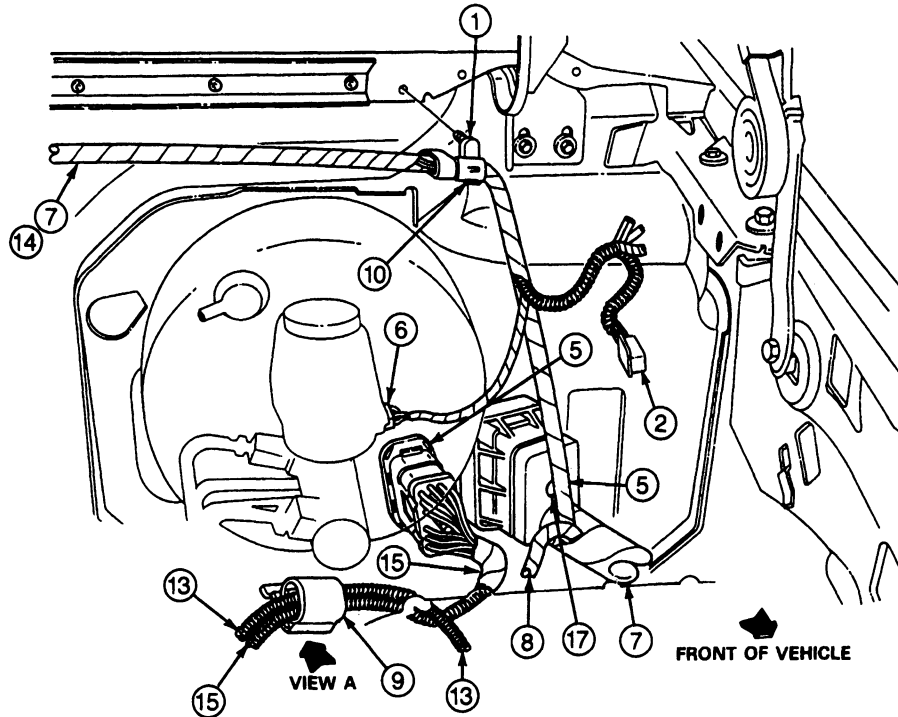
Item No.	Part Number	Description
1	19N704	Clip
2	—	To 15A702 Wiring Assembly
3	—	To 14401 Wiring Assembly
4	—	EEC Module
5	—	To Speed Control Servo
6	12A581	Wiring Assembly
8	15525	Wiring Assembly
10	14405	Wiring Assembly

Item No.	Part Number	Description
12	—	To Brake Booster
13	—	To Windshield Wiper Motor
14	N381811-S55X	Screw
15	—	Map Sensor and Bracket
16	18456	Heater Assembly
17	—	Dash Panel
19	—	Position Locator in Hole Provided
20	—	Bulkhead Bolt 4.5-6.8 N·m (40-60 In·Lb)

CK17328-A

REMOVAL AND INSTALLATION (Continued)

Dash Panel Wiring, F-Series with 7.3L Diesel Engine without E4OD Transmission

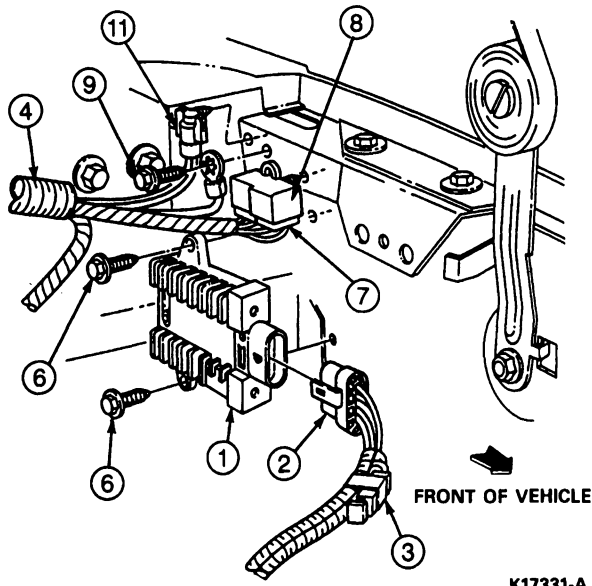


K17329-A

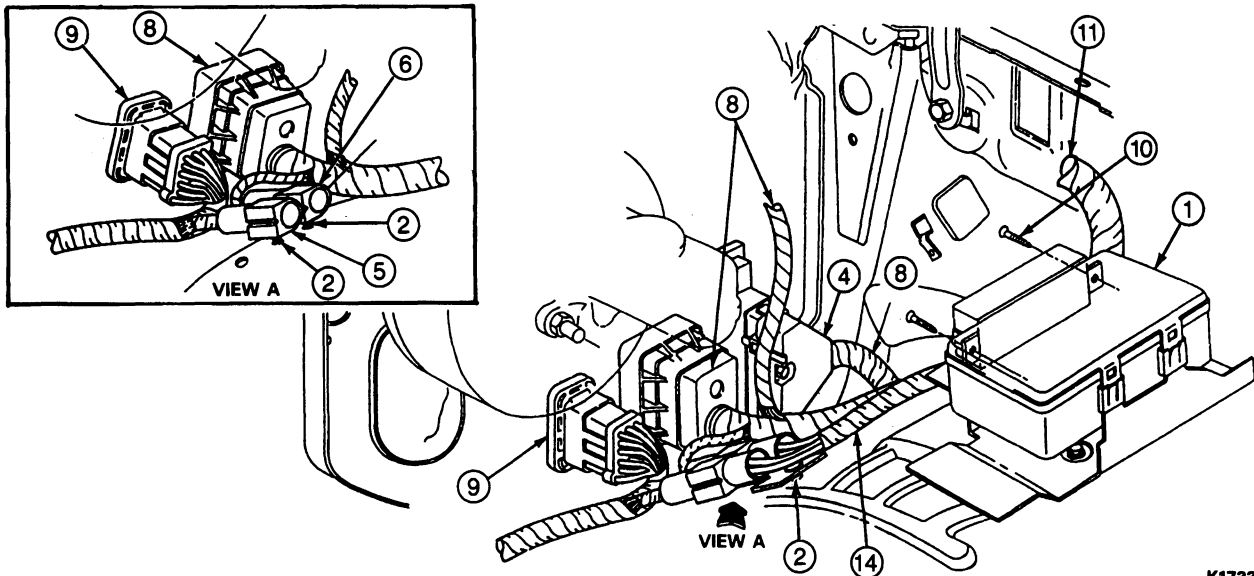
Item	Part Number	Description
1	—	Position Locator in Hole Provided
2	—	To Speed Control
5	—	To 14401 Wiring Assembly
6	—	To Brake Booster
7	12A581	Wiring Assembly
8	—	Aux Lamp Connector
9	19N704	Clip

(Continued)

Item	Part Number	Description
10	—	To 15A702 Wiring Assembly
11	N381801-S55X	Screw
13	15525	Wiring Assembly
14	—	Dash Panel
15	14405	Wiring Assembly Bulk Head Bolt 76 Way 4.5-6.8 N-m (40-60 In-Lb)
17	—	Bulkhead Bolt 4.5-6.8 N-m (40-60 In-Lb)

REMOVAL AND INSTALLATION (Continued)**Dash Panel Wiring, TFI and Self-Test Output Connector, F-Series, Bronco**

Item	Part Number	Description
1	12B582	TFI Module (Gas Engines Only)
2	12A581	Wiring Assembly to TFI Module
3	—	Base Timing Starting Plug
4	12A581	Wiring Assembly
6	N605892-S39	Screw 9-14 N-m (7-10 Ft-Lb)
7	12A581	To Self Test Output Connector
8	14A593	VIP Cap (All Gas Engines and Diesel Engine with E4OD Transmission)
9	N801846-S36MG	Screw (All Gas Engines and Diesel Engine with E4OD Transmission)
11	14A666	Cap

Dash Panel and Relay Wiring, F-Series with Trailer Tow Package

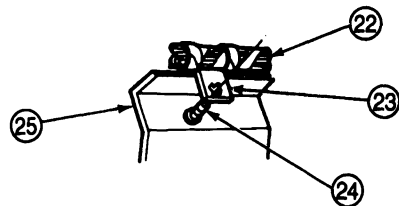
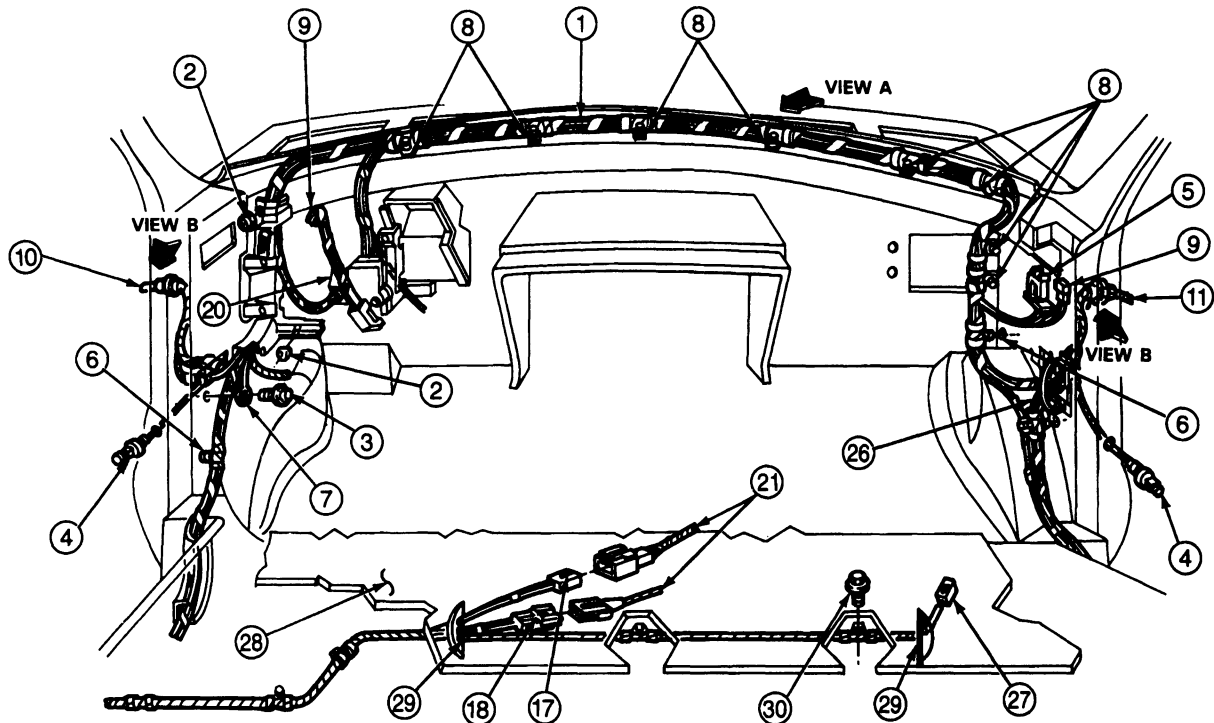
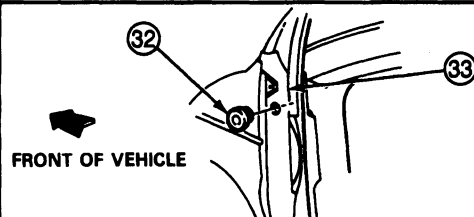
Item	Part Number	Description
1	12A581	Power Network Box, Wiring Assembly
2	—	Locator, Position in Hole Provided
4	12A581	To EEC Module (Except Diesel)

(Continued)

Item	Part Number	Description
5	—	Cap (Bronco, Diesel or F-Series with D.R.L., Without Trailer Tow)
6	—	Cap (Dual Rear Wheels Without Trailer Tow)
8	12A581	Wiring Assembly
9	14405	Wiring Assembly
10	N801817-S2	Screw 2.5-3.2 N-m (23-28 In-Lb)

REMOVAL AND INSTALLATION (Continued)

Dash Panel Wiring, E-Series with Gasoline and Diesel Engines

VIEW SHOWING TOP COWL WIRING HARNESS RETENTION
VIEW AL.H. "A" PILLAR SIDE SHOWN, R.H. SYMM. OPPOSITE
VIEW B

K17335-A

DASH PANEL WIRING, E-SERIES WITH (EFI) GASOLINE AND DIESEL ENGINES (LEGEND)

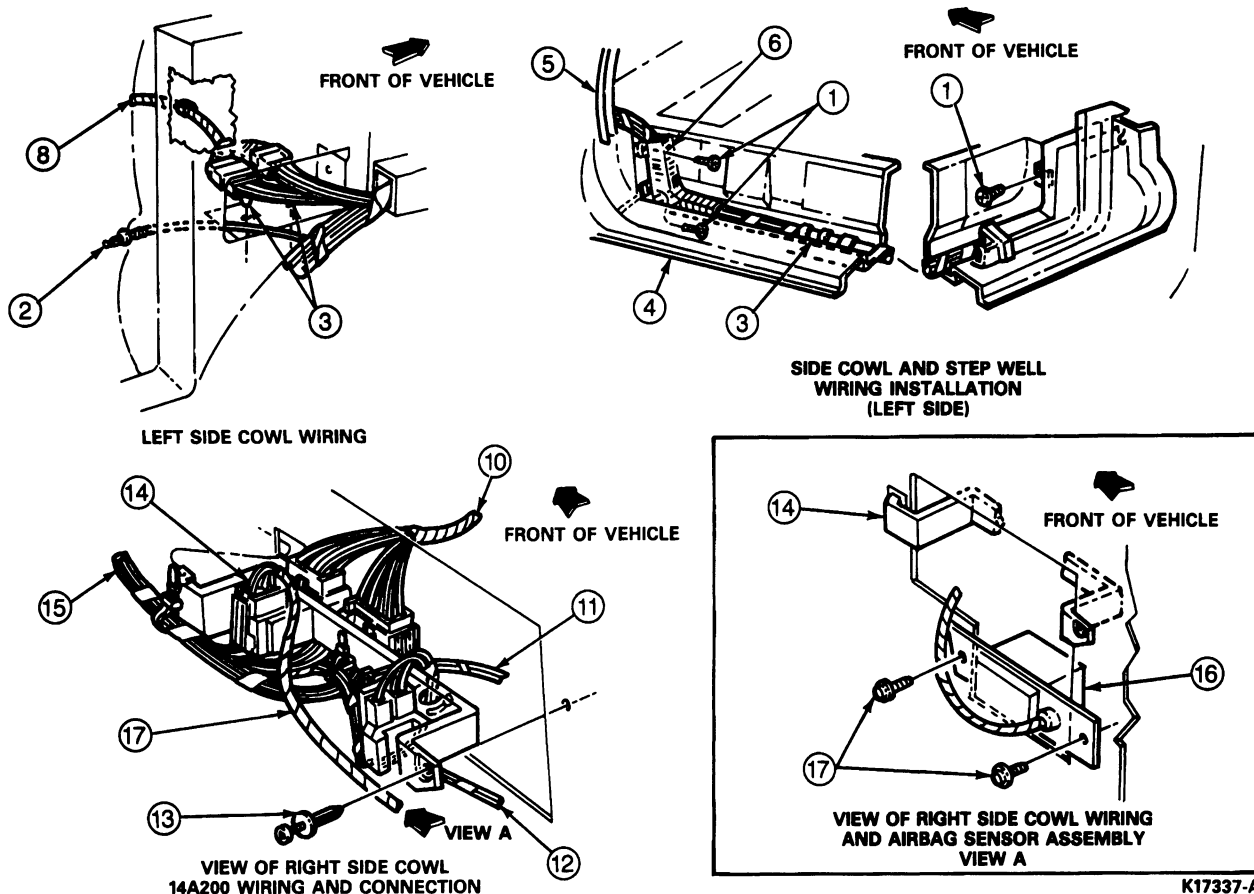
Item No.	Part Number	Description
1	14A200	Wiring Assembly
2	N621905-S2	Nut and Washer Assembly
3	N805375	Ground Screw
4	13713	Courtesy Lamp Switch
5	—	Inertia Switch
6	—	Place Locators in Holes Provided
7	—	Ground Lead
8	—	Place Retainers on Studs as Shown
9	—	To 14401 Wiring Assembly
10	14360	Wiring Assembly
11	14361	Wiring Assembly
17	—	To Power Seats
18	—	To Seat Belt Warning Switch

Item No.	Part Number	Description
21	—	Connectors and Wiring
22	14A200	Wiring Assembly
23	—	Retainer
24	—	Existing Stud
25	—	Inner Top Cowl
26	—	Air Bag Sensor Assembly
27	—	To Right Power Lumbar
28	—	Carpet
29	—	Opening in Carpet, Route Wiring as Shown
30	N803739-S2	Plastic Rivet
32	N802981	Plug Button
33	—	A-Pillar

CK17336-A

REMOVAL AND INSTALLATION (Continued)

Cowl Wiring



K17337-A

COWL WIRING (LEGEND)

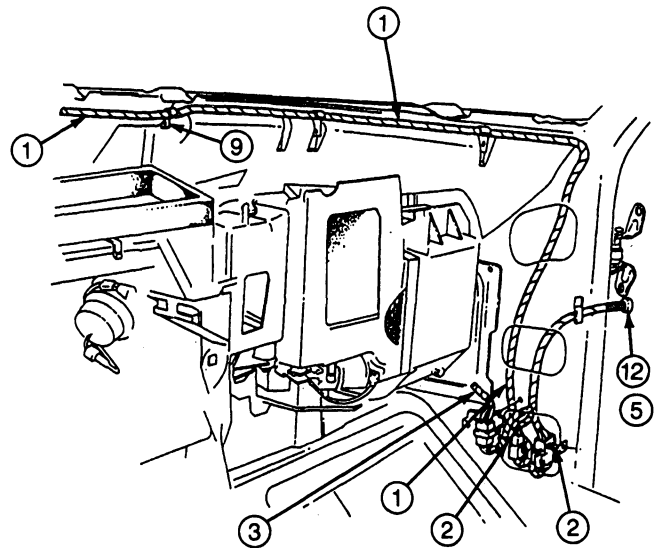
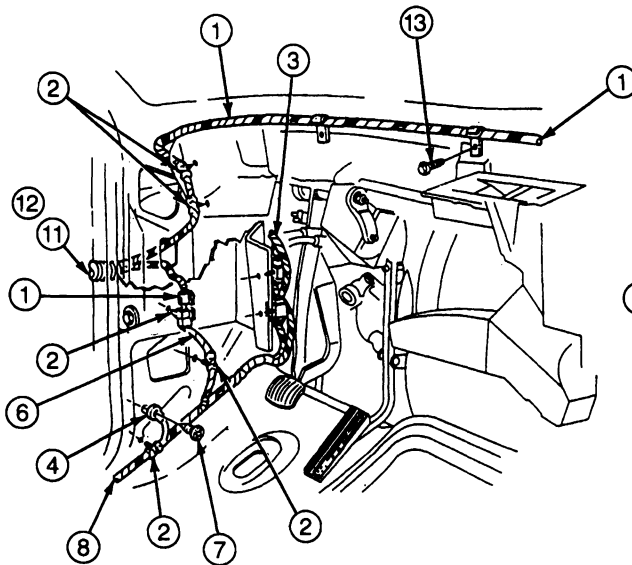
Item No.	Part Number	Description
1	N610956-S36BX	Screw
2	—	Courtesy Lamp Switch
3	—	Place Locators in Holes Provided
4	—	Step Well
5	—	A-Pillar
6	—	Shield
8	14630	Wiring Assembly
10	14631	Wiring Assembly

Item No.	Part Number	Description
11	—	To Courtesy Lamp Switch
12	14014	Wiring Assembly
13	387843-S	Pin
14	—	Bracket
15	14A200	Wiring Assembly
16	14A686	Sensor and Wiring Assembly
17	N806327-S190	Screw and Washer Assembly

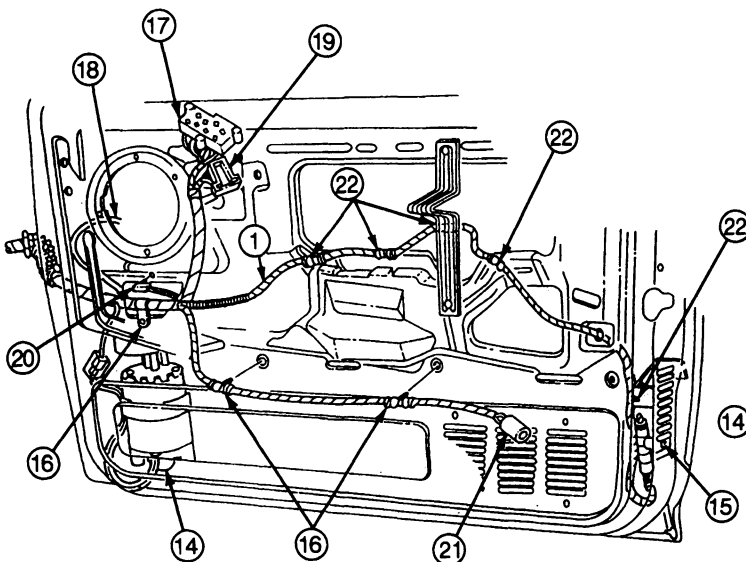
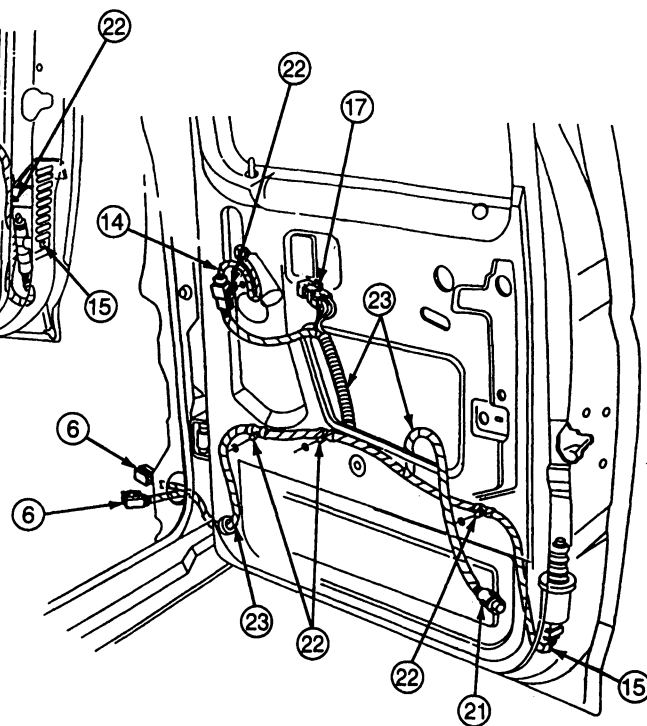
CK17338-A

REMOVAL AND INSTALLATION (Continued)

Wiring Installation, F-Super Duty Commercial Stripped Chassis with 7.3 Diesel Engine



VIEW SHOWING INSTALLATION OF RIGHT COWL AND DASH WIRING

VIEW SHOWING SWITCH & WIRING ASSY. INSTALLATION
RIGHT SIDE WITH ROUTING SYMMETRICALLY
OPPOSITE FOR LEFT SIDE

K17339-A

REMOVAL AND INSTALLATION (Continued)

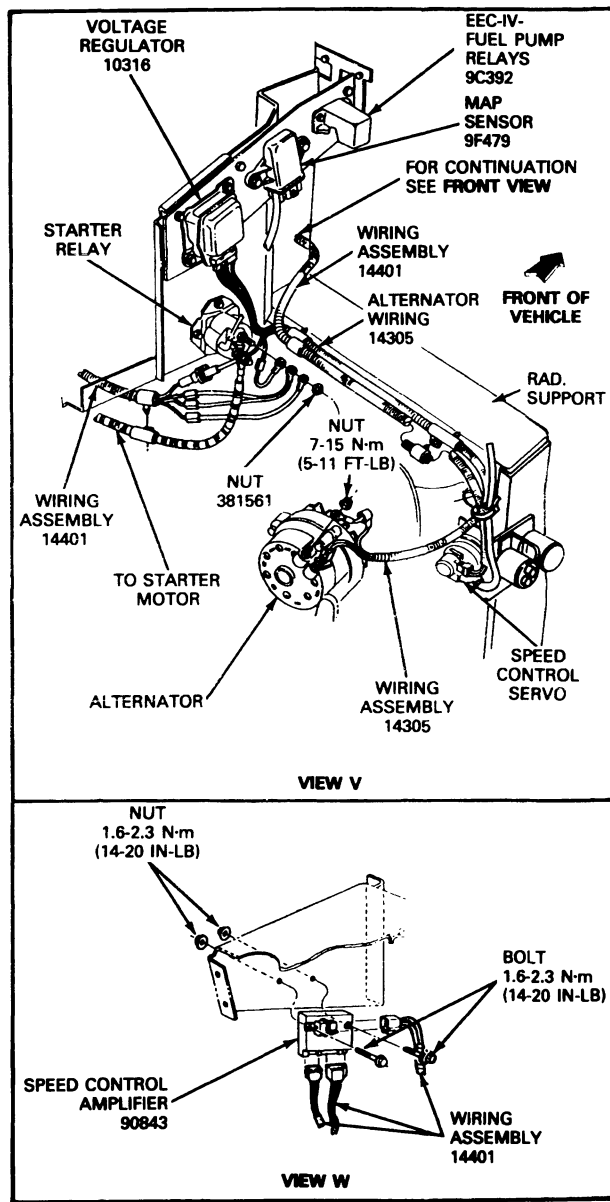
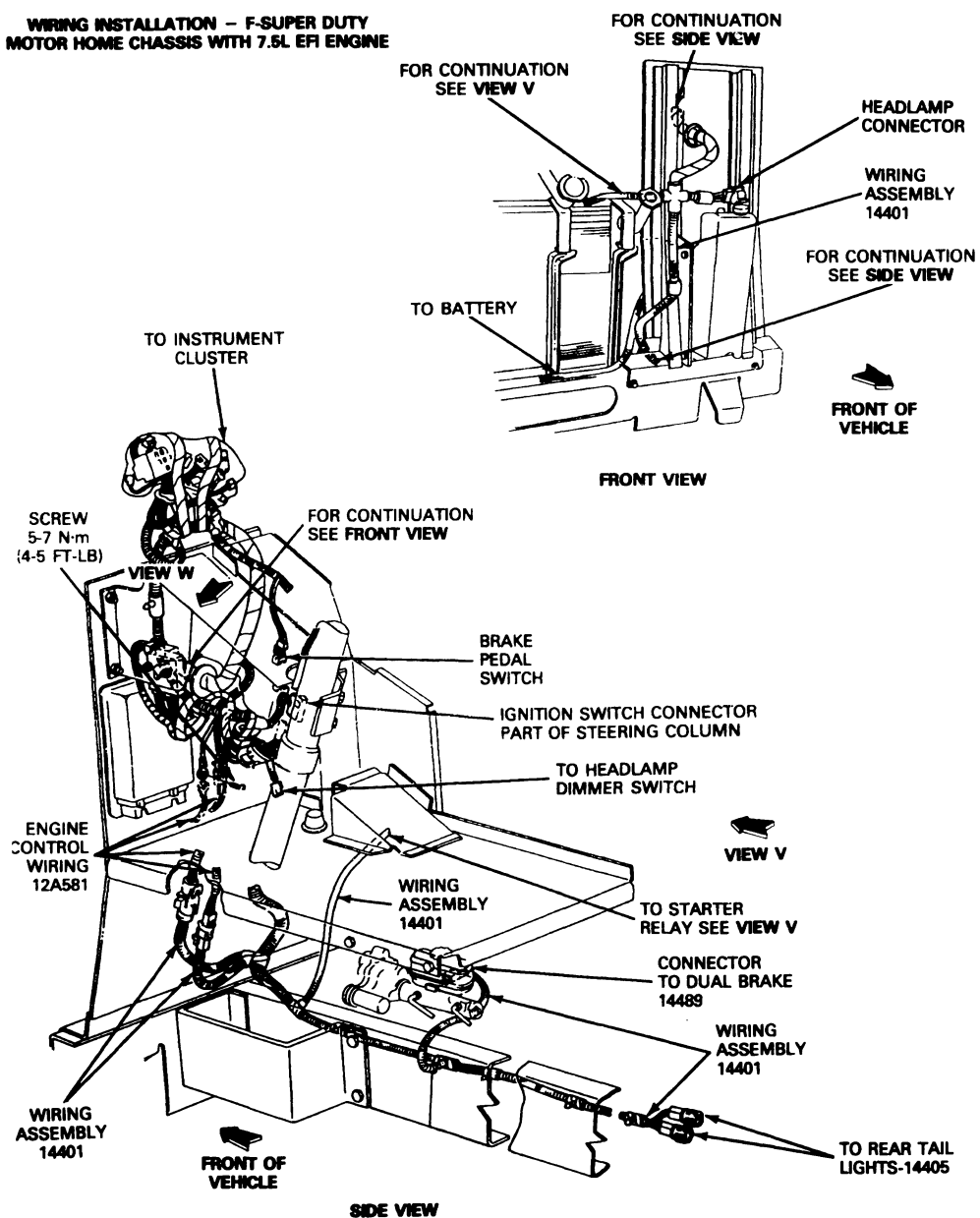
Item	Part Number	Description
1	14A509	Wiring Assembly
2	—	Install Locator in Hole Provided
3	14401	Wiring Assembly
4	14463	To Ground
5	14A265	Wiring Assembly
6	14A504	Wiring Assembly
7	N805375-S36MG	Screw to Weld Nut
8	14A504	Wiring Assembly
9	14A163	Clip
11	14A509	Wiring Assembly
12	19A123	Wiring Assembly
13	381801-S55X	Screw

(Continued)

Item	Part Number	Description
14	—	Power Window Motor
15	—	Door Lock Actuator
16	13A506	Locator, Install in Hole Provided After Water Shield is Installed
17	—	To Power Window Lock Switch
18	—	To Radio Speaker
19	—	To Power Mirror Switch
20	—	To Power Mirror Pigtail
21	—	To Courtesy Lamp
22	13A506	Install Locator in Hole Provided
23	14632	Wiring Assembly

REMOVAL AND INSTALLATION (Continued)

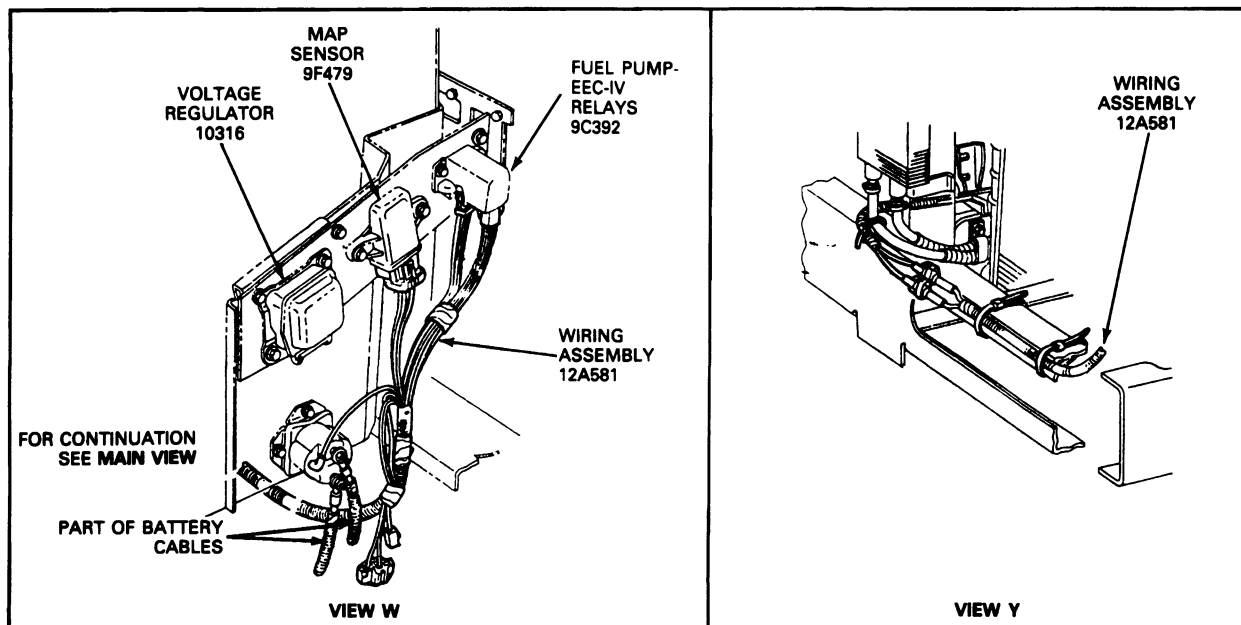
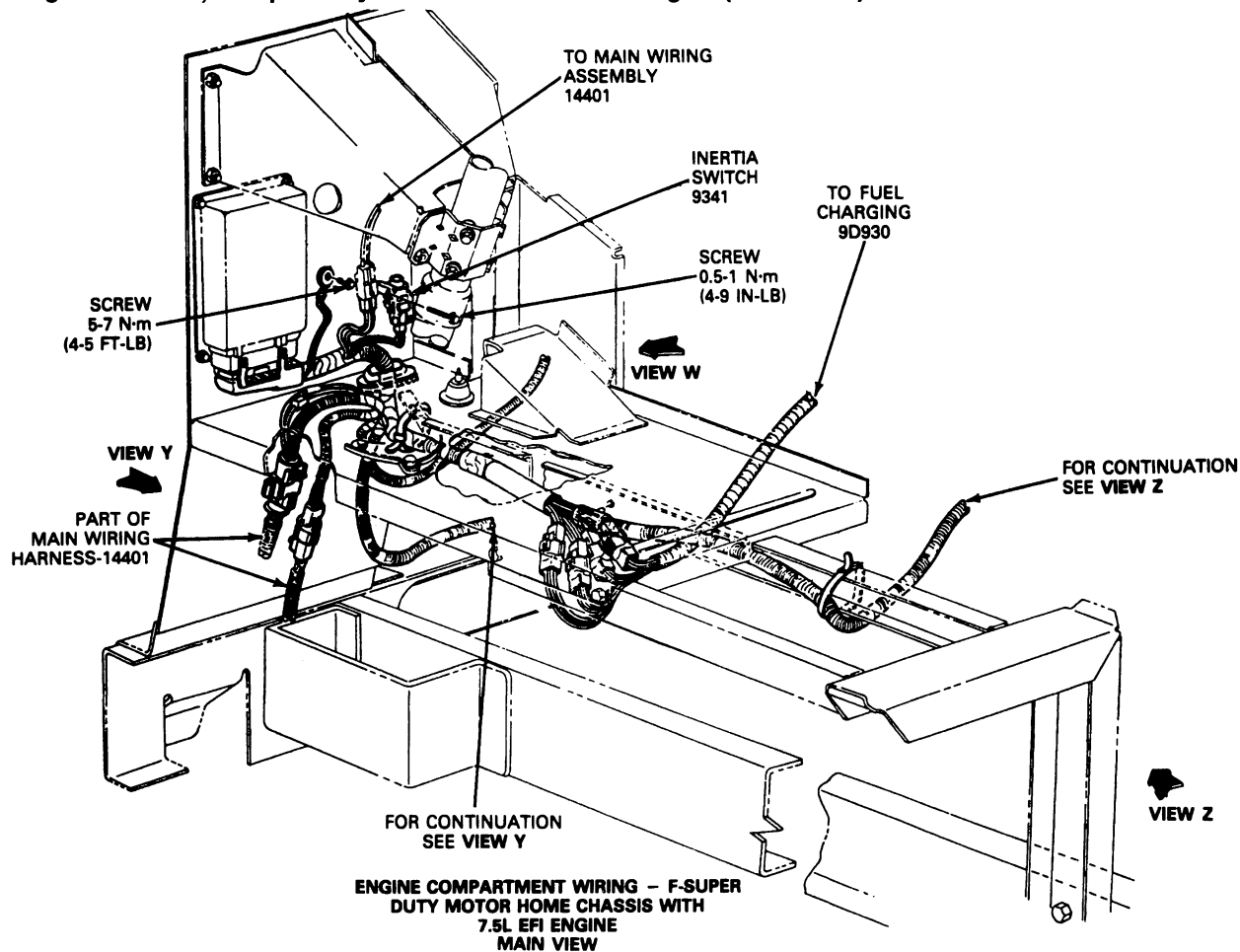
Wiring Installation, F-Super Duty Motorhome with 7.5L Engine

WIRING INSTALLATION - F-SUPER DUTY
MOTOR HOME CHASSIS WITH 7.5L EFI ENGINE

K14461-B

REMOVAL AND INSTALLATION (Continued)

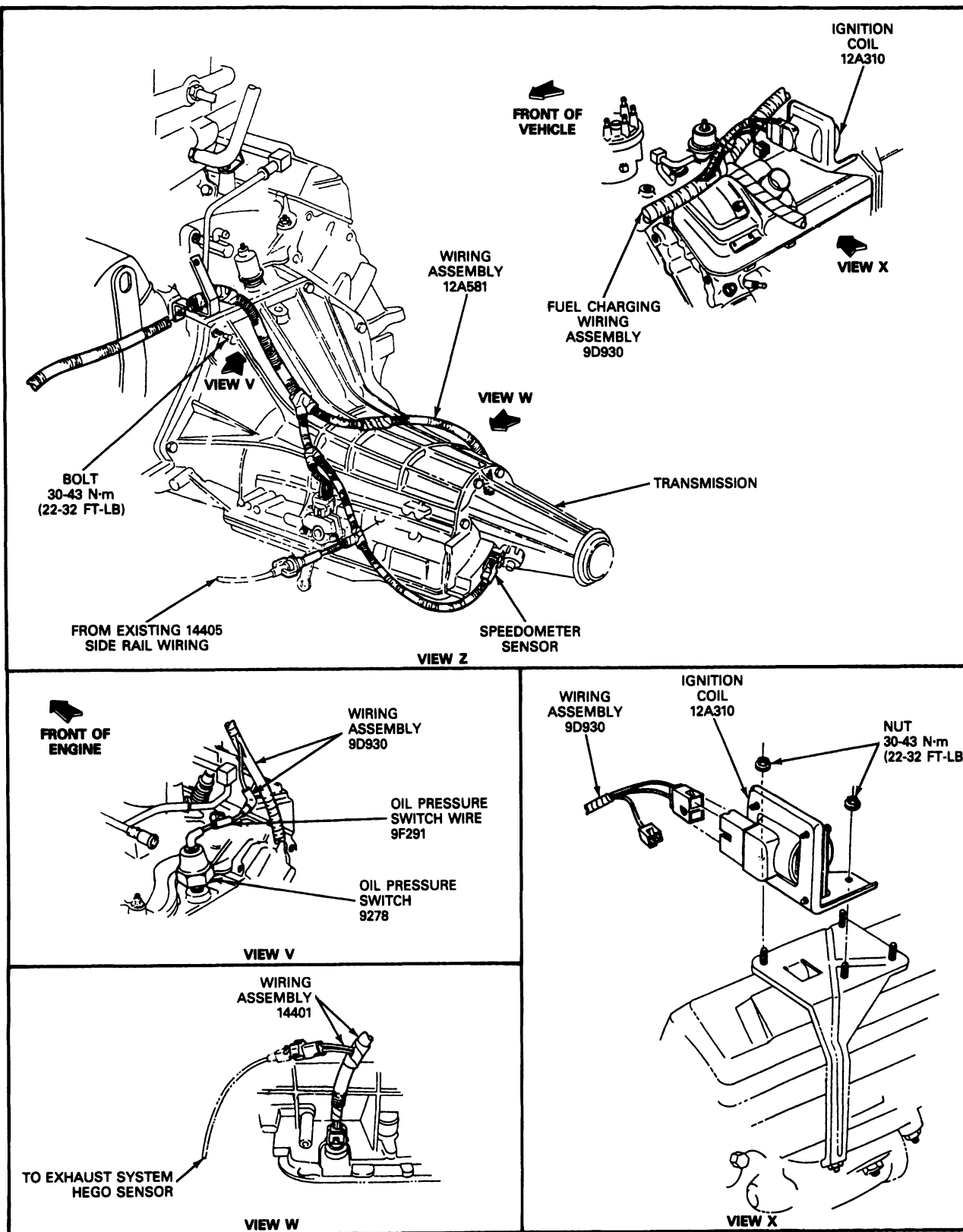
Wiring Installation, F-Super Duty Motorhome with 7.5L Engine (Continued)



K14462-C

REMOVAL AND INSTALLATION (Continued)

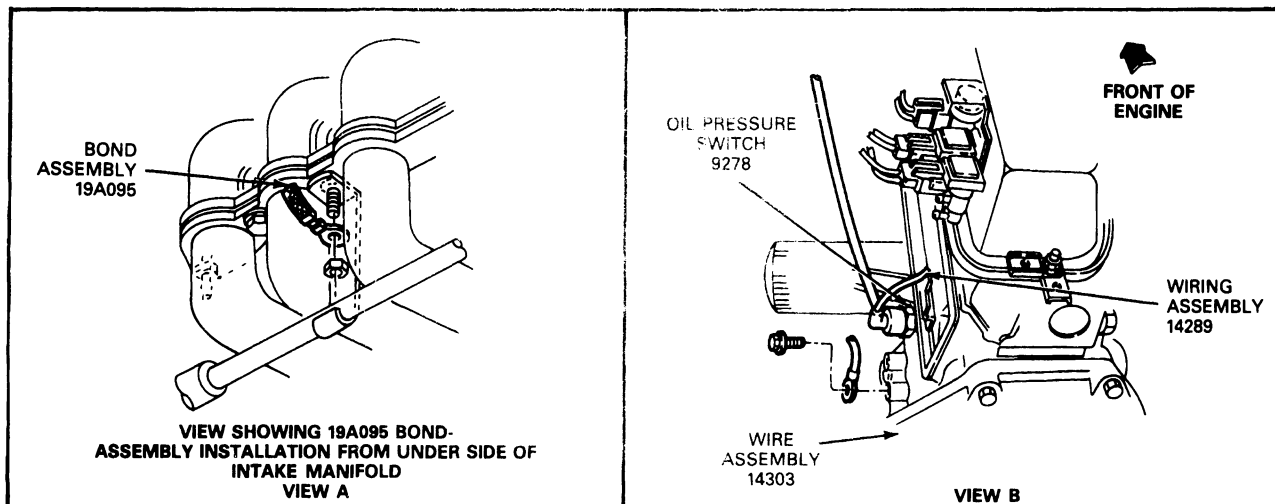
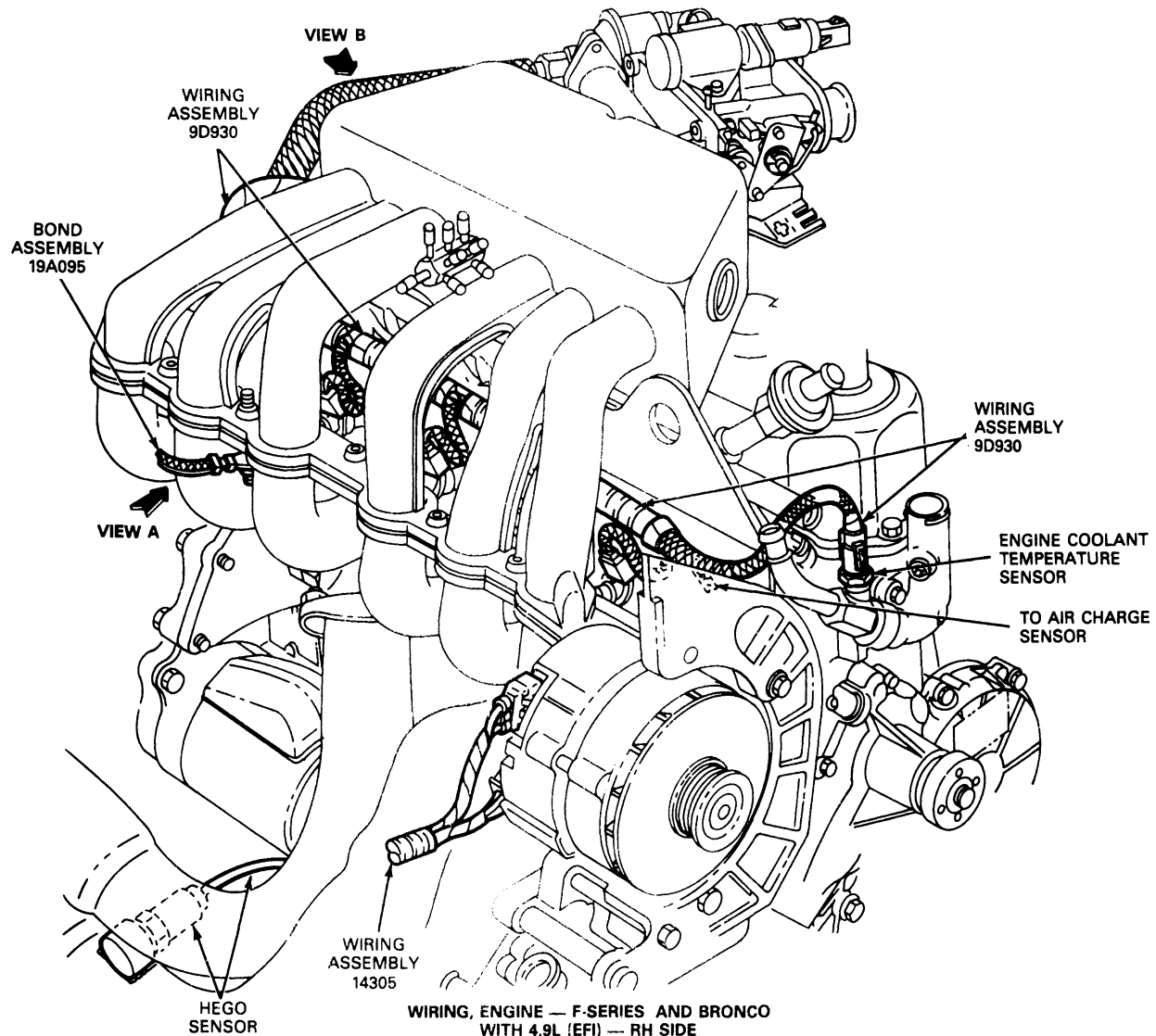
Wiring Installation, F-Super Duty Motorhome with 7.5L Engine (Continued)



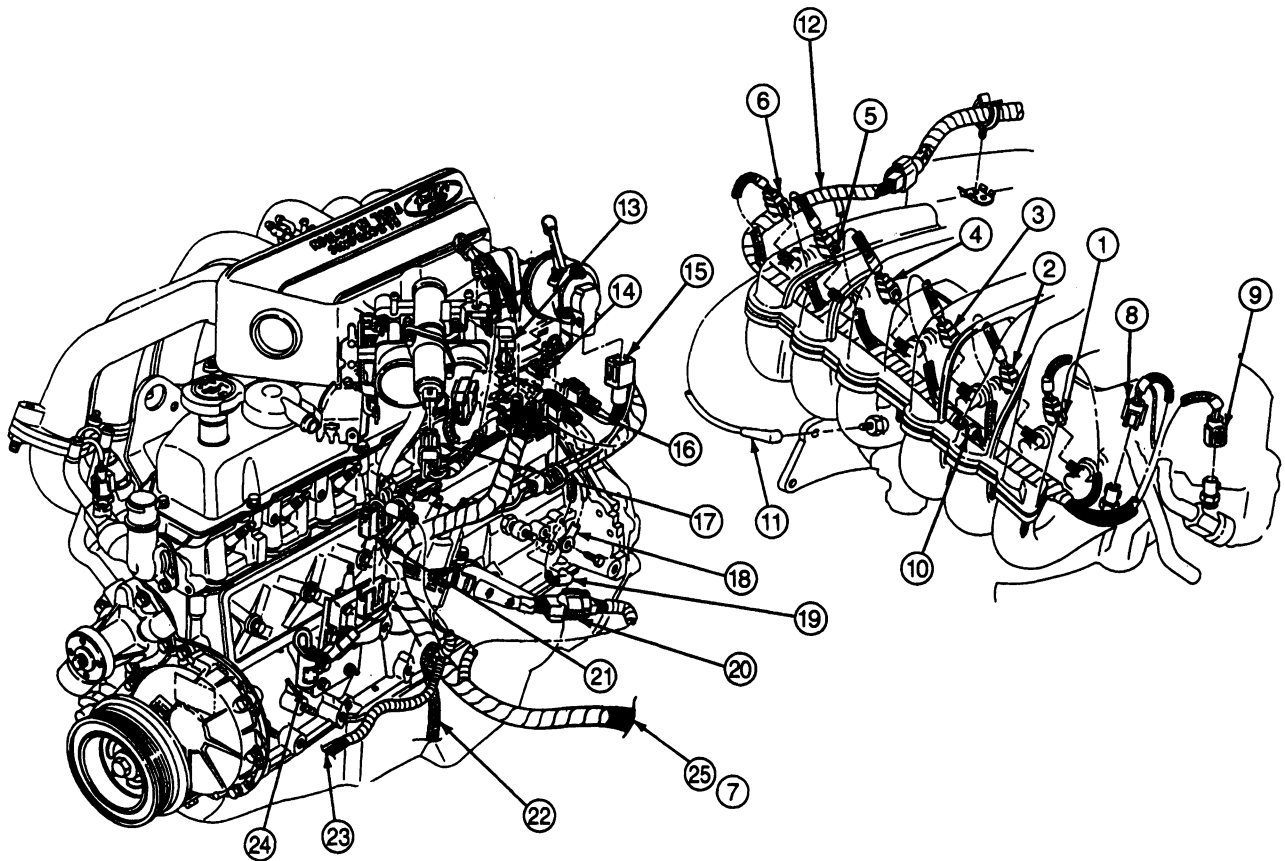
K14463-B

REMOVAL AND INSTALLATION (Continued)

Wiring Engine, F-Series and Bronco with 4.9L, Right Side



K11972-C

REMOVAL AND INSTALLATION (Continued)**Wiring, Engine, F-Series and Bronco with 4.9L, Left Side**

K17341-A

WIRING, ENGINE, F-SERIES AND BRONCO WITH 4.9L (EFI), LEFT SIDE (LEGEND)

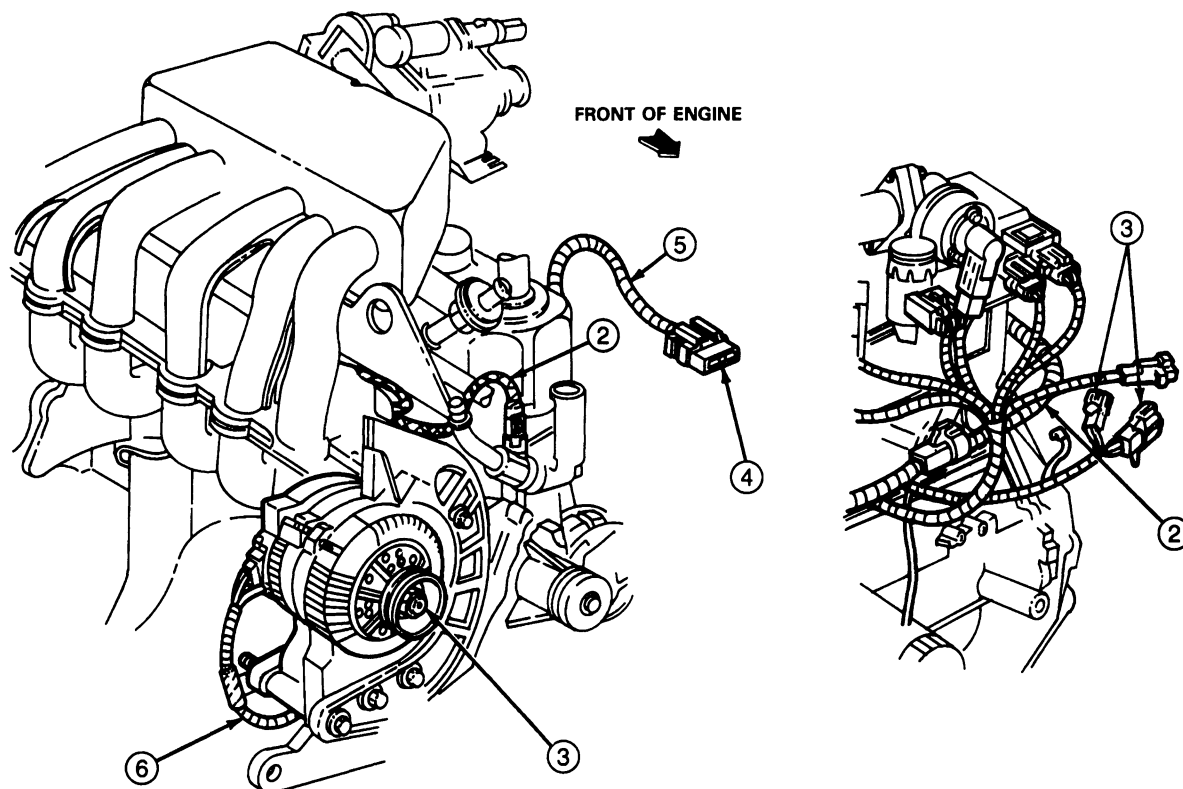
Item No.	Part Number	Description
1	—	To Fuel Injector #1
2	—	To Fuel Injector #2
3	—	To Fuel Injector #3
4	—	To Fuel Injector #4
5	—	To Fuel Injector #5
6	—	To Fuel Injector #6
7	14289	Wiring Assembly
8	—	To Air Charge Sensor
9	—	To Engine Coolant Temperature Sensor
10	—	To Canister Purge
11	—	To Water Temperature Sensor
12	9D930	Wiring Assembly
13	—	To TPS

Item No.	Part Number	Description
14	—	To TAB
15	—	To EGR Control
16	—	To TAD
17	—	To Idle Speed Control
18	—	To Ground
19	—	To Oil Pressure Sender
20	—	To Distributor Pigtail
21	—	To E Coil
22	—	To Knock Sensor
23	—	To A/C Clutch
24	—	To Radio Capacitor
25	—	To 12A581 Wiring Assembly

CK17342-A

REMOVAL AND INSTALLATION (Continued)

Wiring, Engine, E-Series

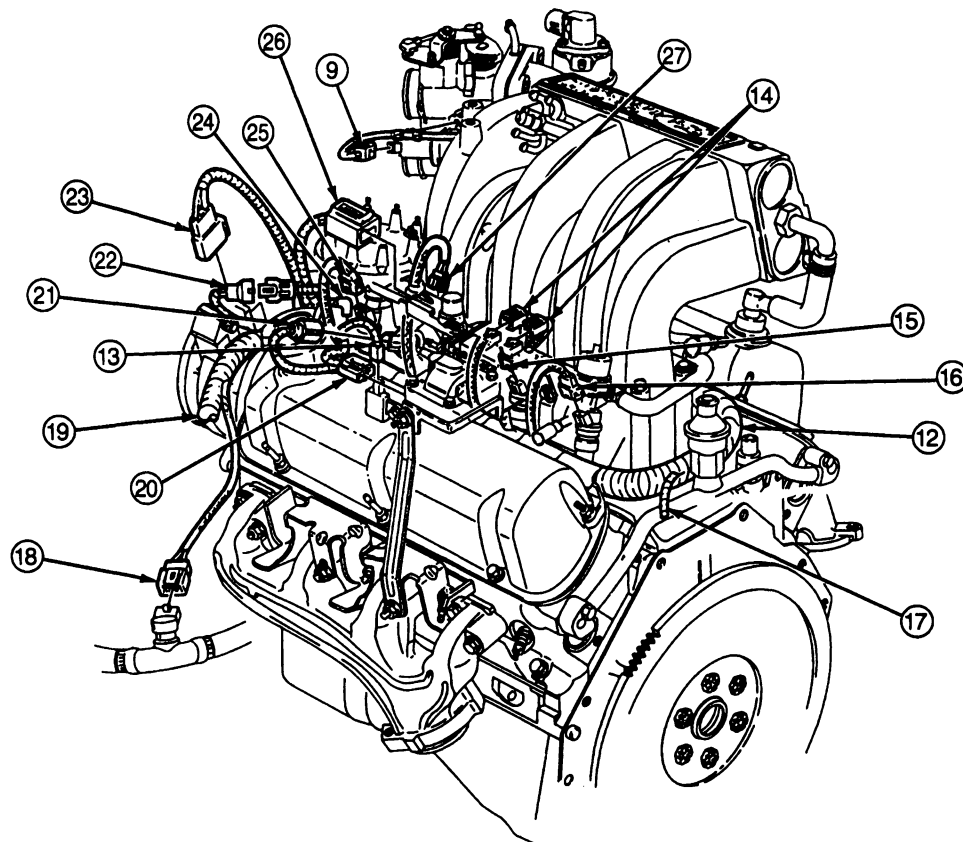
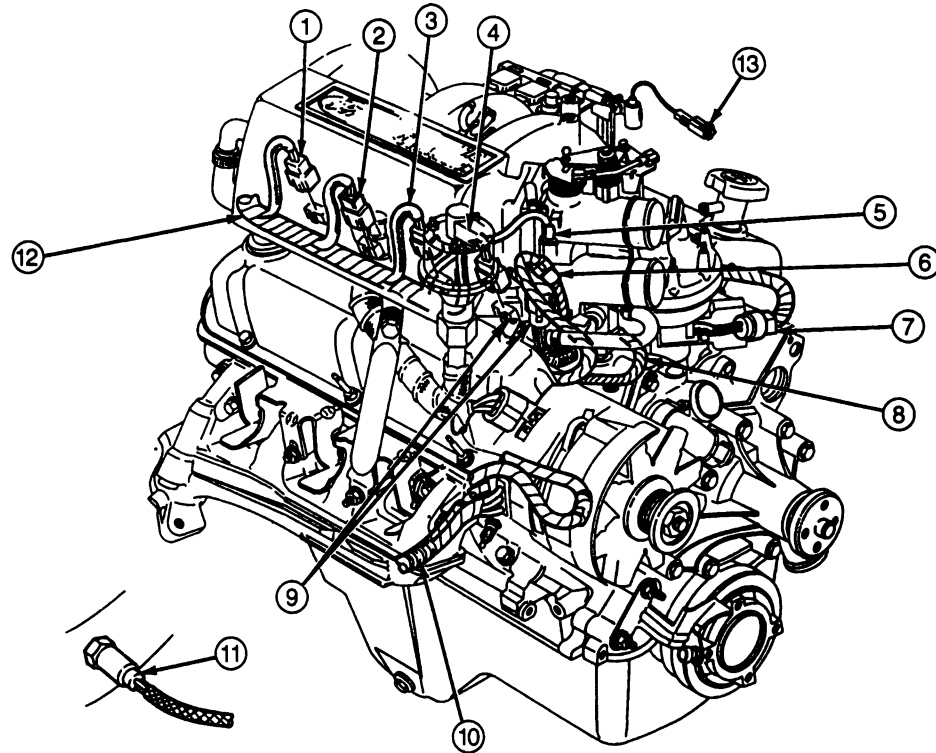


K17343-B

WIRING, ENGINE, E-SERIES (LEGEND)

Item No.	Part Number	Description
2	9D930	Wiring and Connector
3	—	To 15525 Wiring Assembly
4	—	To 12A581 Wiring Assembly
5	14289	Wiring Assembly
6	14305	Wiring Assembly

CK17344-A

REMOVAL AND INSTALLATION (Continued)**Wiring, Engine, F-Series and Bronco with 5.0L and 5.8L**

K17345-A

REMOVAL AND INSTALLATION (Continued)

WIRING, ENGINE, F-SERIES AND BRONCO WITH 5.0L AND 5.8L EFI (LEGEND)

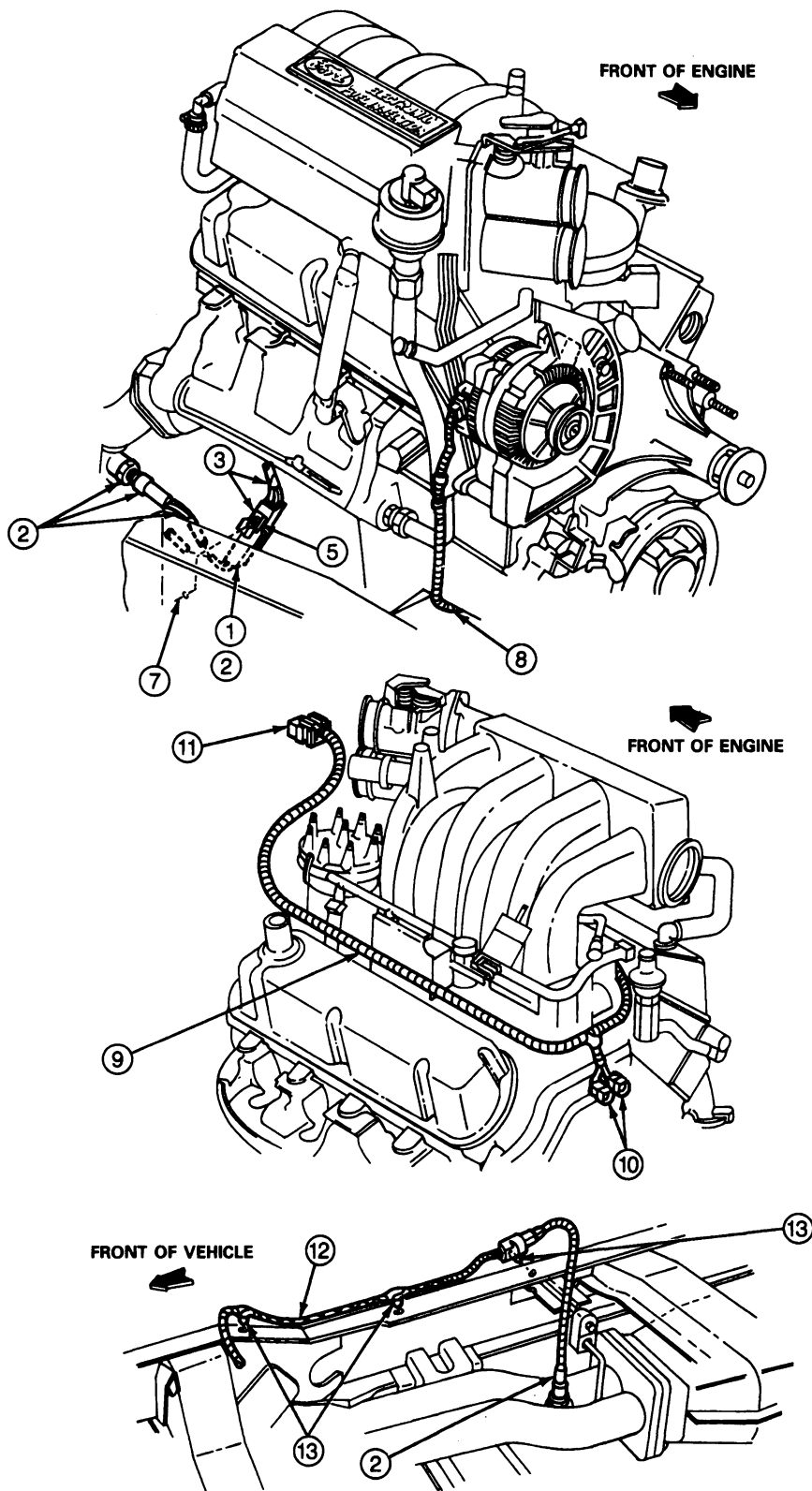
Item No.	Part Number	Description
1	—	To Fuel Injector #4
2	—	To Fuel Injector #3
3	—	To Fuel Injector #2
4	—	To Fuel Injector #1
5	—	To Idle Speed Control
6	—	To EVP
7	—	To Distributor
8	—	To Engine Coolant Temperature Switch
9	—	To TPS
10	14305	Wiring Harness to Alternator
11	—	HEGO Assembly
12	9D930	Wiring Assembly
13	—	To Radio Capacitor
14	—	To Tab

Item No.	Part Number	Description
15	—	To Fuel Injector #7
16	—	To Fuel Injector #8
17	—	To Knock Sensor (Except 5.8L Engine)
18	—	To PSPS (Except 5.8L Engine)
19	—	To 12A581 Wiring Assembly
20	—	To E Coil
21	—	To Air Charge Temperature Switch
22	—	To Distributor Pigtail
23	—	To A/C Clutch
24	—	To Water Temperature Switch
25	—	To Fuel Injector #5
26	—	To EGR
27	—	To Fuel Injector #6

CK17346-A

REMOVAL AND INSTALLATION (Continued)

Wiring, Engine, E-Series with 5.0L and 5.8L



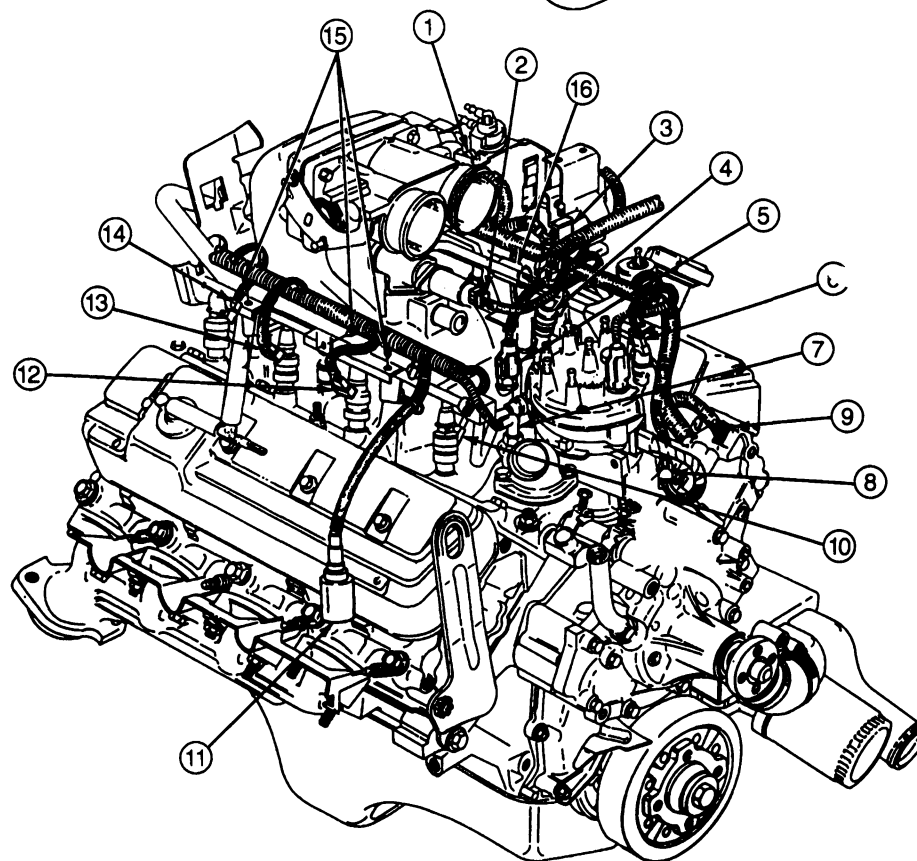
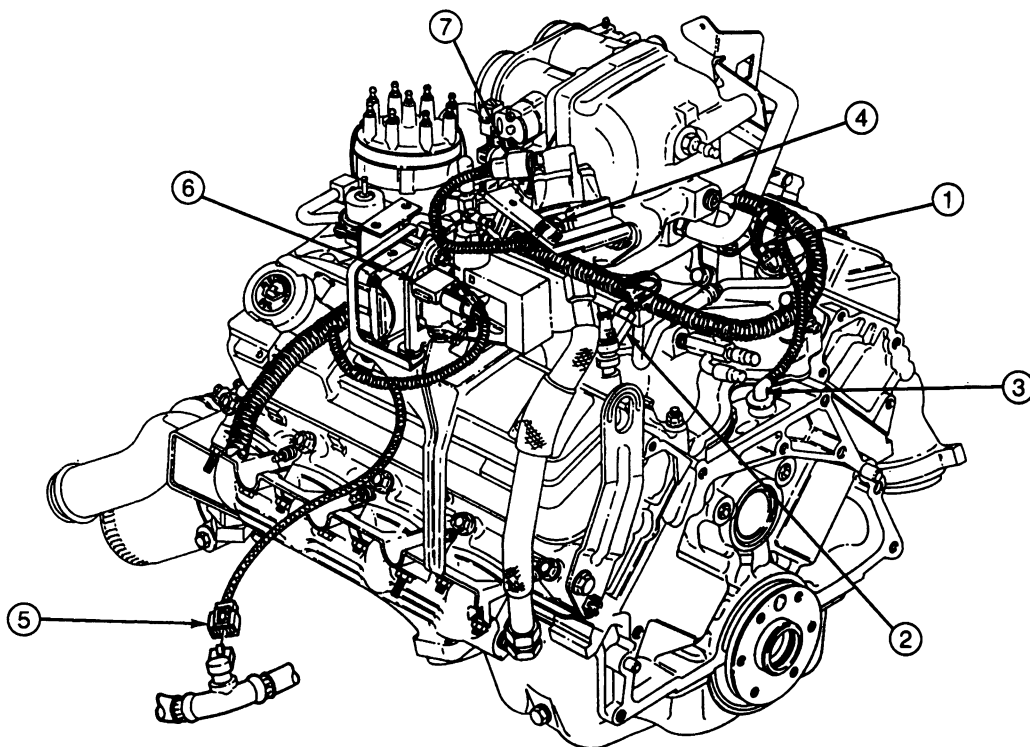
K17347-B

REMOVAL AND INSTALLATION (Continued)**WIRING, ENGINE, E-SERIES WITH 5.0L AND 5.8L EFI (LEGEND)**

Item No.	Part Number	Description
1	—	HEGO Sensor Assembly (U/8500)
2	—	HEGO Sensor Assembly
3	14305	Wiring Assembly
5	—	Place Locator in Hole Provided
7	—	Existing Hole in Inner Right Side Frame
8	14B060	Cable Assembly

Item No.	Part Number	Description
9	9D930	Wiring and Connector
10	—	To 15525 Wiring Assembly
11	—	To 12A581 Wiring Assembly
12	12A522	Jumper Wire Assembly
13	—	Locator, Install in Existing Hole

CK17348-A

REMOVAL AND INSTALLATION (Continued)**Wiring, Engine, F-250-350 and F-Super Duty with 7.5L**

K17349-A

REMOVAL AND INSTALLATION (Continued)**WIRING, ENGINE F-250-350 AND F-SUPER DUTY WITH 7.5L EFI (LEGEND)**

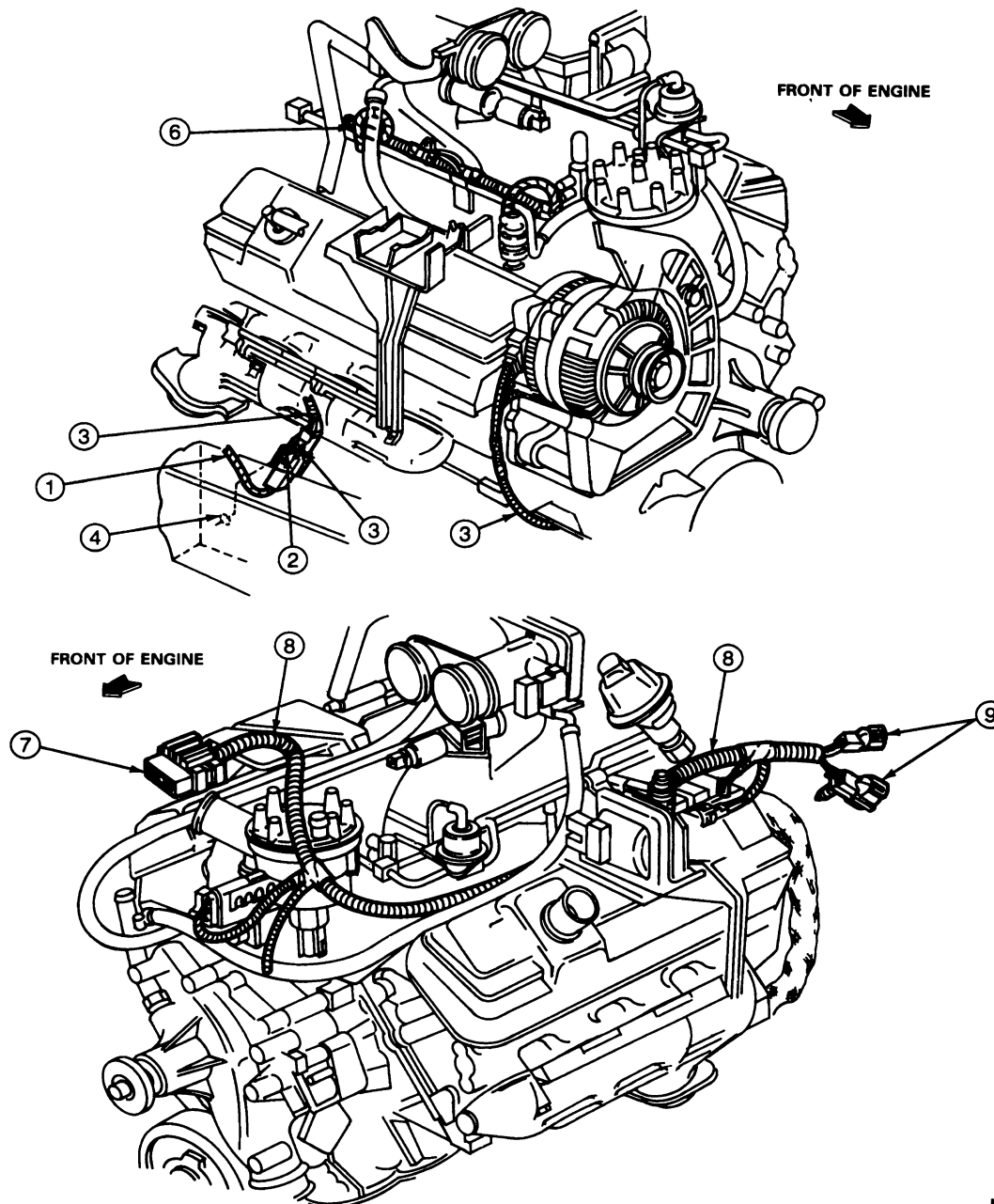
Item No.	Part Number	Description
1	—	To Fuel Injector #4
2	—	To Fuel Injector #8
3	—	To Oil Pressure Sender
4	—	To Fuel Injector #7
5	—	To EGR Control
6	—	To TAB
7	—	To EVP
8	—	To TPS
9	—	To Idle Speed Control
10	—	To E-Coil
11	—	To Fuel Injector #6
12	—	To Air Charge Temperature Switch

Item No.	Part Number	Description
13	—	To Fuel Injector #5
14	—	To Engine Coolant Temperature Switch
15	—	To Distributor
16	—	To A/C Clutch
17	—	To Fuel Injector #1
18	—	To Canister Purge
19	—	To Fuel Injector #2
20	—	To Fuel Injector #3
21	—	To Fuel Injector #4
22	—	Locator, Position in Hole Provided
23	—	To Radio Capacitor

CK17350-A

REMOVAL AND INSTALLATION (Continued)

Wiring, Engine, E-Series with 7.5L

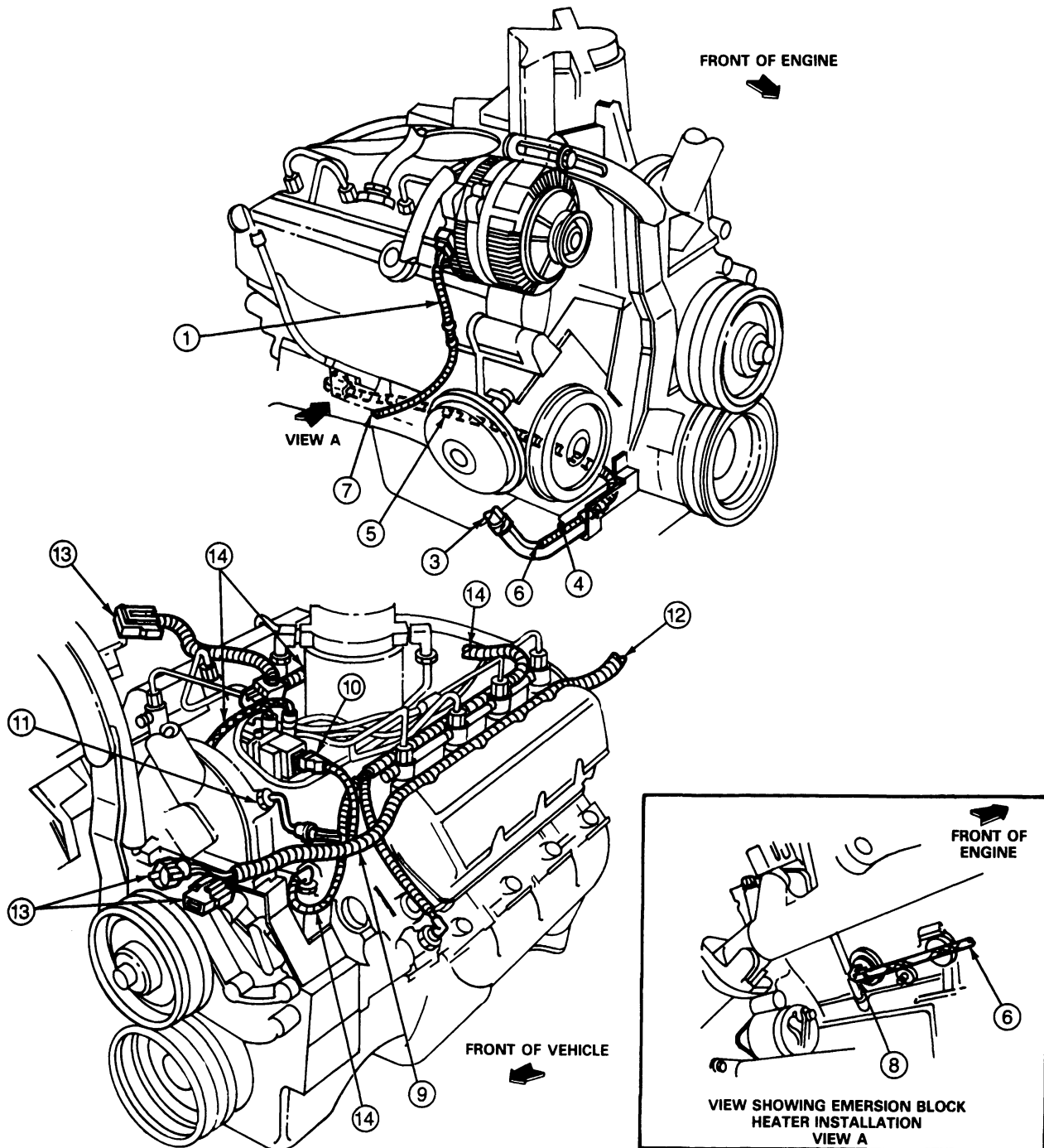


K17351-B

WIRING, ENGINE, E-SERIES WITH 7.5L EFI (LEGEND)

Item No.	Part Number	Description
1	—	Hego Sensor Assembly
2	—	Place Locator in Existing Hole
3	14305	Cable Assembly
4	—	Existing Hole in Inner Right Side Frame
6	9D930	Wiring Assembly
7	—	42 Way Connector, to 12A581 Wiring Assembly
8	9D930	Wiring Assembly
9	—	To 15525 Wiring Assembly

CK17352-A

REMOVAL AND INSTALLATION (Continued)**Wiring, Engine, E-Series with 7.3L Diesel Engine**

K17353-A

REMOVAL AND INSTALLATION (Continued)

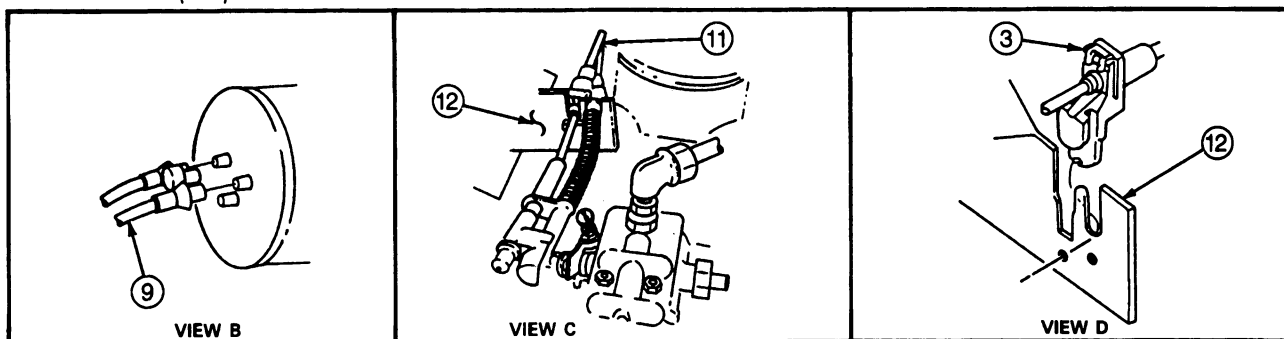
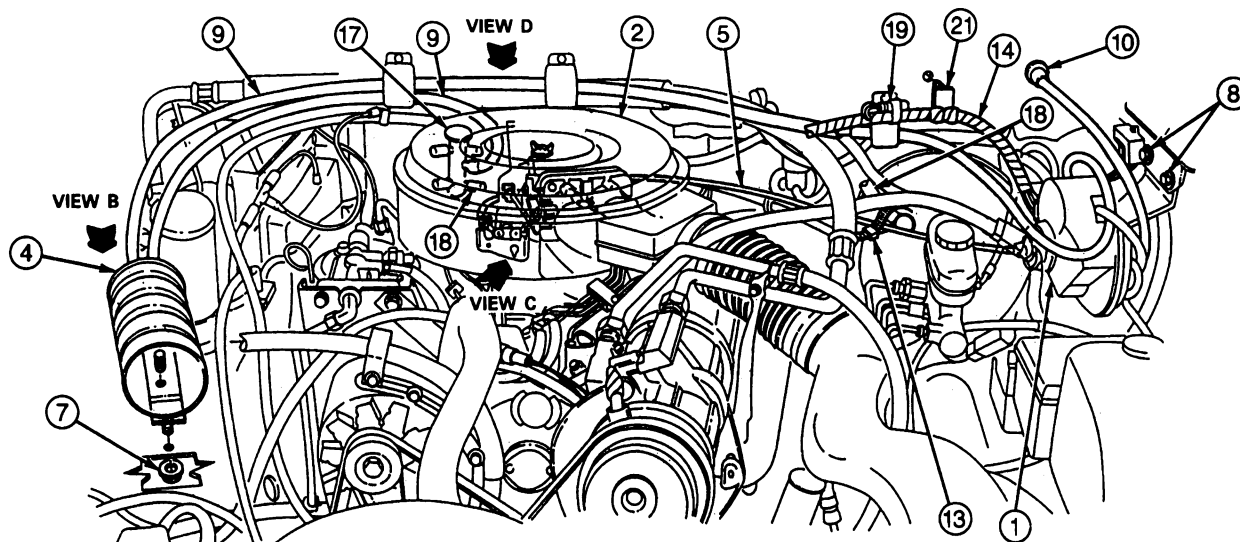
WIRING, ENGINE, E-SERIES WITH 7.3L DIESEL ENGINE (LEGEND)

Item No.	Part Number	Description
1	14305	Wiring Assembly
3	14300	Cable Assembly
4	14301	Cable Assembly
5	6B018	Wiring Assembly
6	—	To 6B018 Wiring Assembly
7	—	To 14305 Wiring Assembly
8	—	Emmersion Block Heater Assembly

Item No.	Part Number	Description
9	9D930	Fuel Charge Wiring Assembly
10	—	TPS Assembly (E40D Transmission)
11	17B384	Tachometer Sensor Assembly (E40D Transmission)
12	9D930	Wiring Assembly
13	—	To 12A581 Wiring Assembly
14	—	Engine Wiring Assembly

CK17354-A

Wiring, Engine, F-150-250-350 and F-Super Duty with 7.3L Diesel Engine



K17355-A

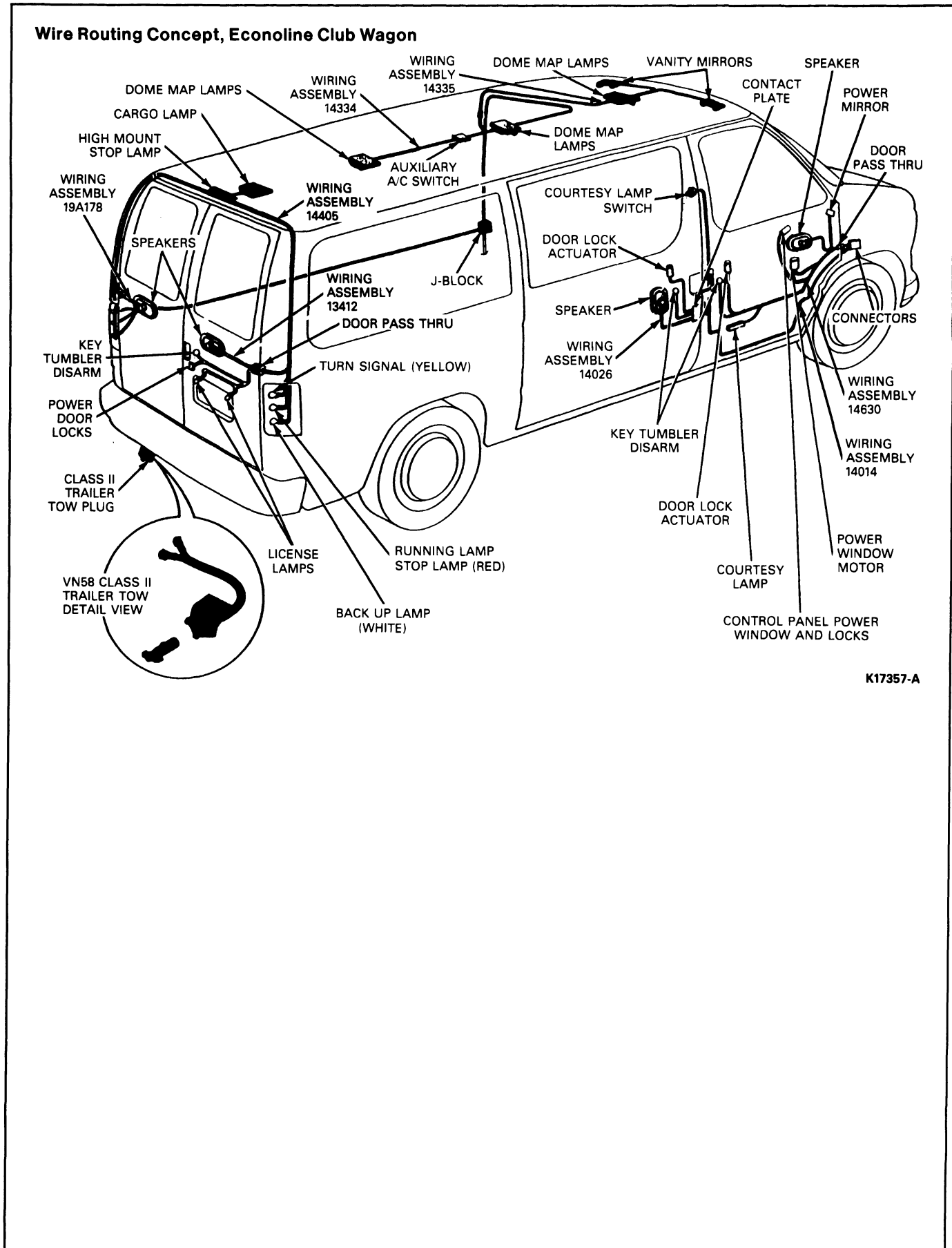
WIRING, ENGINE, F-150-250-350 AND F-SUPER DUTY WITH 7.3L DIESEL ENGINE (LEGEND)

Item No.	Part Number	Description
1	9C734	Servo Assembly
2	—	Air Cleaner
3	9D726	Clip
4	9E453	Reservoir and Bracket Assembly
5	9A825	Actuator Assembly
7	34657-S36	Nut 8-11 N·m (71-97 In·Lb)
8	N605902-S2	Bolt 15-18 N·m (11.1-13.2 Ft·Lb)
9	9E802	Hose Assembly
10	9E802	Hose Assembly

Item No.	Part Number	Description
11	9A758	Accelerator Cable
12	9728	Throttle Bracket Assembly
13	95874-S	Strap
14	12A581	Wiring Assembly
17	—	Vacuum Distribution
18	—	Brake Booster Hose
19	—	To Hood Light
21	—	Clip

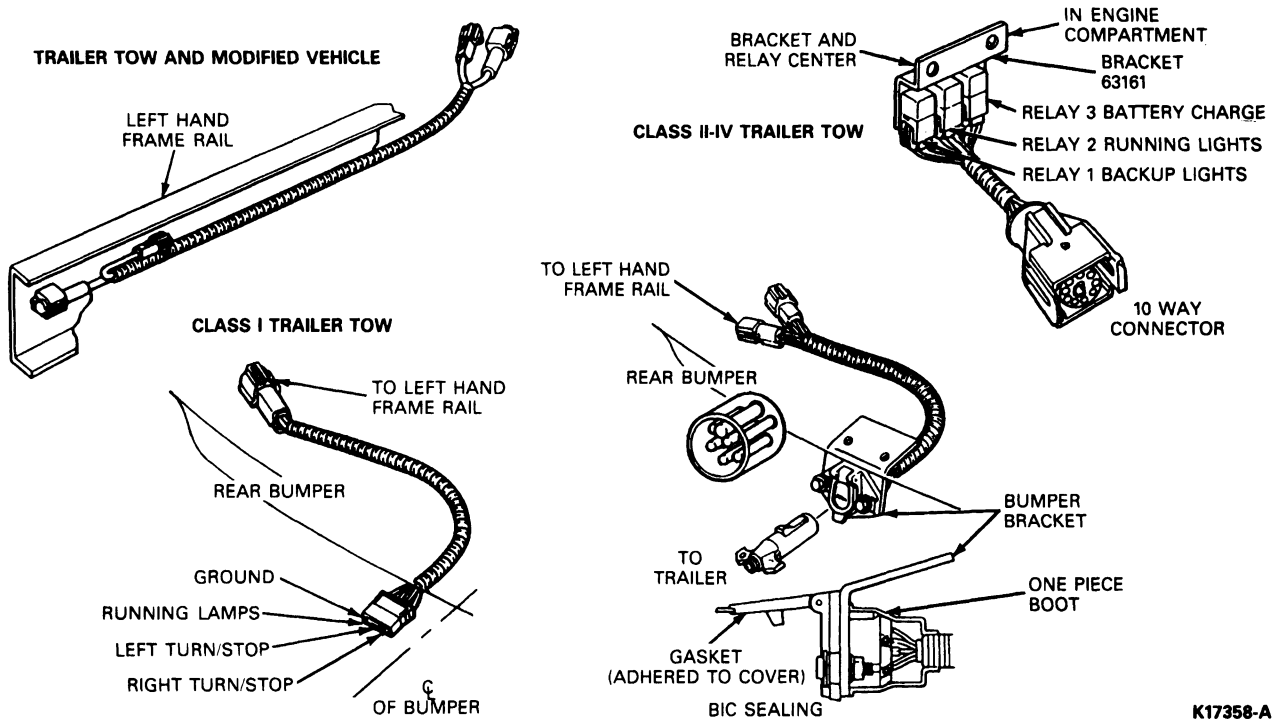
CK17356-A

REMOVAL AND INSTALLATION (Continued)



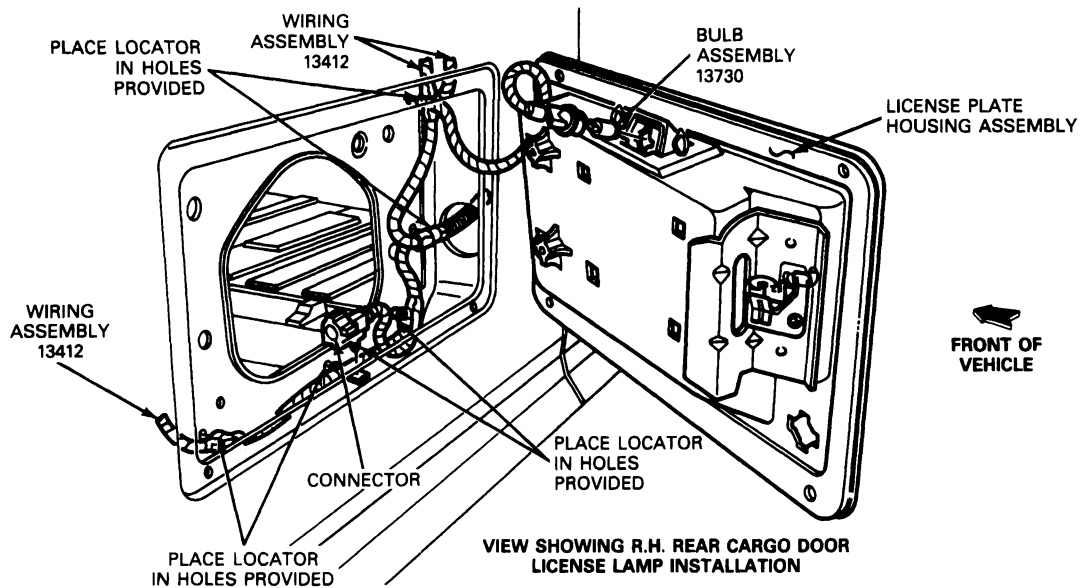
REMOVAL AND INSTALLATION (Continued)

Trailer Tow, Econoline



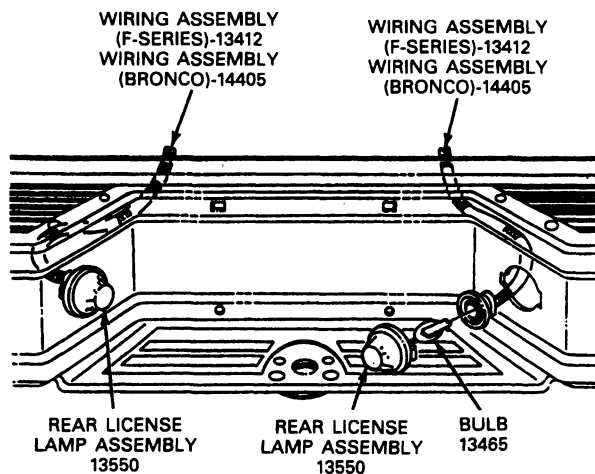
K17358-A

Lamp, Rear License, E-150, E-350

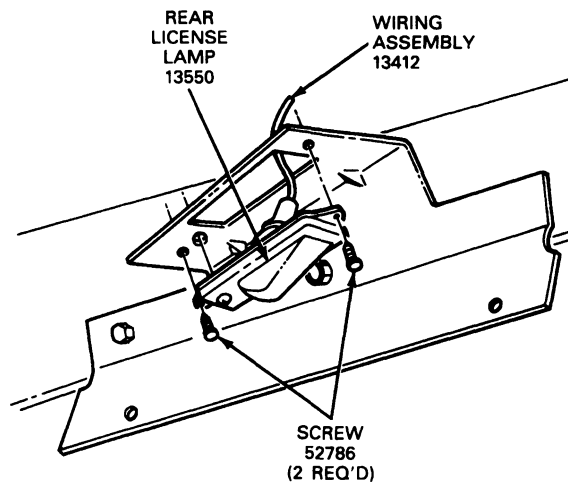


K17359-B

REMOVAL AND INSTALLATION (Continued)

Lamp, Rear License, Bronco, F-150-250-350 with Bumper

VIEW SHOWING INSTALLATION OF
LICENSE LAMP ASSEMBLY WITH
STEP-UP BUMPER FOR CONVENTIONAL TRUCK
(STYLE SIDE PICK-UP) K17361-B

Lamp, Rear License, F-150-250-350 without Bumper

F-150-F-350 (4x2) AND (4x4) WITHOUT BUMPER

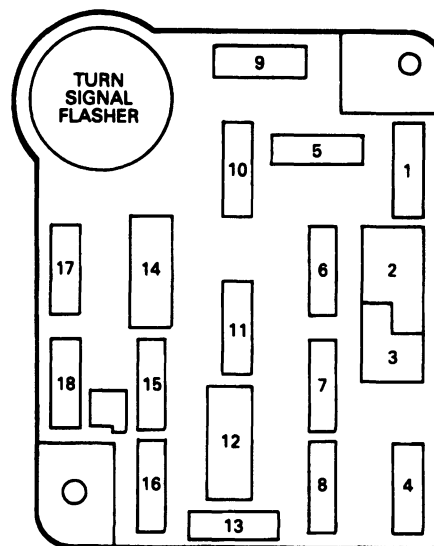
K16310-B

SPECIFICATIONS

Refer to the following charts for electrical specifications.

E-150-250-350 CIRCUIT PROTECTION FUSE PANEL

Fuse Protection	Amps	Fuse Color	Fuse Panel
1	15	Lt. Blue	Stoplamps, Hazard Flasher
2	8.25 C.B.		Windshield Wiper/Washer, Intermittent Wiper
3	Blank		
4	20	Yellow	Running Lamps, Flash to Pass
5	15	Lt. Blue	Turn Signal, Back-Up Lamps
6	20	Yellow	Speed Control, Customer Convenience Plug (Located Below Fuse) Hot in RUN or ACCY
7	30	Green	Ignition Coil
8	15	Lt. Blue	Dome Lamp, Radio Memory, Map Lamps, Rear Cargo Lamp
9	15	Lt. Blue	A/C-Heater Blower Motor Relay Coil, A/C Clutch
10	20/30	Yel/Grn	Cigar Lighter/Rear Power Outlet
11	15	Lt. Blue	Radio and Clock
12	20 C.B.		Power Door Locks
13	5	Tan	Instrument Panel Illumination Lamps
14	20 C.B.		Power Windows
15	20	Yellow	Air Bag
16	30	Green	Power Lumbar/Modified Vehicle Tap
17	20	Yellow	Brake Anti-Lock Module/PSOM
18	15	Lt. Blue	Instrument Warning Lamps, Warning Buzzer, Rear Anti-Lock Warning, Warning Lamps, Fluid Level Light



FUSE PANEL DIAGRAM — E-150-250-350

CK11854-D

E150-250-350 NON-FUSE PANEL CIRCUIT PROTECTION

Circuit Protected	Type of Protection	Location
Glow Plug Right Bank	14 Gage Fuse Link	SMR*
Glow Plug Left Bank	14 Gage Fuse Link	SMR*

* Starter Motor Relay

CK17883-A

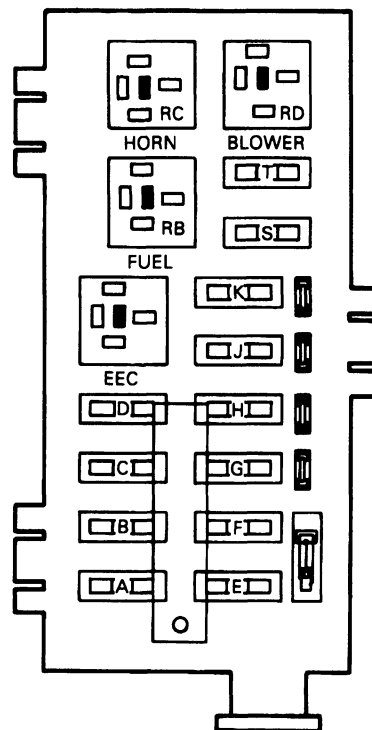
SPECIFICATIONS (Continued)

E150-250-350 CIRCUIT PROTECTION FUSE PANEL
(ENGINE COMPARTMENT)

Fuse Protection	Amps	Fuse Color	Fuse Panel
A	60	Blue	Aux. Heater
B	60	Blue	Modified Vehicle
C	30	Lt. Green	EEC
D	20	Yellow	Elect. Brake
E	60	Blue	Pwr. Seat, Driver Pwr. Lumbar
F	60	Blue	Blower/Cigar
G	60	Blue	Ignition Switch
H	30	Lt. Green	Fuel Pump
J	40	Orange	Trailer Tow
K	30	Lt. Green	Trailer Tow
L	—		EEC Diode
M	10	Red	Turn Signal (Trailer Tow)
N	10	Red	Turn Signal (Trailer Tow)
P	10	Red	Running Lights (Trailer Row)
R	15	Blue	Horn
S	60	Blue	Interior Fuse Panel Feed
T	60	Blue	Trailer Tow & Aux. Batt. Relay

CK17684-A

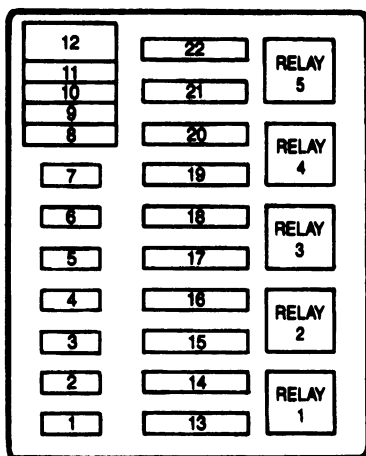
Engine Compartment Fuse Panel, Econoline



K17363-A

SPECIFICATIONS (Continued)

F-Series and Bronco Power Distribution Box, Diesel Engine Only



Item No.	Part Number	Description
1	20A	Headlamp Flash-to-Pass; Daytime Running Lamps (Canada Only).
2	—	Not Used.
3	20A	Horn; Speed Control.
4	25A	Trailer Backup and Running Lamps.
5	15A	Backup Lamps; Daytime Running Lamp Module (Canada Only); Trailer Battery Charge Relay; Speed Control.
6	5A	Trailer RH Stop/Turn Lamp.
7	5A	Trailer LH Stop/Turn Lamp.
8	—	Not Used.

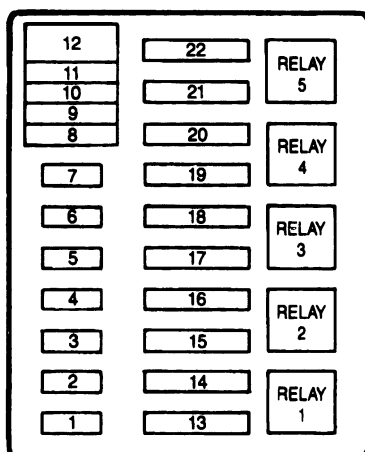
*() Indicates Electronic Transmission Function Only.

Item No.	Part Number	Description
9	(20A Maxi)*	(Electronic Transmission Control System.)*
10	20A Maxi	Starter Relay Coil; Instrument Panel Fuses: 15, 18
11	20A Maxi	Glow Plug Controller Relay; Fuel Shutoff Solenoid; Cold Idle Solenoid.
12	(Diode)*	(Electronic Transmission Control System Relay.)*
13	50A Maxi	Instrument Panel Fuses: 5, 9, 13.
14	—	Not Used.
15	50A Maxi	Instrument Panel Fuses: 1, 7; Power Network Box Fuse 5.
16	—	Not Used.
17	50A Maxi	Instrument Panel Fuses: 2, 6, 11, 14, 17; Power Network Box Fuse: 11, 22; Alt. Charge Lamp.
18	30A Maxi	Trailer Battery Charge.
19	40A Maxi	Headlamps.
20	50A Maxi	Instrument Panel Fuses: 4, 8, 12, 16.
21	30A Maxi	Trailer Brake Feed.
22	20A Maxi*	(Electronic Transmission Control System Relay);* Ambulance Package Alternator; Fuel Heater.
Relay 1	(Relay)*	(Electronic Transmission Control System.)*
Relay 2	Relay	Trailer Backup Lamps.
Relay 3	Relay	Horn.
Relay 4	Relay	Trailer Tow and/or Dual Rear Wheel Running Lamps.
Relay 5	Relay	Trailer Battery Charge.

CK17364-B

SPECIFICATIONS (Continued)

F-Series and Bronco Power Distribution Box, Gas Engine Only



Item No.	Part Number	Description
1	20A	Headlamp Flash-to-Pass; Daytime Running Lamps (Canada Only).
2	30A	Anti-Lock Brakes.
3	20A	Horn; Speed Control.
4	25A	Trailer Backup and Running Lamps.
5	15A	Oxygen Sensor Heater; Backup Lamps; Daytime Running Lamp Module (Canada Only); Trailer Battery Charge Relay; Speed Control.
6	5A	Trailer RH Stop/Turn Lamp.
7	5A	Trailer LH Stop/Turn Lamp.
8	30A	Anti-Lock Brakes.

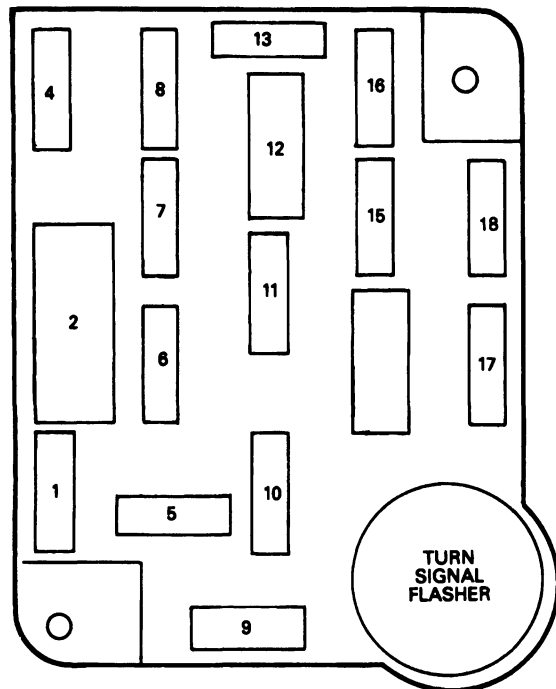
*() Indicates Bronco Function Only.

Item No.	Part Number	Description
9	20A Maxi	Electronic Engine Control System, Fuel Pump Relay Coil.
10	20A Maxi	Starter Relay Coil; Instrument Panel Fuses: 15, 18
11	—	Not Used.
12	(Diode)	Electronic Engine Control Relay.
13	50A Maxi	Instrument Panel Fuses: 5, 9, 13.
14	(30A Maxi)*	(Rear Window Defrost.)*
15	50A Maxi	Instrument Panel Fuses: 1, 7; Power Network Box Fuse 5.
16	20A Maxi	Fuel Pump Feed.
17	50A Maxi	Instrument Panel Fuses: 2, 6, 11, 14, 17; Power Network Box: Fuse 22; Alt. Charge Lamp.
18	30A Maxi	Trailer Battery Charge.
19	40A Maxi	Headlamps.
20	50A Maxi	Instrument Panel Fuses: 4, 8, 12, 16.
21	30A Maxi	Trailer Brake Feed.
22	20A Maxi	TFI Module; Ignition Coil; Distributor Pickup; Electronic Engine Control Relay Coil.
Relay 1	Relay	Electronic Engine Control.
Relay 2	Relay	Fuel Pump.
Relay 3	Relay	Horn.
Relay 4	Relay	Trailer Tow and/or Dual Rear Wheel Running Lamps.
Relay 5	—	Not Used.

CK17365-B

SPECIFICATIONS (Continued)

Fuse Panel, F-Series and Bronco

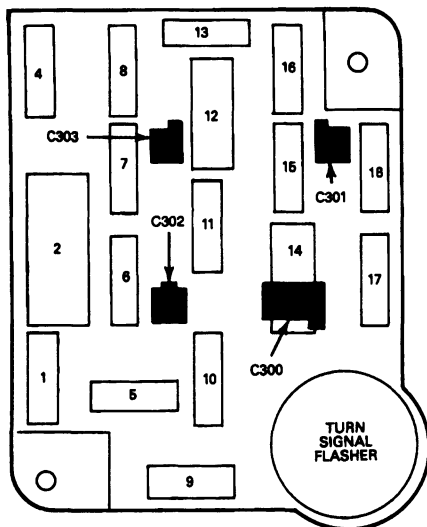


FUSE POSITION	AMPS	CIRCUITS PROTECTED
1	3D	Heater/A/C Blower.
2	8.25 c.b.	Wiper/Washer.
3	—	Not Used.
4	15	Warning Buzzer/Chime Module; Exterior Lamps; Instrument Illumination; Trailer Exterior Lamp Relay.
5	—	Not Used.
6	15	A/C Clutch; (Diesel Aux. Fuel Selector)*.
7	15	Turn Lamps; (Rear Window Defrost)*.
8	15	Courtesy/Dome/ Cargo Lamps; Electric Outside Mirrors; Radio/Clock Memory; Speedometer Memory; Warning Buzzer/ Chime Module.
9	15	Power Point.
10	4	Instrument Illumination.
11	15	Radio; Radio Display Dim.
12	20 c.b.	Power Door Locks; Electronic Shift Motor 4WD; Power Lumbar; (Tailgate Power Window; Key Switch)*.
13	15	Stop/Hazard Lamps; Anti-lock Brake Module Memory Power (F-Series Only); Speed Control; Stop sense for: Electronic Engine Control; Anti-lock Brakes.
14	20 c.b.	Power Windows; (Tailgate Power Window; Instrument Panel Switch)*.
15	20	Anti-lock Brakes (F-Series only).
16	15	Cigar Lighter
17	10	Warning Buzzer/Chime Module; Warning Indicators; (Diesel Indicators)*; Gauges; Tachometer; Transmission Control Switch.
18	10	Electronic Shift Module 4WD; Speedometer.

*() Indicates diesel or Bronco functions only.

CK19630-A

SPECIFICATIONS (Continued)



Fuse Value Amps	Color code
4	Pink
5	Tan
10	Red
15	Light Blue
20	Yellow
25	Natural
30	Light Green

F-SUPER DUTY
MOTORHOME CHASSIS

Fuse Position	Amp	Circuits Protected
1	15	Stop Lamps, Emergency Flasher
2	*	Windshield Wiper Motor
4	15	Marker Lamps
5	15	Turn Signals, Backup Lamps
6	10	Speed Control
7	15	Accy. Feed (Run Only)
8	15	Interior Lamps
9	*	Blower Motor
10	5	Low Voltage Battery Feed
11	5	Radio
12	—	
13	5	Instruments Illumination
14	10	Accy. Feed (Run & Accy.)
15	5	Transmission O.D. Control
16	10	Horn
17	—	
18	15	Warning Indicators

* To be determined by the customer, based on amp required.

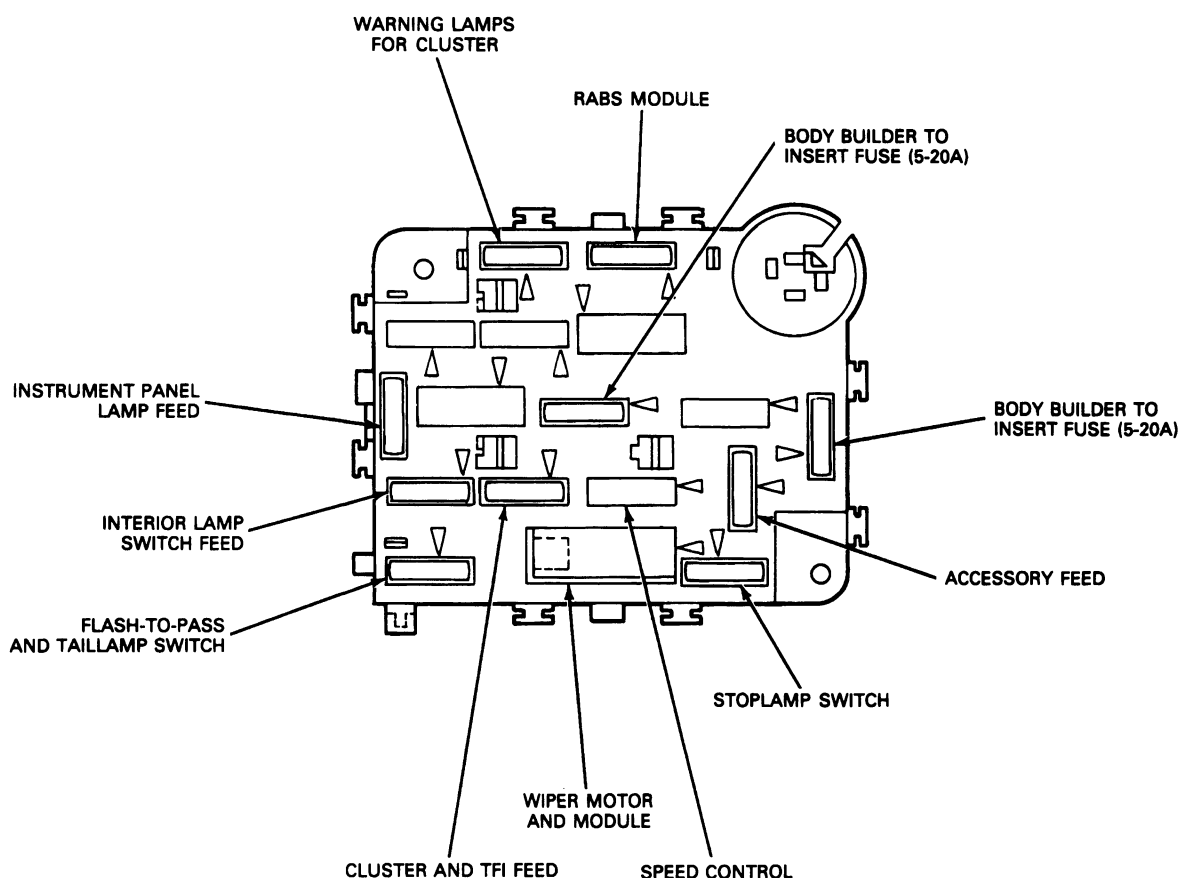
2 not to exceed 8.25 amp CB

9 not to exceed 30 amp

CK14221-C

SPECIFICATIONS (Continued)

Fuse Panel, E-350 RV Chassis

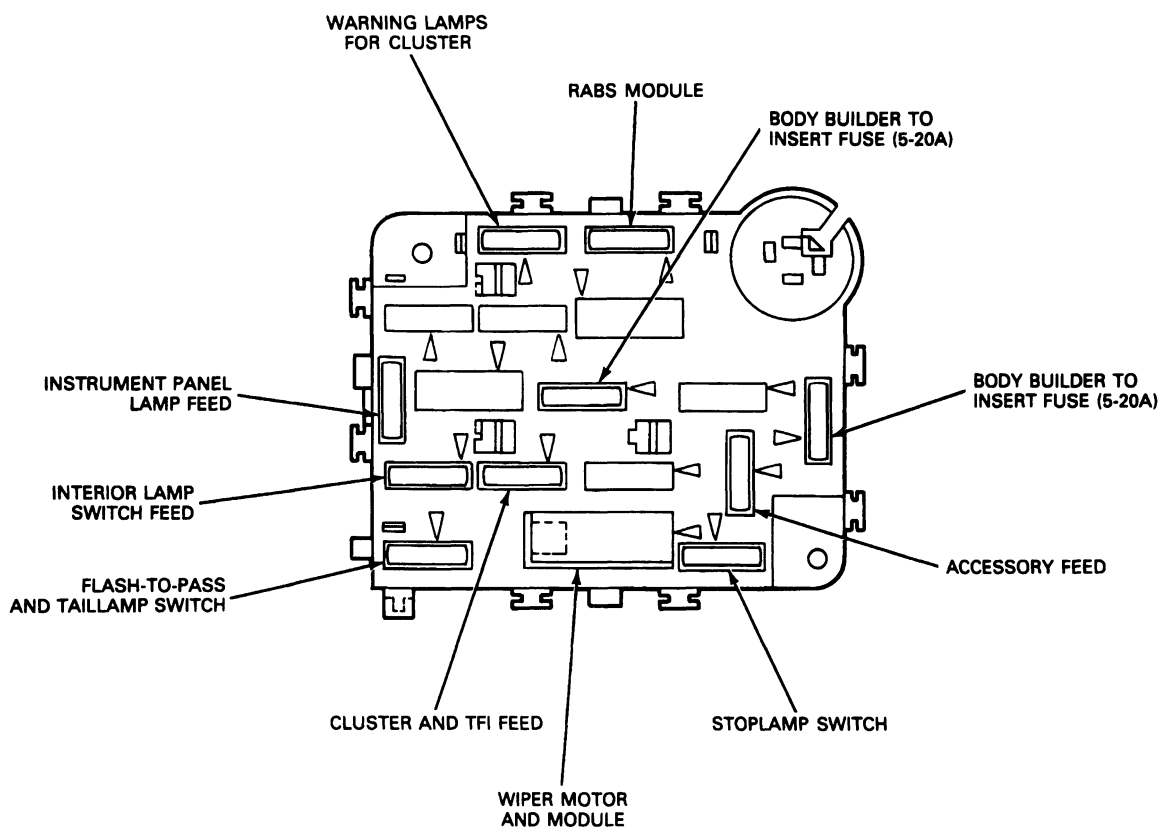


FUSE	DESCRIPTION	FUSE	DESCRIPTION
1 (15A)	STOPLAMP SWITCH FEED	10 —	VACANT
2 (8.25 CB)	WIPER MOTOR AND MODULE FEED	11 (5-20A)	ACCY FEED (HOT IN RUN AND ACCESSORY) BODY BUILDER TO INSERT 5-20A FUSE
3 —	N/A	12 —	VACANT
4 (20A)	FLASH-TO-PASS AND TAILLAMP SWITCH	13 (5A)	INSTRUMENT PANEL LAMP FEED
5 (15A)	ACCESSORY FEED	14 —	VACANT
6 (20A)	SPEED CONTROL	15 —	VACANT
7 (30A)	CLUSTER AND TFI FEED	16 —	VACANT
8 (15A)	INTERIOR LAMP SWITCH FEED	17 (20A)	RABS MODULE FEED
9 (5-20A)	BODY BUILDER TO INSERT 5-20A FUSE BATTERY FEED	18 (15A)	WARNING LAMPS FOR CLUSTER

K17885-A

SPECIFICATIONS (Continued)

Fuse Panel, E-250 Commercial Chassis



FUSE	DESCRIPTION	FUSE	DESCRIPTION
1 (15A)	STOPLAMP SWITCH FEED	10 —	VACANT
2 (8.25 CB)	WIPER MOTOR AND MODULE FEED	11 (5-20A)	ACCY FEED (HOT IN RUN AND ACCESSORY) BODY BUILDER TO INSERT 5-20A FUSE
3 —	N/A	12 —	VACANT
4 (20A)	FLASH-TO-PASS AND TAILLAMP SWITCH	13 (5A)	INSTRUMENT PANEL LAMP FEED
5 (15A)	ACCESSORY FEED	14 —	VACANT
6 —	VACANT	15 —	VACANT
7 (30A)	CLUSTER AND TFI FEED	16 —	VACANT
8 (15A)	INTERIOR LAMP SWITCH FEED	17 (20A)	RABS MODULE FEED
9 (5-20A)	BODY BUILDER TO INSERT 5-20A FUSE BATTERY FEED	18 (15A)	WARNING LAMPS FOR CLUSTER

K17886-A

SPECIFICATIONS (Continued)

Flashers	Location
Turn Signal Flasher	Front of fuse panel
Hazard Warning Flasher	Rear of fuse panel behind turn signal flasher


FLASHER/LOCATION CHART

F-150-F-350, F-SUPER DUTY AND BRONCO
NON-FUSE PANEL CIRCUIT PROTECTION

Circuit Protected	Type of Protection	Location
Headlamp	22 amp C.B.	Integral w/lighting switch
Alternator	12 gauge fuse link (for 60, 75, 80, 95 amp alternators)	Starter motor relay
Alternator	(2) 12 gauge fuse link (for 130 amp alternator) — Diesel	Starter motor relay
Underhood power distribution box	(2) 12 GA fuse links	Starter motor relay
Diesel glow plugs	(2) 14 GA fuse links	Starter motor relay

CK6379-H

SPECIAL SERVICE TOOLS

Tool Number/ Description	Illustration
T67S-17018-A Wire Fitting Crimping Tool	 T67S-17018-A

Index/ Important Information

METRICS

**J1930 TERMINOLOGY
LIST**

GLOSSARY

ALPHABETICAL INDEX

**WE WANT TO HEAR
FROM YOU**

INTRODUCTION

Most threaded fasteners are covered by specifications that define required mechanical properties, such as tensile strength, yield strength, proof load and hardness. These specifications are carefully considered in initial selection of fasteners for a given application. To assure continued satisfactory vehicle performance, replacement fasteners used should be of the correct strength, as well as the correct nominal diameter, thread pitch, length, and finish.

Most original equipment fasteners (English system or Metric) are identified with markings or numbers indicating the strength of the fastener. These markings are described in the pages that follow. Attention to these markings is important in assuring that the proper replacement fasteners are used.

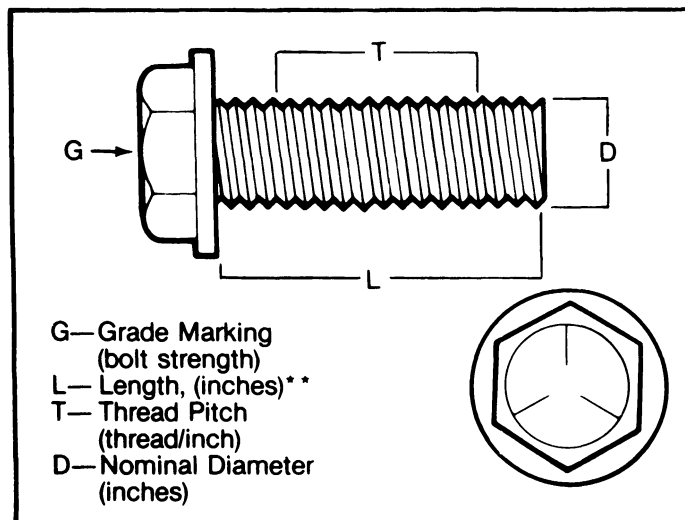
Further, some metric fasteners, especially nuts, are colored blue. This metric blue identification is in most cases a temporary aid for production start-up, and color will generally revert to normal black or bright after start-up.

English system and metric system fasteners are available through your Ford Parts and Service operation.

NOMENCLATURE FOR BOLTS

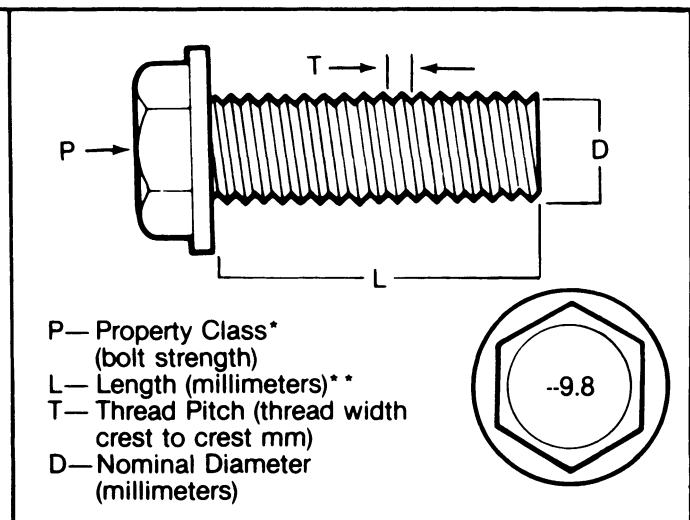
(ENGLISH) INCH SYSTEM

Bolt, 1/2-13x1



METRIC SYSTEM

Bolt M12-1.75x25



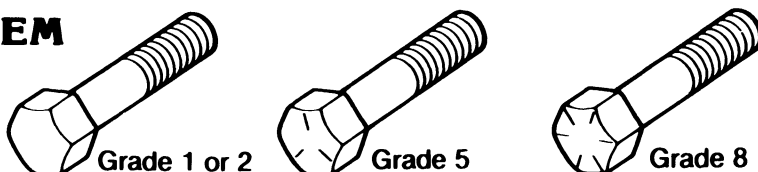
*The property class is an Arabic numeral distinguishable from the slash SAE English grade system.

**The length of all bolts is measured from the underside of the head to the end.

Metrics

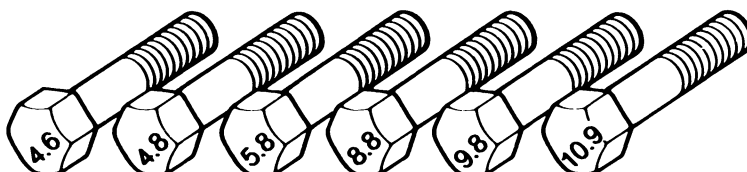
BOLT STRENGTH IDENTIFICATION

(ENGLISH) INCH SYSTEM



English (Inch) bolts—Identification marks correspond to bolt strength—increasing number of slashes represent increasing strength.

METRIC SYSTEM







Metric bolts—Identification class numbers correspond to bolt strength—increasing numbers represent increasing strength. Common metric fastener bolt strength property are 9.8 and 10.9 with the class identification embossed on the bolt head.

HEX NUT STRENGTH IDENTIFICATION

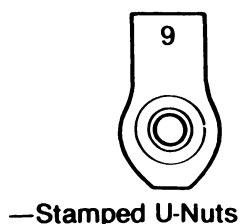
(ENGLISH) INCH SYSTEM

METRIC SYSTEM

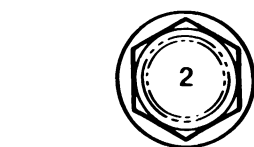
Grade	Hex Nut Grade 5	Hex Nut Grade 8	Class	Hex Nut Property Class 9	Hex Nut Property Class 10
Identification			Identification		
	3 Dots	6 Dots		Arabic 9	Arabic 10
Increasing dots represent increasing strength.			May also have blue finish or paint daub on hex flat. Increasing numbers represent increasing strength.		

OTHER TYPES OF PARTS

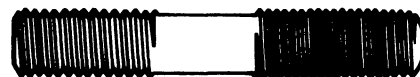
Metric identification schemes vary by type of part, most often a variation of that used of bolts and nuts. Note that many types of English and metric fasteners carry no special identification if they are otherwise unique.



—Stamped U-Nuts



—Tapping, thread forming and certain other case hardened screws



CLASS 10.9



CLASS 9.8



CLASS 8.8

—Studs, Large studs may carry the property class number. Smaller studs use a geometric code on the end.

Metrics

ENGLISH METRIC CONVERSION

Description	Multiply	By	For Metric Equivalent
ACCELERATION	Foot/sec ²	0.3048	metre/sec ² (m/s ²)
	Inch/sec ²	0.0254	metre/sec ²
TORQUE	Pound-inch	0.11298	newton-metres (N·m)
	Pound-foot	1.3558	newton-metres
POWER	horsepower	0.746	kilowatts (kw)
PRESSURE or STRESS	inches of water	0.2491	kilopascals (kPa)
	pounds/sq. in.	6.895	kilopascals (kPa)
	pounds/sq. in.	0.069	bar
ENERGY or WORK	BTU	1055.	joules (J)
	foot-pound	1.3558	joules (J)
	kilowatt-hour	3,600,000. or 3.6 x 10 ⁶	joules (J = one W's)
LIGHT	foot candle	10.764	lumens/metre ² (lm/m ²)
FUEL PERFORMANCE	miles/gal	0.4251	kilometres/litre (km/l)
	gal/mile	2.3527	litres/kilometre (l/km)
VELOCITY	miles/hour	1.6093	kilometres/hr. (km/h)
LENGTH	inch	25.4	millimetres (mm)
	foot	0.3048	metres (m)
	yard	0.9144	metres (m)
	mile	1.609	kilometres (km)
AREA	inch ²	645.2	millimetres ² (mm ²)
		6.45	centimetres ² (cm ²)
	foot ²	0.0929	metres ² (m ²)
VOLUME	yard ²	0.8361	metres ²
	inch ³	16,387.	mm ³
		16.387	cm ³
		0.0164	litres(1)
	quart	0.9464	litres
MASS	gallon	3.7854	litres
	yard ³	0.7646	metres ³ (m ³)
	pound	0.4536	kilograms (kg)
	ton	907.18	kilogram (kg)
FORCE	ton	0.90718	tonne (t)
	kilogram	9.807	newtons (N)
	ounce	0.278	newtons
TEMPERATURE	pound	4.448	newtons
	degree fahrenheit	(°F – 32) 0.556	degree Celsius (°C)

Metrics

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal Inch	Metric mm
1/64	.015625	.397
1/32	.03125	.794
3/64	.046875	1.191
1/16	.0625	1.588
5/64	.078125	1.984
3/32	.09375	2.381
7/64	.109375	2.778
1/8	.125	3.175
9/64	.140625	3.572
5/32	.15625	3.969
11/64	.171875	4.366
3/16	.1875	4.763
13/64	.203125	5.159
7/32	.21875	5.556
15/64	.234375	5.953
1/4	.250	6.35
17/64	.265625	6.747
9/32	.28125	7.144
19/64	.296875	7.54
5/16	.3125	7.938
21/64	.328125	8.334
11/32	.34375	8.731
23/64	.359375	9.128
3/8	.375	9.525
25/64	.390625	9.922
13/32	.40625	10.319
27/64	.421875	10.716
7/16	.4375	11.113
29/64	.453125	11.509
15/32	.46875	11.906
31/64	.484375	12.303
1/2	.500	12.7

Fractions	Decimal Inch	Metric mm
33/64	.515625	13.097
17/32	.53125	13.494
35/64	.546875	13.891
9/16	.5625	14.288
37/64	.578125	14.684
19/32	.59375	15.081
39/64	.609375	15.478
5/8	.625	15.875
41/64	.640625	16.272
21/32	.65625	16.669
43/64	.671875	17.066
11/16	.6875	17.463
45/64	.703125	17.859
23/32	.71875	18.256
47/64	.734375	18.653
3/4	.750	19.05
49/64	.765625	19.447
25/32	.78125	19.844
51/64	.796875	20.241
13/16	.8125	20.638
53/64	.828125	21.034
27/32	.84375	21.431
55/64	.859375	21.828
7/8	.875	22.225
57/64	.890625	22.622
29/32	.90625	23.019
59/64	.921875	23.416
15/16	.9375	23.813
61/64	.953125	24.209
31/32	.96875	24.606
63/64	.984375	25.003
1	1.00	25.4

Metrics

TORQUE CONVERSION

NEWTON METRES (N·m)	POUND-FEET (LB·FT)
1	0.7376
2	1.5
3	2.2
4	3.0
5	3.7
6	4.4
7	5.2
8	5.9
9	6.6
10	7.4
15	11.1
20	14.8
25	18.4
30	22.1
35	25.8
40	29.5
50	36.9
60	44.3
70	51.6
80	59.0
90	66.4
100	73.8
110	81.1
120	88.5
130	95.9
140	103.3
150	110.6
160	118.0
170	125.4
180	132.8
190	140.1
200	147.5
225	166.0
250	184.4

POUND-FEET (LB·FT)	NEWTON METRES (N·m)
1	1.356
2	2.7
3	4.0
4	5.4
5	6.8
6	8.1
7	9.5
8	10.8
9	12.2
10	13.6
15	20.3
20	27.1
25	33.9
30	40.7
35	47.5
40	54.2
45	61.0
50	67.8
55	74.6
60	81.4
65	88.1
70	94.9
75	101.7
80	108.5
90	122.0
100	135.6
110	149.1
120	162.7
130	176.3
140	189.8
150	203.4
160	216.9
170	230.5
180	244.0

J1930 Terminology List

NOTE: Certain Ford component names have been changed in this Service Manual to conform to Society of Automotive Engineers (SAE) directive J1930.

SAE J1930 standardizes automotive component names for all vehicle manufacturers.

This chart lists new 1993 SAE J1930 component names and the obsolete 1992 component names.

New Term	New Acronyms/ Abbreviations	Old Acronyms/ Term
4X4 Low	4X4L	– 4X4L – 4X4 Low
Air Conditioning	A/C	– A/C – Air Conditioning
Air Conditioning Clutch	ACC	– ACC – Air Conditioning Clutch
Air Conditioning Cyclic Switch	ACCS	– ACCS – Air Conditioning Cyclic Switch
Air Conditioning Demand	ACD	– ACD – Air Conditioning Demand
Air Conditioning On	ACON	– ACON – Air Conditioning On
Automatic Ride Control	ARC	– ACL – Acceleration Signal
Barometric Pressure	BARO	– BP – Barometric Pressure
Battery Positive Voltage	B+	– BATT+ – Battery Positive
Blower	BLR	– BLR – Blower
Brake On/Off	BOO	– BOO – Brake On/Off
Bypass Air	BPA	– BPA – Bypass Air
Canister Purge	CANP	– CANP – Canister Purge
Charge Air Cooler	CAC	– Intercooler
Clutch Pedal Position switch	CPP switch	– CES – CIS – Clutch Engage Switch – Clutch Interlock Switch
Coast Clutch Solenoid	CCS	– CCS – Coast Clutch Solenoid
Computer Control Dwell	CCD	– CCD – Computer Control Dwell
Constant Control Relay Module	CCRM	– IRCM – Integrated Relay Control Module
Crankshaft Position sensor	CKP sensor	– CPS – VRS – Variable Reluctance Sensor

J1930 Terminology List

New Term	New Acronyms/ Abbreviations	Old Acronyms/ Term
Cylinder Identification	CID	– CID – Cylinder Identification
Data Link Connector	DLC	– Self-Test connector
Data Negative	DATA-	– DATA- – Data Negative
Data Output Line	DOL	– DOL – Data Output Line
Data Positive	DATA+	– DATA+ – Data Positive
Daytime Running Lamps	DRL	– DRL – Daytime Running Lamps
Defroster	DEF	– DEF – Defroster
Diagnostic Test Mode	DTM	– Self-Test mode
Diagnostic Trouble Code	DTC	– Self-Test code
Differential Pressure Feedback EGR	DPFE	– DPFE – Differential Pressure Feedback EGR
Distributor Ignition	DI	– CBD – DS – TFI – Closed Bowl Distributor – Duraspark Ignition – Thick Film Ignition
Dual Overhead Cam	DOHC	– DOHC – Dual Overhead Cam
Dual Plug Inhibit	DPI	– DPI – Dual Plug Inhibit
EGR Pressure Transducer	EPT	– EPT – EGR Pressure Transducer
EGR Temperature	EGRT	– EGRT – EGR Temperature
EGR Vacuum Regulator	EVR	– EVR – EGR Vacuum Regulator
EGR Valve Position	EVP	– EVP – EGR Valve Position
Electronic Air Pump	EAP	– EAP – Electronic Air Pump
Electronic Engine Control	EEC	– EEC – Electronic Engine Control
Electronic Ignition	EI	– DIS – EDIS – Distributorless Ignition System – Electronic Distributorless Ignition System
Electronic Pressure Control	EPC	– EPC – Electronic Pressure Control
Electronic Secondary Air Injection	EAIR	– EAM – Electronic Air Management

J1930 Terminology List

New Term	New Acronyms/ Abbreviations	Old Acronyms/ Term
Engine Coolant Temperature	ECT	– ECT – Engine Coolant Temperature
Engine RPM sensor	RPM sensor	– RPMS – Engine RPM sensor
Exhaust Gas Recirculation	EGR	– EGR – Exhaust Gas Recirculation
Fan Control	FC	– EDF – Electro-Drive Fan
Flexible Fuel sensor	FF sensor	– FCS – FFS – FFV – Fuel Compensation Sensor – Flex Fuel Sensor
Flexible Fuel vehicle	FF vehicle	– FFV – Flexible Fuel Vehicle
Fuel Pressure Regulator Control	FPRC	– FPRC – Fuel Pressure Regulator Control
Fuel Pump	FP	– FP – Fuel Pump
Fuel Pump Monitor	FPM	– FPM – Fuel Pump Monitor
Governor Control Module	GCM	– GEM – Governor Electronic Module
Ground	GND	– GND – Ground
Headlamp	HDL	– HDL – Headlamp
Heated Oxygen Sensor	HO2S	– HEGO – Heated Exhaust Gas Oxygen Sensor
High Fan Control	HFC	– HEDF – High Speed Electro-Drive Fan
High Fuel Pump	HFP	– HFP – High Fuel Pump
High Output	HO	– HO – High Output
High Swirl Combustion	HSC	– HSC – High Swirl Combustion
Idle Air Control	IAC	– ISC – Idle Speed Control
Idle Air Control Bypass Air	IAC BPA	– ISC-BPA – Idle Speed Control — Bypass Air
Ignition Control Module	ICM	– DIS module – EDIS module – TFI module
Ignition Diagnostic Monitor	IDM	– IDM – Ignition Diagnostic Monitor
Inertia Fuel Shutoff switch	IFS switch	– Inertia Switch

J1930 Terminology List

New Term	New Acronyms/ Abbreviations	Old Acronyms/ Term
Intake Air Temperature	IAT	– ACT – Air Charge Temperature
Intake Manifold Runner Control	IMRC	– IAC – Inlet Air Control
Keep Alive Memory	KAM	– KAM – Keep Alive Memory
Keep Alive Power	KAPWR	– KAPWR – Keep Alive Power
Knock Sensor	KS	– KS – Knock Sensor
Low Fan Control	LFC	– EDF – Electro-Drive Fan
Low Fuel Pump	LFP	– LFP – Low Fuel Pump
Malfunction Indicator Lamp	MIL	– CEL – “CHECK ENGINE” Light – “SERVICE ENGINE SOON” Light
Manifold Absolute Pressure	MAP	– MAP – Manifold Absolute Pressure
Manifold Absolute Pressure Per Altitude	MAPPA	– GMAPPA – Governor Manifold Absolute Pressure Per Altitude
Manual Lever Position	MLP	– MLP – Manual Lever Position
Mass Air Flow	MAF	– MAF – Mass Air Flow
Mass Air Flow Return	MAF RTN	– MAF RTN – Mass Air Flow Return
Multiport Fuel Injection	MFI	– EFI – Electronic Fuel Injection
Octane Adjust	OCT ADJ	– OCT ADJ – Octane Adjust
Overhead Cam	OHC	– OHC – Overhead Cam
Oxidation Catalytic Converter	OC	– COC – Conventional Oxidation Catalyst
Park/Neutral Position switch	PNP switch	– NDS – NGS – TSN – Neutral Drive Switch – Neutral Gear Switch – Transmission Select Switch Neutral
Positive Crankcase Ventilation	PCV	– PCV – Positive Crankcase Ventilation
Power Ground	PWR GND	– PWR GND – Power Ground

J1930 Terminology List

New Term	New Acronyms/ Abbreviations	Old Acronyms/ Term
Power Steering Pressure switch	PSP switch	<ul style="list-style-type: none"> – PSPS – Power Steering Pressure Switch
Powertrain Control Module	PCM	<ul style="list-style-type: none"> – ECA – ECM – ECU – EEC processor – Engine Control Assembly – Engine Control Module – Engine Control Unit
Pressure Feedback EGR	PFE	<ul style="list-style-type: none"> – EPT – Exhaust Pressure Transducer
Profile Ignition Pickup	PIP	<ul style="list-style-type: none"> – PIP – Profile Ignition Pickup
Programmable Speedometer/Odometer Module	PSOM	<ul style="list-style-type: none"> – PSOM – Programmable Speedometer/ Odometer Module
Pulsed Secondary Air Injection	PAIR	<ul style="list-style-type: none"> – MPA – PA – Thermactor II – Managed Pulse Air – Pulse Air
Reduction Oxidation Catalytic Converter	REDOX	<ul style="list-style-type: none"> – REDOX – Reduction Oxidation Catalytic Converter
Scan Tool	ST	<ul style="list-style-type: none"> – GST – NGS – Generic Scan Tool – New Generation STAR Tester
Secondary Air Injection	AIR	<ul style="list-style-type: none"> – AM – CT – MTA – Air Management – Conventional Thermactor – Managed Thermactor Air – Thermactor
Secondary Air Injection Bypass	AIRB	<ul style="list-style-type: none"> – AM1 – TAB – Air Management 1 – Thermactor Air Bypass
Secondary Air Injection Diverter	AIRD	<ul style="list-style-type: none"> – AM2 – TAD – Air Management 2 – Thermactor Air Diverter
Self-Test Input	STI	<ul style="list-style-type: none"> – STI – Self-Test Input
Self-Test Output	STO	<ul style="list-style-type: none"> – STO – Self-Test Output
Sequential Multiport Fuel Injection	SFI	<ul style="list-style-type: none"> – SEFI – Sequential Electronic Fuel Injection

J1930 Terminology List

New Term	New Acronyms/ Abbreviations	Old Acronyms/ Term
Shift Indicator Lamp	SIL	– SIL – Shift Indicator Lamp
Shift Solenoid	SS	– SS – Shift Solenoid
Signal Return	SIG RTN	– SIG RTN – Signal Return
Solid State Relay	SSR	– SSR – Solid State Relay
Spark Output	SPOUT	– SAW – Spark Angle Word
Speed Density	SD	– SD – Speed Density
Super High Output	SHO	– SHO – Super High Output
Supercharger/Supercharged	SC	– SC – Supercharger/Supercharged
Tachometer	TACH	– TACH – Tachometer
Three Way Catalytic Converter	TWC	– TWC – Three Way Catalytic Converter
Three Way + Oxidation Catalytic Converter	TWC+OC	– TWC & COC – Three Way Catalyst and Conventional Oxidation Catalyst
Throttle Body	TB	– TB – Throttle Body
Throttle Body Injection	TBI	– CFI – Central Fuel Injection
Throttle Position	TP	– TP – Throttle Position
Throttle Position Output	TPOUT	– TPOUT – Throttle Position Output
Torque Converter Clutch	TCC	– CCC – CCO – MCCC – Converter Clutch Control – Converter Clutch Override – Modulated Converter Clutch Control
Torque Converter Clutch solenoid	TCC solenoid	– LUS – MLUS – Lock Up Solenoid – Modulated Lock Up Solenoid
Transmission Control Module	TCM	– 4EAT Module
Transmission Control Switch	TCS	– TCS – Transmission Control Switch

J1930 Terminology List

New Term	New Acronyms/ Abbreviations	Old Acronyms/ Term
Transmission Control Indicator Lamp	TCIL	– TCIL – Transmission Control Indicator Lamp
Transmission Oil Temperature	TOT	– TOT – Transmission Oil Temperature
Transmission Range Reverse	TRR	– TSR – Transmission Select Switch Reverse
Transmission Range Overdrive	TROD	– TSOD – Transmission Select Switch Overdrive
Transmission Range Drive	TRD	– TSD – Transmission Select Switch Drive
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Glossary

The glossary is a list of technical terms or acronyms and their definitions. It is not intended to be a dictionary of components and their functions. If you desire a detailed description of a specific component, refer to the related Service Manual Group.

4EAT: 4-Speed Electronic Automatic Transaxle.

4X4L: 4X4 Low input switch.

A4LD: Automatic 4-Speed Lock-up – converter Drive.

ACC: A/C Clutch Compressor signal input to the EEC-IV processor relating status of the A/C clutch.

ACCS: A/C Cycling Switch.

ACD: Air Conditioner Demand switch.

ACL: Automatic Adjustable Shock Controller.

A/C: Air Conditioning.

A/C DV: Air Cleaner Duct and Valve motor.

A/CL BIMET: Air Cleaner Bimetal sensor.

A/C P: A/C Pressure Cut-out switch.

ACV: (Thermactor) Air Control Valve.

AHFSS: Air Conditioning/Heater Function Select Switch input to the EEC-IV processor relating status of the A/C heater function select switch.

AIR (THERMACTOR): Secondary Air Injector. A system for injection of air into the exhaust system to aid in the control of hydrocarbon and carbon monoxides in the exhaust.

AIRB (AM1): Secondary Air Injector Bypass.

AIRB/AIRD (TAB/TAD): Secondary Air Injection Bypass/Diverter.

AIR BPV: (Thermactor) Air Bypass Valve.

AIRD (AM2): Secondary Air Injector Diverter.

AMBIENT TEMPERATURE: Temperature of air surrounding an object e.g., temperature where vehicle is being worked on.

ANTI-BFV: Anti-Backfire Valve.

AOD: Automatic Overdrive.

A/T: Automatic Transaxle.

ATDC: After Top Dead Center.

AVOM: Analog Volt-Ohm Meter.

AXOD: Automatic Transaxle Overdrive.

AXOD-E: Automatic Transaxle Overdrive, Electronically Controlled.

B+ (BATT+): Battery Positive Voltage.

BARO (BP): Barometric Pressure Sensor.

BASE IDLE: Idle RPM determined by throttle lever hardset on throttle body while Idle Speed Control is fully retracted and disconnected.

BATT: Battery.

BATT (-): Battery negative post or its circuit.

BOB: (Breakout Box) An EEC-IV test device which connects in series with the processor and the EEC-IV harness and permits measurements of processor inputs and outputs.

BOO: Brake On-Off input to the EEC-IV processor indicating a braking drive mode.

BPA: By-Pass Air Solenoid. Used to control idle speed on EFI and SEFI vehicles.

BREAKOUT BOX: A service tool that “tees” in-between the EEC-IV processor and the 60-pin harness connector. The breakout box contains 60 test pins that can be probed for EEC-IV testing.

BTDC: Before Top Dead Center.

BV: Bowl Vent (Carburetor Fuel Bowl).

BVT: Back Pressure Variable Transducer.

CANP: Canister Purge solenoid or its control circuit.

CARB (FBC): Carburetor.

Glossary

CATALYST: A muffler-like device in the exhaust system containing a monolithic substrate (a ceramic honeycomb structure) that is coated with catalytic metals such as platinum or palladium. When hot exhaust gases come in contact with these metals a chemical reaction takes place to consume unburned hydrocarbon, carbon monoxide and nitrous oxides.

CCD: Computer Controlled Dwell.

CCRM (IRCM): Constant Control Relay Module.

CFAN: Condenser Fan Relay.

CCS: Coast Clutch Solenoid or its control circuit.

CFI: Central Fuel Injection. A computer controlled fuel metering system which sprays atomized fuel into a throttle body mounted atop the intake manifold.

“CHECK ENGINE” OR “SERVICE ENGINE SOON” LAMP: A dash panel lamp used either to aid in the identification and diagnosis of EEC system problems or to indicate that maintenance is required on non-EEC equipped vehicles.

CID: Cylinder Identification sensor or its signal circuit.

CKP (VR or VRS): Crankshaft Position Sensor. A non-contact CKP transducer that converts mechanical motion into electrical control signals.

CKP (PIP): Crankshaft Position.

CLC: Converter Lock-up Clutch.

CLUTCH: Clutch engagement switch or its control circuit.

COMPUTED TIMING: The total spark advance in degrees before top dead center. Calculated by the EEC-IV processor based on input from a number of sensors.

CONTINUOUS SELF-TEST: A continuous test of the EEC-IV system conducted whenever the vehicle is in operation.

CPP (CES): Clutch Pedal Position.

CSE GND: Case Ground (EEC-IV processor case).

CURB IDLE: Computer controlled idle rpm.

CWM: Cold Weather Modulator.

DCL: Data Communications Link.

DFI (FI): Direct Fuel Injection.

DFS: Decel Fuel Shut-off.

DI (CBD): Distributor Ignition.

DI (EDIS): Distributor Ignition.

DI (TFI): Distributor Ignition.

DLC: Data Link Connector.

DOL: Data Output Link. Fuel calculation data from the EEC-IV processor to the electronic tripminder.

DPDIS: Dual Plug Distributorless Ignition System.

DPH: Dual Plug Head.

DPI: Dual Plug Inhibit.

DSS: Down Shift Solenoid.

DV: Delay Valve.

DVOM: Digital Volt-Ohm Multimeter that displays voltage or resistance measurements in digital form on a Liquid Crystal Display (LCD).

DV TW: Delay Valve Two-Way.

EATC: Electronic Automatic Temperature Control.

E4OD: Electronic 4-Speed Overdrive transmission.

ECA: Electronic Control Assembly.

ECT: Engine Coolant Temperature sensor or its signal circuit.

ECTF: Cooling Fan Engine Coolant Temperature sensor.

EEC: Electronic Engine Control. A computer controlled system of engine control.

EEGR: Electronic EGR Valve (Sonic).

EGR: Exhaust Gas Recirculation system designed to allow the flow of inert exhaust gases into the combustion chamber to cool the combustion and thus reduce nitrous oxides in the exhaust.

Glossary

EGRC: EGR Control vacuum solenoid valve or its control circuit.

EGR S/O: EGR Shut-Off.

EGRT: EGR Temperature sensor.

EGRV: EGR Vent vacuum solenoid valve or its control circuit.

EHC: Exhaust Heat Control vacuum solenoid valve or its control circuit.

EI (DIS): Electronic Ignition.

ENGINE RUNNING SELF-TEST: A test of the EEC-IV system conducted with the engine running and the vehicle at rest.

EPC: Electronic Pressure Control (used in E4OD transmissions).

ER: Engine Running Self-Test (same as KOER).

ERS: Engine RPM Sensor or its signal circuit.

EVP: EGR Valve Position sensor or its signal circuit.

EVR: EGR Vacuum Regulator solenoid or its control circuit.

FC (EDF): Fan Control.

FCS: Fuel Control Solenoid or its control circuit.

FF (FCS): Flexible Fuel.

FIPL: Fuel Injection Pump Lever sensor or its signal circuit.

FLC: Fluid Lock-Up Converter.

FMEM: Failure Mode Effects Management. This alternative strategy protects vehicle function from adverse effects of an EEC component failure.

FP: Fuel Pump relay or its control circuit.

FPM: Fuel Pump Monitor. A circuit in the EEC system used to monitor the electric fuel pump operation on some EEC-IV equipped vehicles.

FTO: Filtered Tach Output. An output from the DIS TFI-IV module which provides a filtered ignition signal to the processor in order to control dwell.

FUEL RICH/LEAN: A qualitative evaluation of air/fuel ratio based on an A/F value known as stoichiometry or 14.7. In the EEC-IV system rich/lean is determined by a voltage signal from the EGO sensor. An excess of oxygen (lean) is an EGO voltage of less than 0.4 volts, a rich condition is indicated by an EGO voltage of greater than 0.6 volts.

FWD: Front Wheel Drive.

GND or GRND: A common ground circuit for all vehicle power.

GOOSE: A brief opening and closing of the throttle.

HALL EFFECT: A process where current is passed through a small slice of semi-conductor material at the same time as a magnetic field to produce a small voltage in the semi-conductor.

HBV: Heater Blower Voltage input to the EEC-IV processor reflecting heater blower voltage demand.

HFC (HEDF): Fan Control.

HIC: Hot Idle Compensator.

HLOS: Hardware Limited Operation Strategy. Certain types of computer malfunctions will place the EEC-IV processor into HLOS mode. Output commands are replaced with fixed values.

HO: High Output.

HO2S (HEGO): Heated Oxygen Sensor.

HSC: High Swirl Combustion.

IAS: Inlet Air Solenoid valve or its control circuit.

IAT (ACT): Intake Air Temperature.

IAT (VAT): Intake Air Temperature.

IBP: Integral Back Pressure.

IDLE LIMITER: A device to control minimum and maximum idle fuel richness. The idle limiter is intended to prevent unauthorized persons from making overly rich idle adjustments.

Glossary

IDM: Ignition Diagnostics Monitor. A continuous monitor of the ignition input to the EEC-IV processor used to detect intermittent ignition faults.

IGN: Ignition circuit or system.

INJ: Injector (Fuel).

INJ GND: Injector Ground (Fuel).

ISC: Idle Speed Control. Currently there are two types of computer controlled idle speed controls: DC motor ISC and air bypass ISC.

ITR: In-Tank Reservoir.

ITS: Idle Tracking Switch. Used on CFI vehicles to inform EEC if the throttle is in contact with the DC motor.

KAM: Keep Alive Memory. A series of vehicle battery powered memory locations in the microprocessor which allows the microprocessor to store input failures identified during normal operation for use in later diagnostic routines and adapts some calibration parameters to compensate for changes in the vehicle system.

KAPWR: Keep Alive Power.

KEY ON ENGINE RUNNING SELF-TEST: A test of the EEC-IV system conducted with power applied and the engine at idle.

KOEO: Key On Engine Off Self-Test.

KOER: Key On Engine Running Self-Test (same as Engine Running (ER) Self-Test).

KS: Knock Sensor or its signal circuit.

L: Liters.

MA or MAF: Mass Air Flow sensor or its signal circuit.

MAP: Manifold Absolute Pressure sensor or its signal circuit.

MC (FBC): Mixture Control.

MC-VAF: Measuring Core Volume Air Flow Meter.

MECS: Mazda Equipped Control System.

MFI (EFI): Multiport Fuel Injection. A computer controlled fuel system that distributes atomized fuel through an injector located in each intake port of the engine. The fuel injectors are fired using bank-to-bank circuitry.

MIL: Malfunction Indicator Lamp. An electric circuit between the EEC-IV processor and the "CHECK ENGINE" or "SERVICE ENGINE SOON" lamp on the dash panel of EEC-equipped vehicles.

MLP: Manual Lever Position switch or its signal circuit.

MONITOR BOX: An optional EEC-IV test device which connects in series with the EEC-IV processor and its harness, and permits measurements in various units of processor inputs and outputs.

M/T: Manual Transaxle.

O2S (EGO): Oxygen Sensor.

OASIS: On-line Automobile Service Information System.

OBD (SELF-TEST): On-Board Diagnostic.

OCC: Output Circuit Check.

OC (COC): Oxidation Catalytic Converter.

OCIL: Overdrive Cancel Indicator Lamp.

OCS: Overdrive Cancel Switch.

OCT ADJ: Octane Adjust device which modifies spark advance.

OHC: Overhead Cam.

OPEN CIRCUIT: A circuit which does not provide a complete path for the flow of current.

OSC: Output State Check.

OVERLAY CARD: A plastic card used with the Monitor box to identify EEC-IV signals for each engine. The card also programs the monitor for auto mode measurements.

PAIR (THERMACTOR II): Pulsed Secondary Air Injection. See Pulse Air System.

Glossary

PCM (MCU): Powertrain Control Module.

PCV: Positive Crankcase Ventilation. A system which controls the flow of crankcase vapors into the engine intake manifold where they are burned in combustion rather than being discharged into the atmosphere.

PFE: Pressure Feedback EGR sensor or its signal circuit.

PNP (NDS): Park/Neutral Position Switch.

PNP (NGS): Neutral Gear Switch or its signal circuit.

PNP (NPS): Park/Neutral Position Switch.

PROCESSOR: EEC-IV Electronic Control Assembly.

PSG: Pulse Signal Generator.

PSP (PSPS): Power Steering Pressure switch.

PULSE AIR SYSTEM: Part of the emission control system that utilizes a reed-type check valve which allows air to be drawn into the exhaust system as a result of exhaust pulses.

PVS: Ported Vacuum Switch.

PWR GND: Power Ground.

QUICK TEST: A functional diagnostic test of the EEC system consisting of vehicle preparation and hookup. Key On Engine Off, Engine Running and Continuous Self-Tests.

RECORDER: An optional EEC-IV test device which works jointly with the Monitor box. It allows up to 8 EEC-IV signals to be electronically recorded over a 50 second period.

RELAY: A switching device operated by a low current circuit which controls the opening and closing of another circuit of higher current capacity.

RELIEF VALVE: Pressure limiting valve located in the exhaust chamber of the thermactor air pump. It functions to relieve part of the exhaust airflow if the pressure exceeds a calibrated value.

RWD: Rear Wheel Drive.

SC: Super Charged.

SCB (SBS): Supercharger Bypass.

SDV: Spark Delay Valve.

SFI (SEFI): Sequential Multiport Fuel Injection. A computer controlled fuel system that distributes atomized fuel through an injector located in each intake port of the engine. Each injector is fired separately and has individual circuits.

SHO: Super High Output.

SHORT CIRCUIT: An undesirable connection between a circuit and any other point.

SIG RTN: Signal Return circuit for all sensor signals except HEGO.

SIL: Shift Indicator Light. A system that provides a visual indication to the driver of a vehicle when to shift to the next higher gear to obtain optimum fuel economy.

SOLENOID: A wire coil with a moveable core that changes position by means of electro-magnetism when current flows through the coil.

SPOUT: Spark Output Signal from the EEC-IV processor.

SPOUT (SAW): Spark Output.

SS1: Shift Solenoid 1 or its control circuit.

SS2: Shift Solenoid 2 or its control circuit.

SS 3/4-4/3: Shift Solenoid 3/4-4/3. Output from the EEC-IV processor to the transmission that selects 3rd and 4th gears.

STAR: Self-Test Automatic Readout. A testing device in which the EEC and MCU systems output service codes in a digital format.

STI: Self-Test Input circuit in the EEC and MCU systems used to initiate Self-Test.

STO: Self-Test Output circuit in the EEC and MCU systems that transmits diagnostic trouble codes (pulses) to either a VOM or STAR tester.

TBI (EFI): Electronic Fuel Injection. A computer controlled system that distributes atomized fuel through an injector located in each intake port of the engine. The fuel injectors are fired using bank-to-bank circuitry.

Glossary

TCC (CCC): Torque Converter Clutch.

TCC (CCO): Torque Converter Clutch.

TCC (LUS): Torque Converter Clutch.

TCM: Transaxle Control Module.

TCP: Temperature Compensated (Acceleration) Pump.

TGS: Top Gear Switch. A lock out mechanism that prevents the SIL from lighting when the vehicle is in top gear.

THS: Transmission Hydraulic Switch. An input to the processor that indicates the occurrence of a shift between specific gears.

THS 3/2: Transmission Hydraulic Switch 3rd/2nd gear.

THS 4/3: Transmission Hydraulic Switch 4th/3rd gear.

TIMING: Relationship between spark plug firing and piston position usually expressed in crankshaft degrees before (BTDC) or after (ATDC) top dead center of the compression stroke.

TIV: Thermactor Idle Vacuum valve.

TK: Throttle Kicker vacuum solenoid valve or its control circuit.

TOT: Transmission Oil Temperature sensor or its signal circuit.

TP: Throttle Position sensor or its signal circuit.

TSP: Throttle Solenoid Positioner.

TTS: Transmission Temperature Switch.

TVV: Thermal Vent Valve.

TVV (TVS): Thermal Vacuum Valve.

TWC: Three Way Catalyst.

VAF: Vane Air Flow sensor or its signal circuit.

VBAT: Vehicle Battery voltage.

VCK-V: Vacuum Check Valve.

VCV: Vacuum Control Valve.

VDV: Vacuum Delay Valve.

VM: Vane Meter.

VOM: Volt-Ohm Meter used to measure voltage and resistance. Readings are indicated by sweep hand on a printed scale rather than a digital display.

VOTM: Vacuum Operated Throttle Modulator.

VPWR: Vehicle Power supply voltage regulated to 10-14 volts.

VR/S: Vacuum Regulator/Solenoid.

VRDV: Vacuum Retard Delay Valve.

VREF: Reference voltage supplied by the EEC-IV processor to some sensors and regulated to 4-6 volts.

VRESER: Vacuum Reservoir.

VREST: Vacuum Restrictor.

VRIS: Variable Resonance Induction System.

VRV: Vacuum Regulator Valve.

VSC: Vehicle Speed Control sensor or its signal circuit.

VSS: Vehicle Speed Sensor or its signal circuit.

VVA: Venturi Vacuum Amplifier.

VVC: Variable Voltage Choke relay or its control circuit.

VVV: Vacuum Vent Valve.

WAC: Wide-open throttle A/C Cutoff.

WOT: Wide-Open Throttle.

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